

UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

ESCOLA TÉCNICA SUPERIOR DE ENXEÑARÍA



Grado en Ingeniería Química

FINAL DEGREE PROJECT

**PRODUCTION FACILITY OF POLILACTIC
ACID FROM LACTIC ACID**

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safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



Lactic acid 80%, of that \geq 95% L(+)-lactic acid

article number: **8460**
Version: **1.0 en**

date of compilation: 2016-10-28

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

1.1 Product identifier

Identification of the substance	Lactic acid
Article number	8460
Registration number (REACH)	not relevant (mixture)

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

Identified uses: laboratory chemical

1.3 Details of the supplier of the safety data sheet

Carl Roth GmbH + Co KG
Schoemperlenstr. 3-5
D-76185 Karlsruhe
Germany

Telephone: +49 (0) 721 - 56 06 0

Telefax: +49 (0) 721 - 56 06 149

e-mail: sicherheit@carlroth.de

Website: www.carlroth.de

Competent person responsible for the safety data sheet : Department Health, Safety and Environment

e-mail (competent person) : sicherheit@carlroth.de

1.4 Emergency telephone number

Emergency information service **Poison Centre Munich: +49/(0)89 19240**

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

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

Classification acc. to GHS			
Section	Hazard class	Hazard class and category	Hazard statement
3.2	skin corrosion/irritation	(Skin Irrit. 2)	H315
3.3	serious eye damage/eye irritation	(Eye Dam. 1)	H318

Remarks

For full text of Hazard- and EU Hazard-statements: see SECTION 16.

safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



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2.2 Label elements

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

Signal word

Danger

Pictograms



Hazard statements

H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements

Precautionary statements - prevention

P280 Wear protective gloves/eye protection.

Precautionary statements - response

P302+P352 IF ON SKIN: Wash with plenty of water.
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.

Hazardous ingredients for labelling: L-lactic acid

Labelling of packages where the contents do not exceed 125 ml

Signal word: **Danger**

Symbol(s)



H318 Causes serious eye damage.
P280 Wear protective gloves/eye protection.
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.
contains: L-lactic acid

2.3 Other hazards

There is no additional information.

safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



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SECTION 3: Composition/information on ingredients

3.2 Mixtures

Description of the mixture

Composition/information on ingredients.

Name of substance	Identifier	wt%	Classification acc. to 1272/2008/EC	Pictograms	Specific Conc. Limits
L-lactic acid	CAS No 79-33-4 EC No 201-196-2 REACH Reg. No 01-2119474164- 39-xxxx	80	Skin Irrit. 2 / H315 Eye Dam. 1 / H318		Skin Irrit. 2; H315: C \geq 10 % Eye Dam. 1; H318: C \geq 3 % Eye Irrit. 2; H319: 1 % \leq C < 3 %

Remarks

For full text of Hazard- and EU Hazard-statements: see SECTION 16.

SECTION 4: First aid measures

4.1 Description of first aid measures



General notes

Take off contaminated clothing.

Following inhalation

Provide fresh air. In all cases of doubt, or when symptoms persist, seek medical advice.

Following skin contact

Rinse skin with water/shower. In case of skin irritation, consult a physician.

Following eye contact

In case of contact with eyes flush immediately with plenty of flowing water for 10 to 15 minutes holding eyelids apart and consult an ophthalmologist.

Following ingestion

Rinse mouth. Call a doctor if you feel unwell.

4.2 Most important symptoms and effects, both acute and delayed

Irritation, Corrosivity, Gastrointestinal complaints, Nausea, Diarrhoea, Risk of serious damage to eyes

4.3 Indication of any immediate medical attention and special treatment needed

none

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according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



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SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Co-ordinate fire-fighting measures to the fire surroundings
water spray, foam, dry extinguishing powder, carbon dioxide (CO₂)

Unsuitable extinguishing media

water jet

5.2 Special hazards arising from the substance or mixture

Ingredients of the mixture combustible.

Hazardous combustion products

in case of fire and/or explosion do not breathe fumes

5.3 Advice for firefighters

Fight fire with normal precautions from a reasonable distance. Wear self-contained breathing apparatus.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Do not breathe vapour/spray. Avoid contact with skin and eyes.

6.2 Environmental precautions

Keep away from drains, surface and ground water.

6.3 Methods and material for containment and cleaning up

Advices on how to contain a spill

Covering of drains.

Advices on how to clean up a spill

Absorb with liquid-binding material (e.g. sand, diatomaceous earth, acid- or universal binding agents).

Other information relating to spills and releases

Place in appropriate containers for disposal. Ventilate affected area.

Reference to other sections

Hazardous combustion products: see section 5. Personal protective equipment: see section 8.
Incompatible materials: see section 10. Disposal considerations: see section 13.

safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



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SECTION 7: Handling and storage

7.1 Precautions for safe handling

Provide adequate ventilation. Handle and open container with care.

Advice on general occupational hygiene

Wash hands before breaks and after work.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed. May cause decomposition by long-term light influence.

Incompatible substances or mixtures

Observe hints for combined storage.

Consideration of other advice

• Ventilation requirements

Use local and general ventilation.

• Specific designs for storage rooms or vessels

Recommended storage temperature: 15 - 25 °C.

7.3 Specific end use(s)

No information available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

National limit values

Occupational exposure limit values (Workplace Exposure Limits)

Data are not available.

Relevant DNELs/DMELs/PNECs and other threshold levels

• relevant PNECs of components of the mixture

Name of substance	CAS No	Endpoint	Threshold level	Environmental compartment
L-lactic acid	79-33-4	PNEC	1,3 mg/l	freshwater
L-lactic acid	79-33-4	PNEC	10 mg/l	sewage treatment plant (STP)

8.2 Exposure controls

Individual protection measures (personal protective equipment)



Eye/face protection

Use safety goggle with side protection.

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Skin protection

• hand protection

Wear suitable gloves. Chemical protection gloves are suitable, which are tested according to EN 374. For special purposes, it is recommended to check the resistance to chemicals of the protective gloves mentioned above together with the supplier of these gloves.

• type of material

NBR (Nitrile rubber)

• material thickness

>0,11 mm

• breakthrough times of the glove material

>480 minutes (permeation: level 6)

• other protection measures

Take recovery periods for skin regeneration. Preventive skin protection (barrier creams/ointments) is recommended.

Respiratory protection

Respiratory protection necessary at: Aerosol or mist formation. Type: A (against organic gases and vapours with a boiling point of > 65 °C, colour code: Brown).

Environmental exposure controls

Keep away from drains, surface and ground water.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state	liquid (viscous)
Colour	colourless - light yellow
Odour	faintly perceptible
Odour threshold	No data available

Other physical and chemical parameters

pH (value)	acidic
Melting point/freezing point	not determined
Initial boiling point and boiling range	122 °C
Flash point	113 °C
Evaporation rate	no data available
Flammability (solid, gas)	not relevant (fluid)
<u>Explosive limits</u>	
• lower explosion limit (LEL)	this information is not available
• upper explosion limit (UEL)	this information is not available
Explosion limits of dust clouds	not relevant
Vapour pressure	This information is not available.
Density	1,21 - 1,22 g/cm ³ at 20 °C
Vapour density	This information is not available.

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Bulk density	Not applicable
Relative density	Information on this property is not available.
<u>Solubility(ies)</u>	
Water solubility	miscible in any proportion
<u>Partition coefficient</u>	
n-octanol/water (log KOW)	-0,62
Auto-ignition temperature	Information on this property is not available.
Decomposition temperature	>200 °C
Viscosity	not determined
Explosive properties	Shall not be classified as explosive
Oxidising properties	none

9.2 Other information

There is no additional information.

SECTION 10: Stability and reactivity

10.1 Reactivity

In case of warming: Vapours can form explosive mixtures with air.

10.2 Chemical stability

The material is stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

10.3 Possibility of hazardous reactions

Violent reaction with: Alkalis, Strong oxidiser

10.4 Conditions to avoid

Decomposition takes place from temperatures above: >200 °C. Direct light irradiation.

10.5 Incompatible materials

There is no additional information.

10.6 Hazardous decomposition products

Hazardous combustion products: see section 5.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Shall not be classified as acutely toxic.

Skin corrosion/irritation

Causes skin irritation.

safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



Lactic acid 80%, of that ≥ 95% L(+)-lactic acid

article number: 8460

Serious eye damage/eye irritation

Causes serious eye damage.

Respiratory or skin sensitisation

Shall not be classified as a respiratory or skin sensitiser.

Summary of evaluation of the CMR properties

Shall not be classified as germ cell mutagenic, carcinogenic nor as a reproductive toxicant

• Specific target organ toxicity - single exposure

Shall not be classified as a specific target organ toxicant (single exposure).

• Specific target organ toxicity - repeated exposure

Shall not be classified as a specific target organ toxicant (repeated exposure).

Aspiration hazard

Shall not be classified as presenting an aspiration hazard.

Symptoms related to the physical, chemical and toxicological characteristics

• If swallowed

gastrointestinal complaints, nausea, diarrhoea, Liver and kidney damage

• If in eyes

Causes serious eye damage, risk of blindness

• If inhaled

data are not available

• If on skin

causes skin irritation

Other information

None

SECTION 12: Ecological information

12.1 Toxicity

acc. to 1272/2008/EC: Shall not be classified as hazardous to the aquatic environment.

Aquatic toxicity (acute)

Aquatic toxicity (acute) of components of the mixture

Name of substance	CAS No	Endpoint	Value	Species	Exposure time
L-lactic acid	79-33-4	EC50	130 mg/l	aquatic invertebrates	48 h
L-lactic acid	79-33-4	ErC50	3,5 g/l	algae	72 h

Aquatic toxicity (chronic)

Aquatic toxicity (chronic) of components of the mixture

Name of substance	CAS No	Endpoint	Value	Species	Exposure time
L-lactic acid	79-33-4	EC50	>88,2 mg/l	microorganisms	3 h

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12.2 Process of degradability

The substance is readily biodegradable.

Degradability of components of the mixture

Name of substance	CAS No	Process	Degradation rate	Time
L-lactic acid	79-33-4	oxygen depletion	50 %	5 d

12.3 Bioaccumulative potential

Does not significantly accumulate in organisms.

n-octanol/water (log KOW) -0,62

Bioaccumulative potential of components of the mixture

Name of substance	CAS No	BCF	Log KOW	BOD5/COD
L-lactic acid	79-33-4		-0,54 (25 °C)	

12.4 Mobility in soil

Data are not available.

12.5 Results of PBT and vPvB assessment

Data are not available.

12.6 Other adverse effects

Data are not available.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.

Sewage disposal-relevant information

Do not empty into drains.

13.2 Relevant provisions relating to waste

The allocation of waste identity numbers/waste descriptions must be carried out according to the EEC, specific to the industry and process.

13.3 Remarks

Waste shall be separated into the categories that can be handled separately by the local or national waste management facilities. Please consider the relevant national or regional provisions.

safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU



Lactic acid 80%, of that \geq 95% L(+)-lactic acid

article number: **8460**

SECTION 14: Transport information

- | | | |
|-------------|---|--|
| 14.1 | UN number | (not subject to transport regulations) |
| 14.2 | UN proper shipping name | not relevant |
| 14.3 | Transport hazard class(es) | not relevant |
| | Class | - |
| 14.4 | Packing group | not relevant |
| 14.5 | Environmental hazards | none (non-environmentally hazardous acc. to the dangerous goods regulations) |
| 14.6 | Special precautions for user | |
| | There is no additional information. | |
| 14.7 | Transport in bulk according to Annex II of MARPOL and the IBC Code | |
| | The cargo is not intended to be carried in bulk. | |
| 14.8 | Information for each of the UN Model Regulations | |
| | • Transport of dangerous goods by road, rail and inland waterway (ADR/RID/ADN) | |
| | Not subject to ADR, RID and ADN. | |
| | • International Maritime Dangerous Goods Code (IMDG) | |
| | Not subject to IMDG. | |

SECTION 15: Regulatory information

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

Relevant provisions of the European Union (EU)

- Regulation 649/2012/EU concerning the export and import of hazardous chemicals (PIC)**

None of the ingredients are listed.

- Regulation 1005/2009/EC on substances that deplete the ozone layer (ODS)**

None of the ingredients are listed.

- Regulation 850/2004/EC on persistent organic pollutants (POP)**

None of the ingredients are listed.

- Restrictions according to REACH, Annex XVII**

None of the ingredients are listed.

- List of substances subject to authorisation (REACH, Annex XIV)**

None of the ingredients are listed.

- Limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products (2004/42/EC, Deco-Paint Directive)**

VOC content 80 %

- Directive on industrial emissions (VOCs, 2010/75/EU)**

VOC content 0 %

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Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) - Annex II

None of the ingredients are listed.

Regulation 166/2006/EC concerning the establishment of a European Pollutant Release and Transfer Register (PRTR)

None of the ingredients are listed.

Directive 2000/60/EC establishing a framework for Community action in the field of water policy (WFD)

None of the ingredients are listed.

15.2 Chemical Safety Assessment

Chemical safety assessments for substances in this mixture were not carried out.

SECTION 16: Other information

Abbreviations and acronyms

Abbr.	Descriptions of used abbreviations
ADN	Accord européen relatif au transport international des marchandises dangereuses par voies de navigation intérieures (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways)
ADR	Accord européen relatif au transport international des marchandises dangereuses par route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
BCF	BioConcentration Factor
BOD	Biochemical Oxygen Demand
CAS	Chemical Abstracts Service (service that maintains the most comprehensive list of chemical substances)
CLP	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures
CMR	Carcinogenic, Mutagenic or toxic for Reproduction
COD	chemical oxygen demand
DMEL	Derived Minimal Effect Level
DNEL	Derived No-Effect Level
EC No	The EC Inventory (EINECS, ELINCS and the NLP-list) is the source for the seven-digit EC number, an identifier of substances commercially available within the EU (European Union)
EINECS	European Inventory of Existing Commercial Chemical Substances
ELINCS	European List of Notified Chemical Substances
Eye Dam.	seriously damaging to the eye
Eye Irrit.	irritant to the eye
GHS	"Globally Harmonized System of Classification and Labelling of Chemicals" developed by the United Nations
IMDG	International Maritime Dangerous Goods Code
index No	the Index number is the identification code given to the substance in Part 3 of Annex VI to Regulation (EC) No 1272/2008
log KOW	n-octanol/water
MARPOL	International Convention for the Prevention of Pollution from Ships (abbr. of "Marine Pollutant")
NLP	No-Longer Polymer
PBT	Persistent, Bioaccumulative and Toxic
PNEC	Predicted No-Effect Concentration
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals

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Abbr.	Descriptions of used abbreviations
RID	Règlement concernant le transport International ferroviaire des marchandises Dangereuses (Regulations concerning the International carriage of Dangerous goods by Rail)
Skin Corr.	corrosive to skin
Skin Irrit.	irritant to skin
VOC	Volatile Organic Compounds
vPvB	very Persistent and very Bioaccumulative

Key literature references and sources for data

- Regulation (EC) No. 1907/2006 (REACH), amended by 2015/830/EU
- Regulation (EC) No. 1272/2008 (CLP, EU GHS)

List of relevant phrases (code and full text as stated in chapter 2 and 3)

Code	Text
H315	causes skin irritation
H318	causes serious eye damage

Disclaimer

The above information describes exclusively the safety requirements of the product and is based on our present-day knowledge. The information is intended to give you advice about the safe handling of the product named in this safety data sheet, for storage, processing, transport and disposal. The information cannot be transferred to other products. In the case of mixing the product with other products or in the case of processing, the information on this safety data sheet is not necessarily valid for the new made-up material.



Safety Data Sheet

According to EU Directive 1907/2006, as amended

Product name: PLA

Date of issue: 23-7-2018

Version: 1.6

1. Identification of the substance/preparation and of the company

- 1.1 Trade name:**
PLA
- 1.2 Use of the product:**
3Dprinter Filament
- 1.3 Supplier:**
3D Platform
6402 E. Rockton Road
Roscoe, Illinois 61073 United States
Phone: +1.779.771.0000
www.3dplatform.com
marketing@3dplatform.com

2. Hazards identification

- 2.1 Classification of the substance or mixture**
Not classified according to Directive 1272/2008/EC.
- 2.2 Label elements**
None
- 2.3 Other hazards**
Danger of burns in contact with hot polymer and hazardous vapors in case of burning.

3. Composition/information on ingredients

- 3.1 Chemical characteristics:**
Biodegradable polymer-blend based on polylactic acid.
- 3.2 CAS no:**
9051-89-2
- 3.3 Additional information:**
No harmful ingredients.

4. First aid measures

- 4.1 On skin contact:**
In case of contact with molten polymer immediately cool the skin with cold water. Medical aid may be required to remove adhering material and for treatment of burns.
- 4.2 After inhalation:**
After inhalation of decomposition gases or dust remove patient to fresh air. Contact a doctor in case of discomfort.
- 4.3 On ingestion:**
No effects known. Rinse mouth with water and drink more water. Contact a doctor in case of discomfort.
- 4.4 On eyes contact:**
Rinse open eyes thoroughly with water.



Safety Data Sheet

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Product name: PLA

Date of issue: 23-7-2018

Version: 1.6

5. Fire fighting measures

5.1 Extinguishing media

Suitable extinguishing media:

Water spray, Dry powder, Carbon dioxide (CO₂).

Unsuitable extinguishing media :

Do not use a solid water stream as it may scatter and spread fire.

5.2 Special hazards arising from the substance or mixture

During incomplete combustion release of carbon monoxide, carbon dioxide and hydrocarbons.

5.3 Advice for fire fighters

Fire fighting measures

Evacuate non-essential personnel Move containers from fire area if you can do it without risk.

Keep containers and surroundings cool with water spray. Prevent fire extinguishing water from contaminating surface water or the ground water system.

Special protective equipment for fire-fighters

Wear self-contained breathing apparatus and protective suit.

5.4 Remark:

Accumulations of dust can be inflammable.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Evacuate personnel to safe areas. Do not touch or walk through spilled material. Avoid dust formation. Avoid contact with skin, eyes and clothing. Do not breathe dust. Use personal protective equipment. Ensure adequate ventilation. Risk of slipping

6.2 Environmental precautions

Should not be released into the environment. Prevent further leakage or spillage if safe to do so.

6.3 Methods and materials for containment and cleaning up

Avoid dust formation. Sweep up and shovel into suitable containers for disposal. Following product recovery, flush area with water.

6.4 Reference to other sections

Refer to section (8)

7. Handling and storage

7.1 Handling

Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing. Avoid dust formation. Do not breathe dust. Ensure adequate ventilation. Wear personal protective equipment. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product.

7.2 Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Keep containers tightly closed in a cool, well-ventilated place. Protect from moisture / Water.

8. Exposure controls/personal protection

8.1 Control parameters



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Product name: PLA

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Components with occupational exposure limits

Contains no substances with occupational exposure limit values.

Biological Limit Values

Not established.

PNEC

The obligation to register acc. to the REACH Regulation (EC) No 1907/2006 does not apply to polymers.

DNEL

The obligation to register acc. to the REACH Regulation (EC) No 1907/2006 does not apply to polymers.

8.2 Exposure controls

Appropriate Engineering Controls

Ensure adequate ventilation, especially in confined areas. Keep at temperatures below 230 °C / 446 °F.

Individual protection measures, such as personal protective equipment

Eye Protection

Tightly fitting safety goggles (EN166).

Hand Protection

Protective gloves (EN374): Butyl rubber. Glove thickness: 0.5 mm. Break through time: >8 hours.

Skin and body protection

Long sleeved clothing.

Respiratory Protection

In case of insufficient ventilation wear suitable respiratory equipment. Recommended Filter Type P2 / FFP2.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice. Workers must be trained in the proper use and handling of this product as required under applicable regulations.

Environmental exposure controls

The product should not be allowed to enter drains, water courses or the soil

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	Solid Filament
Odour	Odourless
Colour	depending on product grade
Odour threshold	Sweet
pH	Not applicable
Melting point	150-170 °C / 302-446 °F
Initial boiling point and boiling range	Not applicable
Flash point	Not applicable
Evaporation rate	Not applicable
Flammability (solid, gas)	flammable
Upper/lower flammability or explosive limits	Not applicable
Vapour pressure	Not applicable
Vapour density	Not applicable
Relative density	Ca. 1.1-1.3 g/cm ³
Solubility(ies)	Insoluble



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Partition coefficient (n-octanol/water)	Not available
Auto-ignition temperature	388°C
Decomposition temperature	>250°C
Viscosity	Not applicable
Explosive properties	Not explosive
Oxidizing properties	Not oxidizing

10. Stability

10.1 Reactivity: No information available

10.2 Chemical stability:
Stable under recommended storage conditions

10.3 Possibility of hazardous reactions:
No hazardous reactions observed under normal handling and storage conditions

10.4 Conditions to avoid
Temperatures above 230 °C / 446 °F.

10.5 Incompatible materials:
Oxidizing agents, Strong bases

10.6 Hazardous decomposition products
Burning produces obnoxious and toxic fumes Aldehydes, Carbon monoxide (CO), carbon dioxide (CO₂)

11. Toxicological information

11.1 Information on toxicological effects

Acute toxicity:

Ingestion: No known effect.

Skin Contact : No known effect.

Inhalation : No known effect.

Product dust may be irritating to eyes, skin and respiratory system. Resin particles, like other inert materials, are mechanically irritating to eyes. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea

Germ Cell Mutagenicity

Not known to cause heritable genetic damage.

Carcinogenicity

Contains no ingredient listed as a carcinogen.

Reproductive Toxicity

Not known to cause birth defects or have a deleterious effect on a developing fetus. Not known to adversely affect reproductive functions and organs.

STOT-single exposure

No known effect.

STOT-repeated exposure

No known effect.

Aspiration Hazard

No known effect.



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Date of issue: 23-7-2018

Version: 1.6

12. Ecological information

12.1 Toxicity

Contains no substances known to be hazardous for the environment.

12.2 Persistence and degradability

Decomposes in contact with water. Hydrolysis product (S-lactic acid): Readily biodegradable

12.3 Bio accumulative potential

No information available.

12.4 Mobility in soil

No information available.

12.5 Results of PBT and vPvB assessment

This substance is not considered to be persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB).

12.6 Other adverse effects

No information available..

13. Disposal considerations

13.1 Waste treatment methods

Waste from residues / unused products

Generation of waste should be minimized, check possibility for recycling. Waste product can be incinerated or dumped together with domestic waste in compliance with local authority requirements.

Contaminated Packaging

Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

Product has been classified as being non-dangerous substance according to transport regulations ADR, RID, IMDG, IATA/ICAO

14.1 UN number

Not applicable

14.2 UN proper shipping name

Not applicable

14.3 Transport hazard class(es)

Not applicable

14.4 Packing Group

Not applicable

14.5 Environmental hazards

No additional data is available

14.6 Special precautions for user

No data available



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According to EU Directive 1907/2006, as amended

Product name: PLA

Date of issue: 23-7-2018

Version: 1.6

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

Not evaluated

15. Regulatory information

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

Restrictions on use: None

Other Regulations : No information available

15.2 Chemical Safety Assessment

No information available.

16. Other information

Information is referenced from other manufacturers.

Abbreviations and acronyms

REACH: Registration, Evaluation, Authorisation and Restriction of Chemical substances

EC: European Commission

STOT: Specific Target Organ Toxicity

PBT: Persistent, Bioaccumulative, Toxic

vPvB: very Persistent and very Bioaccumulating

ADR: Accord européen relatif au transport international des marchandises Dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

ADN: Accord européen relatif au transport international des marchandises Dangereuses par voies de Navigation intérieures (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways)

RID: Règlement concernant le transport international ferroviaire des marchandises dangereuses (Regulations for the International Transport of Dangerous Goods by Rail)

IMDG: International Maritime Dangerous Goods Code

ICAO: International Civil Aviation Organization

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006 and Regulation (EC) No. 2015/830. Label element according to Regulation (EC) No 1272/2008.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Safety Data Sheet

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Version 3.1 - EN

SAFETY DATA SHEET

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www.total-corbion.com pla@total-corbion.com

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

1.1. Product identifier

Product Name	L-Lactide
Trade name	Puralact® L Polymer Grade Lumilact L Polymer Grade
Synonyms	Dilactide
CAS-No	4511-42-6
EC-No	224-832-0
REACH Registration Number	01-2119489904-22-0002

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

Recommended Use	Polymer. See annex for more detailed information.
Uses advised against	No information available.

1.3. Details of the supplier of the safety data sheet

Total Corbion PLA
Arkelsedijk 46
4206 AC Gorinchem
The Netherlands
Tel: +31 183 695695
Fax: +31 183 695604
Email: pla@total-corbion.com

1.4. Emergency telephone number

UK National Health Service (NHS) call 111 or, in life-threatening emergencies, call 999

WAL National Health Service (NHS) call 0845 46 47

IE National Poisons Information Centre
+353 1 809 2566 or +353 1 837 9964 (only for healthcare professionals)

Total Corbion PLA
+31 183 695695

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Classification according to EU
Regulation 1272/2008/EC
Serious eye damage/eye irritation Category 2 - H319

For the full text of the H-Statements mentioned in this section, see Section 16.

2.2. Label elements



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Signal word

Warning

Hazard Statements

H319 - Causes serious eye irritation

Precautionary Statements

P264 - Wash hands thoroughly after handling
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/attention

2.3 Other hazards

This product does not meet the criteria for PBT or vPvB in accordance with Annex XIII of REACH.
Fine dust dispersed in air, in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Chemical Name	EC-No	CAS-No	Weight %	Classification (1272/2008/EC)	REACH Registration Number
(3S-cis)-3,6-dimethyl-1,4-dioxane-2,5-dione	224-832-0	4511-42-6	>98	Eye Irrit. 2 H319	01-2119489904-22-0002

For the full text of the H-Statements mentioned in this section, see Section 16.



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SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General advice	Keep person warm and at rest. When symptoms persist or in all cases of doubt seek medical advice. Wash contaminated clothing before reuse.
Eye contact	Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Consult a physician.
Skin contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention immediately if symptoms occur.
Ingestion	Rinse mouth. Get medical attention immediately if symptoms occur.
Inhalation	Move to fresh air. Get medical attention immediately if symptoms occur.
Protection of first-aiders	Use personal protective equipment. Avoid contact with skin, eyes and clothing.

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

Main symptoms If in eyes: Redness, Itching, Pain.

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

Notes to physician Treat symptomatically.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media	Water spray, Foam, Dry powder, Carbon dioxide (CO ₂).
Unsuitable Extinguishing Media	Do not use a solid water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

Special Hazard Dust can form an explosive mixture in air.

5.3. Advice for firefighters

Fire fighting measures	Evacuate non-essential personnel. Move containers from fire area if you can do it without risk. Keep containers and surroundings cool with water spray. Prevent fire extinguishing water from contaminating surface water or the ground water system.
Special protective equipment for fire-fighters	Wear self-contained breathing apparatus and protective suit.



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SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Evacuate personnel to safe areas. Do not touch or walk through spilled material. Avoid contact with skin, eyes and clothing. Do not breathe dust. Use personal protective equipment. Ensure adequate ventilation.

6.2. Environmental precautions

Should not be released into the environment. Prevent further leakage or spillage if safe to do so.

6.3 Methods and material for containment and cleaning up

Large amounts: Prevent further leakage or spillage if safe to do so. Dike to collect large spills. Cover with plastic sheet to prevent spreading. Sweep up and shovel into suitable containers for disposal. Following product recovery, flush area with water. Small amounts: Shovel or sweep up. After cleaning, flush away traces with water. Never return spills in original containers for re-use.

6.4. Reference to other sections

See sections 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling

Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing. Avoid dust formation. Fine dust dispersed in air may ignite. Do not breathe dust. Ensure adequate ventilation. Wear personal protective equipment. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Handle under nitrogen and protect from moisture. See annex for more detailed information.

7.2. Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Keep containers tightly closed in a cool, well-ventilated place. Protect from moisture.

7.3. Specific end use(s)

Exposure scenario	See annex.
Other information	Not available.



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SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure Limits Contains no substances with occupational exposure limit values.

Biological Limit Values Not established.

Recommended monitoring procedures No information available.

Derived No Effect Level (DNEL) Not determined.

Predicted No Effect Concentration (PNEC)

Chemical Name	Freshwater	Marine water	Intermittent release	Sewage treatment plant	Freshwater sediment	Marine sediment	Soil	Oral
(3S-cis)-3,6-dimethyl-1,4-dioxane-2,5-dione	1.3 mg/L			10 mg/L				

8.2. Exposure controls

Appropriate engineering controls Ensure adequate ventilation, especially in confined areas. Keep at temperatures below 150 °C / 302 °F. Ensure that eyewash stations and safety showers are close to the workstation location. See annex for more detailed information.

Individual protection measures, such as personal protective equipment

Eye protection

Safety glasses with side-shields (EN166).

Hand Protection

Protective gloves (EN374): Butyl rubber. Glove thickness: 0.5 mm. Break through time: >8 hours.

Skin and body protection

Long sleeved clothing.

Respiratory protection

In case of inadequate ventilation wear respiratory protection.

Recommended Filter Type

A1P3

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice. Workers must be trained in the proper use and handling of this product as required under applicable regulations. Do not eat, drink or smoke when using this product. Wash hands before breaks and immediately after handling the product. Remove and wash contaminated clothing before re-use.

Environmental Exposure Controls

The product should not be allowed to enter drains, water courses or the soil.



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SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Physical state @20°C	Solid
Appearance	Flakes
Colour	White
Odour	Odourless
pH	No information available
Melting/freezing point	97 °C / 206.6 °F (@ 1019 hPa)
Boiling point/boiling range	266 °C / 510.8 °F (@ 1019 hPa)
Flash point	150 °C / 302 °F
Evaporation rate	Not applicable
Flammability (solid, gas)	Not flammable
Flammability Limits in Air	Not applicable
Explosive limits	Not applicable
Vapour pressure	0.28 Pa (@25°C)
Vapour density	Not applicable
Relative density	1.33 (water = 1)
Solubility	
Water solubility	16.7 g/L (@ 20.1 °C / 68.2 °F)
Solubility in other solvents	Toluene: > 167 g/L
Partition Coefficient (n-octanol/water)	No information available
Autoignition temperature	Not applicable
Decomposition temperature	No information available
Viscosity, dynamic	No information available
Explosive properties	Not applicable
Oxidising properties	Not applicable

9.2 Other information

Density	0.8 g/cm ³ (Flakes) / 1.33 g/cm ³ (Solid)
Danger of dust explosions	Yes



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SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

None known.

10.2. Chemical stability

Stable under recommended storage conditions

10.3 Possibility of hazardous reactions

Fine dust dispersed in air, in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

10.4. Conditions to avoid

Protect from water.

10.5. Incompatible materials

Water, Moisture (Air).

10.6. Hazardous decomposition products

Carbon oxides.



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SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Acute toxicity
Ingestion No known effect.
Skin contact No known effect.
Inhalation No known effect.

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
(3S-cis)-3,6-dimethyl-1,4-dioxane-2,5-dione	>2000 mg/kg (Rat)	>2000 mg/kg (Rabbit)	>7.94 mg/L (Rat) 4h

Skin corrosion/irritation No known effect.

Serious eye damage/irritation Causes serious eye irritation. OECD 405, Rabbit, 24h: Moderate eye irritation.

Chemical Name	Skin corrosion/irritation	Serious eye damage/irritation
(3S-cis)-3,6-dimethyl-1,4-dioxane-2,5-dione	OECD 404 Rabbit 72h Result Non-irritating	OECD 405 Rabbit 24h Result Moderate eye irritation

Respiratory or skin sensitisation No known effect. Did not cause sensitisation on laboratory animals (Skin Sensitisation, OECD 429, mouse).

Germ cell mutagenicity Not known to cause heritable genetic damage.

Carcinogenicity Contains no ingredient listed as a carcinogen.

Reproductive toxicity Not known to cause birth defects or have a deleterious effect on a developing fetus. Not known to adversely affect reproductive functions and organs.

STOT-single exposure No known effect.

STOT-repeated exposure No known effect.

Aspiration hazard No known effect.



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SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

This product is not known to be hazardous to the environment.

Chemical Name	Toxicity to algae	Toxicity to fish	Toxicity to microorganisms	Toxicity to daphnia and other aquatic invertebrates
(3S-cis)-3,6-dimethyl-1,4-dioxane-2,5-dione			LC50: > 100 mg/L 3h	

12.2. Persistence and degradability

Readily biodegradable.

12.3. Bioaccumulative potential

Does not bioaccumulate.

Chemical Name	Log P _{ow}	Bioconcentration factor (BCF)
(3S-cis)-3,6-dimethyl-1,4-dioxane-2,5-dione	1.65	

12.4. Mobility in soil

No information available.

12.5. Results of PBT and vPvB assessment

No information available.

12.6. Other adverse effects

No information available.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from residues / unused products Dispose of in accordance with local regulations.

Contaminated packaging Dispose of in accordance with local regulations. Do not re-use empty containers.



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SECTION 14: TRANSPORT INFORMATION

According to: ADR, RID, ADN, IMDG, IATA/ICAO.

14.1. UN number

Not regulated.

14.2. UN proper shipping name

Not regulated.

14.3. Transport hazard class(es)

Not regulated.

14.4. Packing group

Not regulated.

14.5 Environmental hazards

Not applicable.

14.6 Special precautions for user

Not applicable.

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

Not applicable.

SECTION 15: REGULATORY INFORMATION

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

Restrictions on use None.

Other Regulations No information available

15.2 Chemical safety assessment

A Chemical Safety Assessment has been carried out for this substance. See annex for more detailed information.



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SECTION 16: OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3	H319 - Causes serious eye irritation
Revision Note	Indication of the changes made to the previous version of the SDS: REACH Registration Number, Section 3.
Training Advice	Workers must be trained in the proper use and handling of this product as required under applicable regulations.
Abbreviations and acronyms	REACH: Registration, Evaluation, Authorisation and Restriction of Chemical substances EC: European Commission STOT: Specific Target Organ Toxicity PBT: Persistent, Bioaccumulative, Toxic vPvB: very Persistent and very Bioaccumulating ADR: Accord européen relatif au transport international des marchandises Dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road) RID: Règlement concernant le transport international ferroviaire des marchandises dangereuses (Regulations for the International Transport of Dangerous Goods by Rail) ADN: Accord européen relatif au transport international des marchandises Dangereuses par voies de Navigation intérieures (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways) IMDG: International Maritime Dangerous Goods Code ICAO: International Civil Aviation Organization
SDS No.	CO00123
Subformat	CTEU

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006 and Regulation (EC) No. 2015/830. Label element according to Regulation (EC) No 1272/2008.

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End of Safety Data Sheet



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READER'S GUIDE

The generic Exposure Scenario GES1 is covering following identified uses:

1. Production of polylactic acid
2. Manufacture of cosmetic products

Generic Exposure Scenario GES1: Production, transport and downstream use of L-lactide:

Lactide is a cyclic dimer of lactic acid, which rapidly hydrolyses into lactic acid in vivo and in the presence of water. Except for local effects (skin and eye contact), all lactide toxicology can be understood in terms of lactic acid toxicology.

Lactic acid is a non-toxic substance that is a basic metabolic and energetic building block in practically all life-forms, from bacteria to primates. It is not labelled for environmental effects or ecotoxicity, and is also not labelled for any human effects, with the exception of skin and eye irritation (Lactic acid is classified for skin as Xi;R38, GHS: Category 2, and for eyes as Xi; R41, GHS: Category 1). Note that the skin and eye irritation potential of lactic acid is a pH effect - buffered lactic acid, even up to 70% aqueous solutions is not irritating.

As such, no risk assessment for the environment is required, and no environmental exposure assessment is necessary. For human health, lactic acid is not labelled for any 'dose-effect' endpoint, and thus no quantitative risk assessment is necessary or possible.

Lactide is labelled for eye irritation (Xi; R36, GHS: Category 2). Under the current classification and labelling requirements for preparations, preparations containing less than 20% lactide do not have to be classified for eye irritation.

In all production, storage and transportation conditions and processes, regardless of use, where PURAC's lactide is handled, i.e. where there would be a potential for human exposure to a 'dangerous substance or preparation', Risk Management Measures are already prescribed, and enforced, that exclude any possible eye exposure to lactide. In all identified downstream uses where lactide is handled (such as the receipt of transported lactide, the storage of lactide, the introduction of lactide in any relevant process, i.e. where there would be a potential for human exposure to a 'dangerous substance or preparation', Risk Management Measures are already prescribed, and enforced, that exclude any possible eye exposure to lactide.

As such, a generic exposure scenario for all identified uses of lactide can be defined:

- For the environment, no hazards are identified, and no exposure assessment is required.
- For human exposure, the only identified hazard is eye irritation, and due to RMM, no exposure to lactide is possible. Exposure is 0.

Annex No. CO10003 /COTG



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Safety Data Sheet

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ANNEX TO THE SAFETY DATA SHEET

1. EXPOSURE SCENARIO

Exposure scenario	GES1
Title	Production, transport and downstream use of L-lactide (pure substance or >=20% in a mixture)
<u>Use Descriptor</u>	
Sector of use	SU10, SU12
Environmental release categories	ERC1, ERC2, ERC6a, ERC6c, ERC7
Product category	PC32, PC39
Process categories	PROC1, PROC2, PROC3, PROC4, PROC5, PROC8a, PROC8b, PROC9, PROC14, PROC15
Article categories	-

2. CONDITIONS OF USE AFFECTING EXPOSURE

2.1 Contributing Scenario - Environment

Not applicable.

2.2 Contributing Scenario - Worker & Consumer

Product characteristics	
Physical state @20°C	Solid
Concentration of substance in product	Covers percentage substance in the product up to 100 %.
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently).
Other operational conditions affecting worker exposure	
Work area	Indoor/outdoor use.
Technical conditions and measures to control dispersion from source towards the worker	Avoid temperatures above 150 °C / 302 °F. Ensure adequate ventilation, especially in confined areas.
General measures	
	Use suitable eye protection (safety glasses with side-shields, tested to EN166)
	Provide basic employee training to prevent/minimize exposures and to report any eye problems that may develop
General measures applicable to all activities	No other specific measures identified.

3. EXPOSURE ESTIMATION AND REFERENCE TO ITS SOURCE

Environment Exposure Estimation	L-lactide is not classified as hazardous for environmental endpoints. A quantitative exposure assessment for the environment has not been conducted.
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Safety Data Sheet

Puralact® L

Health Exposure Estimation

L-Lactide is classified as a skin and eye irritant, which requires a qualitative risk characterization of any dermal or eye exposures according to REACH guidance Chapter E. A quantitative assessment of dermal and eye exposures has not been conducted.

4. GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO

Environmental Exposure Controls

Control of environmental exposure Not applicable.

Used EUSES model No information available.

Non-standard assumptions No information available.

Predicted No Effect Concentration (PNEC) No information available.

Control of worker exposure

ECETOC TRA No information available.

Derived No Effect Level (DNEL) Available hazard data do not enable the derivation of a DNEL for dermal or eye irritant effects. Risk Management Measures are based on qualitative risk characterization.

Available hazard data do not support the need for a DNEL to be established for other health effects. Users are advised to consider national Occupational Exposure Limits or other equivalent values.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Guidance to check compliance with the exposure scenario

No information available.

Annex No. CO20005 /CTES



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SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1. Product identifier**

Product Name	Methanol		
Chemical Name	CAS No	EC No	REACH registration number
Methanol	67-56-1	200-659-6	01-2119433307-44-0057
Pure substance/mixture	Substance		

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

Industrial	Manufacture of substances. Distribution of substance. Formulation and (re)packing of substances and mixtures. Water treatment chemical. Cleaning agent. Use in oil field drilling and production operations. Fuels. Use as laboratory reagent.
Professional	Cleaning agent. Fuels. Use as laboratory reagent.
Consumer	Use in cleaning agents and de-icers (liquid products), in cleaning agents and de-icers (spraying products), of fuels indoors (domestic/hobby use e.g in model engines, fuel cells, fondue sets) and of fuels outdoors (gasoline additive).

Uses advised against Not identified.

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

Perstorp Specialty Chemicals AB
SE-284 80 Perstorp, Sweden
Tel. +46 435 380 00
www.perstorp.com

E-mail address productinfo@perstorp.com

1.4. Emergency telephone number

Europe (+)1 760 476 3961 (contract no: 334101)

United Kingdom (+)44 8 08 189 0979 (contract no: 334101)

SECTION 2: Hazards identification**Hazards description**

The substance is a flammable liquid that burns with a non-luminous, bluish flame. Vapours may form explosive mixtures with air.

Methanol is more toxic to humans and primates than to most experimental animals, due to differences in how it is metabolised. Non-primates do not appear to experience the acidosis or vision effects observed in humans and primates. Methanol is absorbed following ingestion, inhalation, or dermal exposure, and the toxicity is the same regardless of the route of exposure.

2.1. Classification of the substance or mixture**Classification according to Regulation (EC) No. 1272/2008 [CLP]**

Acute toxicity - Oral	Category 3 - (H301)
Acute toxicity - Dermal	Category 3 - (H311)
Acute toxicity - Inhalation (Vapours)	Category 3 - (H331)
Specific target organ toxicity (single exposure)	Category 1 - (H370) optic nerve, central nervous system.
Flammable liquids	Category 2 - (H225)

2.2. Label elements**Symbols/Pictograms**

**Signal word**

Danger

Hazard statements

H225 - Highly flammable liquid and vapour

H301 - Toxic if swallowed

H311 - Toxic in contact with skin

H331 - Toxic if inhaled

H370 - Causes damage to organs
optic nerve, central nervous system**Precautionary Statements**

P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking

P260 - Do not breathe mist/vapours/spray

P280 - Wear protective gloves/protective clothing/eye protection/face protection

P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor

P307 + P311 - IF exposed: Call a POISON CENTER or doctor/physician

P403 + P233 - Store in a well-ventilated place. Keep container tightly closed

Contains: Methanol

2.3. Other hazards

None known.

SECTION 3: Composition/information on ingredients**3.1 Substances**

Chemical Name	EC No	CAS No	REACH registration number	Weight-%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Methanol	200-659-6	67-56-1	01-2119433307-44-0057	~100	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) STOT SE 1 (H370) Flam. Liq. 2 (H225)

Full text of H- and EUH-phrases: see section 16

Additional information

No information available

SECTION 4: First aid measures**4.1. Description of first aid measures**

General advice	Immediate medical attention is required. Keep victim warm and quiet. First aid personnel should pay attention to their own safety.
Inhalation	Move victim to fresh air. Call a doctor or poison control centre immediately.
Skin contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Call a doctor or poison control centre immediately.
Eye contact	Rinse immediately with plenty of water and seek medical advice. Always obtain medical advice immediately, even if there are no symptoms.
Ingestion	Call a doctor or poison control centre immediately. Rinse mouth then drink plenty of water. Induce vomiting, but only if victim is fully conscious.

Self-protection of the first aider

Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Avoid contact with skin, eyes or clothing.

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

Methanol poisoning has a number of symptoms. These include bizarre behavior, extreme dizziness, severe headaches, and coma. Methanol poisoning can cause permanent damage to the optic nerve and central and peripheral nervous system with just a single acute exposure. The digestive system starts to immediately reject methanol and symptoms may include severe stomach pain, nausea, and diarrhea. Methanol also disrupts liver and pancreatic function. Even with treatment, methanol poisoning can cause permanent liver damage. Signs of systemic poisoning may be delayed 8-36 hours after initial exposure.

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

Ethanol may inhibit methanol metabolism.

SECTION 5: Firefighting measures**5.1. Extinguishing media****Suitable extinguishing media**

Carbon dioxide (CO₂). Extinguishing powder, Water spray or fog,

Unsuitable extinguishing media

High volume water jet.

5.2. Special hazards arising from the substance or mixture

Vapours may form explosive mixtures with air. Vapour is heavier than air and may accumulate in low areas and travel a considerable distance up to the source of ignition. Thermal decomposition can lead to release of irritating and toxic gases and vapours. Pay attention to that the substance burns with a non-luminous (nearly invisible) flame.

Hazardous combustion products

Carbon dioxide (CO₂), Carbon monoxide (CO).

5.3. Advice for firefighters

Wear self-contained breathing apparatus and protective suit.

Additional information

Cool containers with flooding quantities of water until well after fire is out.

SECTION 6: Accidental release measures**6.1. Personal precautions, protective equipment and emergency procedures**

Keep unprotected persons away. Keep people away from and upwind of spill/leak. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch or walk through spilled material. Measures involving any personal risk or for which no suitable training have been given, may not be taken. Wear full protective clothing and self contained breathing apparatus.

6.2. Environmental precautions

Do not allow into any sewer, on the ground or into any body of water. Local authorities should be advised if significant spillages cannot be contained.

6.3. Methods and material for containment and cleaning up**Methods for containment**

A vapour suppressing foam may be used to reduce vapours.

Small spill

Ensure adequate ventilation. Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.

Large spill

Pump up the product into a spare container suitably labelled. Ensure adequate ventilation.

Methods for cleaning up

Use clean non-sparking tools to collect absorbed material. Clean contaminated surface thoroughly. After cleaning, flush away traces with water.

Large spill

Pump up the product into a spare container suitably labelled.

Prevention of secondary hazards

Clean contaminated objects and areas thoroughly observing environmental regulations. Ensure adequate ventilation, especially in confined areas.

6.4. Reference to other sections

See Section 7, 8, 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Before handling, investigate the hazards and risk of using this product at your work place. If possible, use only in closed system. Work shall be planned and arranged in such a way that direct contact with the product is prevented. Wear personal protective equipment according to section 8 if risk of exposure. Ensure adequate ventilation.

Vapours may form explosive mixture with air. Keep away from heat/sparks/open flames/hot surfaces. — No smoking. Take necessary action to avoid static electricity discharge (which might cause ignition of organic vapours). Use spark-proof tools and explosion-proof equipment.

General Hygiene Considerations

When using do not eat, drink or smoke. Remove/Take off immediately all contaminated clothing. Use personal protective equipment as required.

7.2. Conditions for safe storage, including any incompatibilities

Store in a locked area. Keep tightly closed in a dry and cool place. Keep away from heat and sources of ignition.

Suitable container/equipment material: Stainless steel. Steel. Glass.

Unsuitable container/equipment material: Aluminium. Zinc. Copper.

7.3. Specific end use(s)

For details, see the separate exposure scenario(s).

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits

Keep personal exposure levels below Derived No Effect Level (DNEL) and national exposure limit values (if existing).

Chemical Name	European Union	United Kingdom
Methanol 67-56-1	TWA: 200 ppm TWA: 260 mg/m ³ Skin	TWA: 200 ppm TWA: 266 mg/m ³ STEL: 250 ppm STEL: 333 mg/m ³ Sk*

Derived No Effect Level (DNEL) - worker

Methanol (67-56-1)			
Type	Exposure route	DNEL	Remarks
Acute effects, local	Inhalation	260	mg/m ³
Acute effects, systemic	Inhalation	260	mg/m ³
Chronic effects, local	Inhalation	260	mg/m ³
Chronic effects, systemic	Inhalation	260	mg/m ³
Acute effects, systemic	Dermal	40	mg/kg bw/d
Chronic effects, systemic	Dermal	40	mg/kg bw/d

Derived No Effect Level (DNEL) - Consumer

Methanol (67-56-1)			
Type	Exposure route	DNEL	Remarks
Acute effects, local	Inhalation	50	mg/m ³
Acute effects, systemic	Inhalation	50	mg/m ³
Chronic effects, local	Inhalation	50	mg/m ³
Chronic effects, systemic	Inhalation	50	mg/kg bw/d
Acute effects, systemic	Dermal	8	mg/kg bw/d
Chronic effects, systemic	Dermal	8	mg/kg bw/d

Predicted No Effect Concentration (PNEC)

Methanol (67-56-1)

Environmental compartment	Predicted No Effect Concentration (PNEC)	Remarks
Freshwater	20.8	mg/l
Intermittent	1540	mg/l
Freshwater sediment	77	mg/kg dry weight
Marine water	2.08	mg/l
Marine sediment	7.7	mg/kg dry weight
Impact on Sewage Treatment	100	mg/l
Soil	3.18	mg/kg dry weight

8.2. Exposure controls

Appropriate engineering controls

Comply with Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres and, Directive 1999/92/EC regarding minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. Emergency shower and eye wash facilities must exist on work place. If possible, use only in closed system.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Hand Protection Wear protective gloves.

Duration of contact	Glove material	Glove thickness	Break through time	Remarks
Short term	Butyl rubber	-	>8h	Gloves must conform to standard EN 374

Skin and body protection Whenever risk of direct contact use full protective suit (e.g. according to EN 14605).

Respiratory protection Suitable respiratory protection for lower concentrations or short-term exposure: Gas filter for gases/vapours of organic compounds (boiling point <65°C, e.g. EN 14387 Type AX) Suitable respiratory protection for higher concentrations or long-term exposure: Self-contained breathing apparatus.

Environmental exposure controls

Further information concerning special risk management measures: see annex of this safety data sheet (exposure scenarios).

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance

liquid
colourless

Odour

weak characteristic

Odour threshold

No data available

Property

Value

Remarks • Method

pH

Not applicable

Melting point / freezing point

- 98 °C

Boiling point / boiling range

65 °C

Flash point

9.7 °C

Evaporation rate

Regulation (EC) No. 440/2008, Annex, A.9

Flammability (solid, gas)

No information available

Explosive limits

Not applicable

Upper explosive limits

40 %

Lower explosive limits

6 %

Vapour pressure

169.27 hPa

@ 25 °C

Vapour density

No information available

Relative density

0.79

@ 20 °C

Water solubility

>1000 g/L

Miscible in water

Solubility(ies)

No information available

Partition coefficient

- 0.77

log POW Partition Coefficient (n-octanol/water)

Autoignition temperature

455 °C

DIN 51794

Decomposition temperature

Not determined

Kinematic viscosity

No information available

Dynamic viscosity

0.544 - 0.59 mPa s

@ 25 °C

Explosive properties

Not explosive. May form explosive mixtures with air

Oxidising properties

Not oxidising.

Density

No information available

Bulk density

No information available

9.2. Other information

No information available.

SECTION 10: Stability and reactivity**10.1. Reactivity**

The substance is an alcohol. Alcohols exhibit both weak acid and weak base behavior. They may initiate the polymerization of isocyanates and epoxides.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Reacts with: Oxidising substances.

10.4. Conditions to avoid

Keep away from heat and sources of ignition.

10.5. Incompatible materials

Incompatible with oxidising agents.

10.6. Hazardous decomposition products

Thermal decomposition may release noxious, toxic or corrosive gases or vapours: Carbon monoxide (CO), Carbon dioxide (CO₂)

SECTION 11: Toxicological information**11.1. Information on toxicological effects****Information on likely routes of exposure**

Inhalation. Dermal.

Symptoms related to the physical, chemical and toxicological characteristics

See Section 4 for more information.

Numerical measures of toxicity**Acute toxicity**

Methanol is more toxic to humans and primates than to most experimental animals, due to differences in how it is metabolised. Non-primates do not appear to experience the acidosis or vision effects observed in humans and primates.

Methanol (67-56-1)				
Method	Species	Exposure route	Effective dose	Remarks
Not defined	Rat	Oral	7000-9000	LD50 (lethal dose) mg/kg
Not defined	Rabbit	Dermal	17100	LD50 (lethal dose) mg/kg
Not defined	Rat	Inhalation	128.2	LC50 4h mg/l

Skin corrosion/irritation

Slightly irritant but not relevant for classification.

Methanol (67-56-1)			
Method	Species	Exposure route	Results:
Not defined	Rabbit	Dermal	Non-irritant

Serious eye damage/eye irritation

Slightly irritant but not relevant for classification.

Methanol (67-56-1)			
Method	Species	Exposure route	Results:

Not defined	Rabbit	Eye	Non-irritant
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Respiratory or skin sensitisation

Not a skin sensitiser.

Methanol (67-56-1)

Method	Species	Exposure route	Results:
OECD Test No. 406: Skin Sensitisation	Guinea pig	Skin	Not sensitising.

Germ cell mutagenicity

Not mutagenic.

Methanol (67-56-1)

Method	Species	Results:
OECD Test No. 471: Bacterial Reverse Mutation Test	in vitro	Negative
OECD Test No. 476: In vitro Mammalian Cell Gene Mutation Test	in vitro	Negative
OECD Test No. 474: Mammalian Erythrocyte Micronucleus Test	in vivo	Negative

Carcinogenicity

Animal studies have not shown any carcinogenic potential.

Methanol (67-56-1)

Method	Species	Exposure route	Effective dose	Remarks
OECD Test No. 453: Combined Chronic Toxicity/Carcinogenicity Studies	Mouse	Inhalation	>1.3	NOAEC mg/l Not considered to be carcinogen.

Reproductive toxicity**Methanol (67-56-1)**

Method	Species	Exposure route	Effective dose	Remarks
OECD Test No. 416: Two-Generation Reproduction Toxicity	Rat	Inhalation	1.3	NOAEC mg/l P
OECD Test No. 416: Two-Generation Reproduction Toxicity	Rat	Inhalation	0.13	NOAEC mg/l F1
OECD Test No. 416: Two-Generation Reproduction Toxicity	Rat	Inhalation	0.13	NOAEC mg/l F2

STOT - single exposure

Inhalation, ingestion, or skin absorption of methanol can cause blindness.

Causes damage to the following organs: optic nerve, central nervous system.

Methanol (67-56-1)

Method	Species	Exposure route	Effective dose	Remarks
Unknown	human data	Oral	-	Causes damage to the following organs if swallowed: Eyes central nervous system

STOT - repeated exposure**Methanol (67-56-1)**

Method	Species	Exposure route	Effective dose	Remarks
Unknown	Monkey	Oral	2340	LOAEL mg/kg bw/d 3d
OECD Test No. 412: Sub-acute Inhalation Toxicity: 28-Day Study	Rat	Inhalation	6.66	NOAEC mg/l
OECD Test No. 453: Combined Chronic	Mouse	Inhalation	1.3	NOAEC mg/l

Toxicity/Carcinogenicity Studies				
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Aspiration hazard

No information available.

SECTION 12: Ecological information**12.1. Toxicity**

Low toxicity to aquatic organisms.

Methanol (67-56-1)					
Method	Species	Exposure route	Effective dose	Exposure time	Remarks
EPA-660/3-75-009	Lepomis macrochirus	Freshwater	15400	96h	LC50 (lethal concentration) mg/l
OECD Test No. 202: Daphnia sp. Acute Immobilization Test	Daphnia magna	Freshwater	18260	96h	EC50 (effective concentration) mg/l
OECD Test No. 201: Freshwater Algae and Cyanobacteria, Growth Inhibition Test	Pseudokirchneriella subcapitata	Freshwater	22000	96h	EC50 (effective concentration) mg/l
OECD Test No. 209: Activated Sludge, Respiration Inhibition Test (Carbon and Ammonium Oxidation)	Bacteria toxicity	Freshwater	>1000	3h	IC50 mg/l
OECD Test No. 207: Earthworm, Acute Toxicity Tests	Eisenia fetida		>1	48h	LC50 (lethal concentration)

12.2. Persistence and degradability

Readily biodegradable.

Methanol (67-56-1)			
Method	Value	Exposure time	Results:
Unknown	95%	20d	Readily biodegradable
Unknown	97%	20d	Readily biodegradable

12.3. Bioaccumulative potential

No bioaccumulation potential.

Chemical Name	Partition coefficient	Bioconcentration factor (BCF)
Methanol	-0.77	

12.4. Mobility in soil

The substance is not expected to adsorb to a high degree to suspended solids and sediment based upon the log Pow.

12.5. Results of PBT and vPvB assessment

This substance does not meet the criteria for classification as PBT or vPvB.

12.6. Other adverse effects

No information available.

SECTION 13: Disposal considerations**13.1. Waste treatment methods****Waste from residues/unused products**

This material and its container must be disposed of as hazardous waste. Incinerate at a licensed installation.

Contaminated packaging

Not applicable.

Waste codes / waste designations according to EWC / AVV

Waste from residues/unused products: 16 03 05*.

Other Information

Waste codes should be assigned by the user based on the application for which the product was used.

SECTION 14: Transport information



ADR Road transport

14.1 UN number	UN1230
14.2 UN proper shipping name	Methanol
Proper Shipping Description	UN1230, Methanol, 3 (6.1), II, (D/E)
14.3 Transport hazard class(es)	3
Subsidiary hazard class	3 + 6.1
14.4 Packing Group	II
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	279
Tunnel restriction code	(D/E)
Limited quantity (LQ)	1 L
ADR Hazard Id (Kemmler Number)	336

RID Rail transport

14.1 UN number	UN1230
14.2 UN proper shipping name	Methanol
Proper Shipping Description	UN1230, Methanol, 3 (6.1), II
14.3 Transport hazard class(es)	3
Subsidiary hazard class	6.1
14.4 Packing Group	II
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	None

IMDG Sea transport

14.1 UN number	UN1230
14.2 UN proper shipping name	Methanol
Proper Shipping Description	UN1230, Methanol, 3 (6.1), II, (11°C c.c.)
14.3 Transport hazard class(es)	3
Subsidiary hazard class	6.1
14.4 Packing Group	II
14.5 Environmental hazards	Not applicable
14.6 Special precautions for user	279
EmS-No	F-E, S-D
Limited quantity (LQ)	1 L
14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	No information available

IATA Air transport

14.1 UN number	UN1230
14.2 UN proper shipping name	Methanol
14.3 Transport hazard class(es)	3
Subsidiary hazard class	6.1
14.4 Packing Group	II
Proper Shipping Description	UN1230, Methanol, 3 (6.1), II
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	A104, A113
Limited quantity (LQ)	1 L
ERG Code	3L

SECTION 15: Regulatory information

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

International Regulations

European Union

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

Take note of Directive 94/33/EC on the protection of young people at work

Comply with Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres and, Directive 1999/92/EC regarding minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

Named dangerous substances per Seveso Directive (2012/18/EU)

Chemical Name	Upper-tier requirements (tons)	Lower-tier requirements (tons)
Methanol - 67-56-1	5000	500

France

Chemical Name	French RG number
Methanol 67-56-1	RG 84

Germany

Water hazard class (WGK)

Hazardous to water (WGK 2)

Denmark

MAL Code Number

4-6

15.2. Chemical safety assessment

No information available.

SECTION 16: Other information

Key or legend to abbreviations and acronyms used in the safety data sheet

Full text of H-Statements referred to under section 3

H301 - Toxic if swallowed

H311 - Toxic in contact with skin

H331 - Toxic if inhaled

H370 - Causes damage to organs if inhaled

H225 - Highly flammable liquid and vapour

Issue Date 11-Dec-2015

Revision Date 04-Dec-2015

Revision Note Not applicable.

This safety data sheet complies with the requirements of: Regulation (EC) No. 1907/2006, COMMISSION REGULATION (EU) No. 453/2010 of 20 May 2010.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES1 - Manufacture of substances. Use as an intermediate and as a process chemical. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC1 - Manufacture of substances 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
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Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information

Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC4
Process category(ies)	PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 95%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC15
Process category(ies)	PROC15 - Use as laboratory reagent
Covers concentrations up to	100%
Exposure duration	>4h

Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

- ERC1 - Manufacture of substances
- 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

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000051
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.000908
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.012837
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.019694
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.029103
Contributing Scenario [CS] PROC4	Worker - dermal, long-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC4	Worker - combined, long-term - systemic			0.085635
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.196944
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS]	Worker - inhalative,			0.038512

PROC8b	long-term - systemic			
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.107083
Contributing Scenario [CS] PROC15	Worker - dermal, long-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC15	Worker - combined, long-term - systemic			0.027389
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.000205
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.001063
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.106127
Contributing Scenario [CS] PROC4	Worker - dermal, short-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC4	Worker - combined, short-term - systemic			0.239683
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - local			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.325317
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.077024
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.145595
Contributing Scenario [CS] PROC15	Worker - dermal, short-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC15	Worker - combined, short-term - systemic			0.053063

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES2 - Distribution of substance. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC1 - Manufacture of substances ERC2 - Formulation of preparations (mixtures)
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Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)

Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC4
Process category(ies)	PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 95%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC9
Process category(ies)	PROC9 - Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%

Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC1 - Manufacture of substances

ERC2 - Formulation of preparations (mixtures)

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000051
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.000908
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.012837
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.019694
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.029103
Contributing Scenario [CS] PROC4	Worker - dermal, long-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC4	Worker - combined, long-term - systemic			0.085635
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.196944
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, long-term - systemic			0.038512
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.107083
Contributing Scenario [CS] PROC9	Worker - dermal, long-term - systemic			0.034286
Contributing Scenario [CS] PROC9	Worker - inhalative, long-term - systemic			0.102698
Contributing Scenario [CS]	Worker - combined,			0.136984

PROC9	long-term - systemic			
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.000205
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.001063
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.106127
Contributing Scenario [CS] PROC4	Worker - dermal, short-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC4	Worker - combined, short-term - systemic			0.239683
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - local			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.325317
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.077024
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.145595
Contributing Scenario [CS] PROC9	Worker - dermal, short-term - systemic			0.034286
Contributing Scenario [CS] PROC9	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC9	Worker - combined, short-term - systemic			0.239683

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES3 - Formulation and (re)packing of substances and mixtures. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC2 - Formulation of preparations (mixtures)

Remarks

Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)
Covers concentrations up to	100%

Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC4
Process category(ies)	PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 95%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC9
Process category(ies)	PROC9 - Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to	Wear suitable gloves tested to EN374

personal protection, hygiene and health evaluation	See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC15
Process category(ies)	PROC15 - Use as laboratory reagent
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC2 - Formulation of preparations (mixtures)

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000051
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.000908
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.012837
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.019694
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.029103
Contributing Scenario [CS] PROC4	Worker - dermal, long-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC4	Worker - combined, long-term - systemic			0.085635
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS]	Worker - combined,			0.196944

PROC8a	long-term - systemic			
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, long-term - systemic			0.38512
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.107083
Contributing Scenario [CS] PROC9	Worker - dermal, long-term - systemic			0.034286
Contributing Scenario [CS] PROC9	Worker - inhalative, long-term - systemic			0.102698
Contributing Scenario [CS] PROC9	Worker - combined, long-term - systemic			0.136984
Contributing Scenario [CS] PROC15	Worker - dermal, long-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC15	Worker - combined, long-term - systemic			0.027389
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.000205
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.001063
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.106127
Contributing Scenario [CS] PROC4	Worker - dermal, short-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC4	Worker - combined, short-term - systemic			0.239683
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - local			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.325317
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.077024
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.145595
Contributing Scenario [CS] PROC9	Worker - dermal, short-term - systemic			0.034286
Contributing Scenario [CS] PROC9	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC9	Worker - combined, short-term - systemic			0.239683
Contributing Scenario [CS] PROC15	Worker - dermal, short-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC15	Worker - combined, short-term - systemic			0.053063

PROC15	short-term - systemic			
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Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES4 - Water treatment chemical. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC7 - Industrial use of substances in closed systems

Remarks

Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies) ERC7 - Industrial use of substances in closed systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.012837
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.019694
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.058206

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES5 - Use: Cleaning agent. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC4 - Industrial use of processing aids in processes and products, not becoming part of articles

Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)

Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC4
Process category(ies)	PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC7
Process category(ies)	PROC7 - Industrial spraying
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) (30%) Ensure that the task is being carried out outside the breathing zone of a worker (distance head-product greater than 1m) Ensure that the worker is situated in an open or closed cabin
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Organisational measures to prevent /limit releases, dispersion and exposure	Assumes a good basic standard of occupational hygiene is implemented
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	100%

Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 95%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC10
Process category(ies)	PROC10 - Roller application or brushing
Covers concentrations up to	80%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC13
Process category(ies)	PROC13 - Treatment of articles by dipping and pouring
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC4 - Industrial use of processing aids in processes and products, not becoming part of articles

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000051
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.000908
Contributing Scenario [CS]	Worker - dermal,			0.006857

PROC2	long-term - systemic			
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.012837
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.019694
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.029103
Contributing Scenario [CS] PROC4	Worker - dermal, long-term - systemic			0.034286
Contributing Scenario [CS] PROC4	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC4	Worker - combined, long-term - systemic			0.085635
Contributing Scenario [CS] PROC7	Worker - dermal, long-term - systemic			0.214286
Contributing Scenario [CS] PROC7	Worker - inhalative, long-term - systemic			0.5425
Contributing Scenario [CS] PROC7	Worker - combined, long-term - systemic			0.756786
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.196944
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, long-term - systemic			0.38512
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.107083
Contributing Scenario [CS] PROC10	Worker - dermal, long-term - systemic			0.109714
Contributing Scenario [CS] PROC10	Worker - inhalative, long-term - systemic			0.102698
Contributing Scenario [CS] PROC10	Worker - combined, long-term - systemic			0.212413
Contributing Scenario [CS] PROC13	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC13	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC13	Worker - combined, long-term - systemic			0.196944
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.000205
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.001063
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.106127
Contributing Scenario [CS]	Worker - dermal,			0.034286

PROC4	short-term - systemic			
Contributing Scenario [CS] PROC4	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC4	Worker - combined, short-term - systemic			0.239683
Contributing Scenario [CS] PROC7	Worker - dermal, short-term - systemic			0.214286
Contributing Scenario [CS] PROC7	Worker - inhalative, short-term - systemic			0.5425
Contributing Scenario [CS] PROC7	Worker - combined, short-term - systemic			0.756786
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - local			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.325317
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.077024
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.145595
Contributing Scenario [CS] PROC10	Worker - dermal, short-term - systemic			0.109714
Contributing Scenario [CS] PROC10	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC10	Worker - combined, short-term - systemic			0.315111
Contributing Scenario [CS] PROC13	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC13	Worker - inhalative, short-term - systemic			0.256746
Contributing Scenario [CS] PROC13	Worker - combined, short-term - systemic			0.325317

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES6 - Use: Cleaning agent. Professional.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC8a - Wide dispersive indoor use of processing aids in open systems ERC8d - Wide dispersive outdoor use of processing aids in open systems
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Remarks

Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS]
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	PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC4
Process category(ies)	PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC10
Process category(ies)	PROC10 - Roller application or brushing
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC11
Process category(ies)	PROC11 - Non industrial spraying

Covers concentrations up to	3%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	General ventilation Open doors and windows Ensure that the task is being carried out outside the breathing zone of a worker (distance head-product greater than 1m)
Conditions and measures related to personal protection, hygiene and health evaluation	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC13
Process category(ies)	PROC13 - Treatment of articles by dipping and pouring
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies) ERC8a - Wide dispersive indoor use of processing aids in open systems
ERC8d - Wide dispersive outdoor use of processing aids in open systems

Remarks
Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method		EasyTRA		
Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000513
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.001371
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.106127

Contributing Scenario [CS] PROC4	Worker - dermal, long-term - systemic			0.020571
Contributing Scenario [CS] PROC4	Worker - inhalative, long-term - systemic			0.154048
Contributing Scenario [CS] PROC4	Worker - combined, long-term - systemic			0.174619
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.131802
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC8b	Worker - inhalative, long-term - systemic			0.064186
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.067615
Contributing Scenario [CS] PROC10	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC10	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC10	Worker - combined, long-term - systemic			0.13523
Contributing Scenario [CS] PROC11	Worker - dermal, long-term - systemic			0.008036
Contributing Scenario [CS] PROC11	Worker - inhalative, long-term - systemic			0.515385
Contributing Scenario [CS] PROC11	Worker - combined, long-term - systemic			0.52342
Contributing Scenario [CS] PROC13	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC13	Worker - inhalative, long-term - systemic			0.256746
Contributing Scenario [CS] PROC13	Worker - combined, long-term - systemic			0.325317
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.002054
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.002911
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.212254
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.410794
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.414222
Contributing Scenario [CS] PROC4	Worker - dermal, short-term - systemic			0.020571
Contributing Scenario [CS] PROC4	Worker - inhalative, short-term - local			0.718889
Contributing Scenario [CS] PROC4	Worker - combined, short-term - systemic			0.73946
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - systemic			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.260175
Contributing Scenario [CS]	Worker - dermal,			0.003429

PROC8b	short-term - systemic			
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.128373
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.131802
Contributing Scenario [CS] PROC10	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC10	Worker - inhalative, short-term - systemic			0.256746
Contributing Scenario [CS] PROC10	Worker - combined, short-term - systemic			0.263603
Contributing Scenario [CS] PROC11	Worker - dermal, short-term - systemic			0.008036
Contributing Scenario [CS] PROC11	Worker - inhalative, short-term - systemic			0.515385
Contributing Scenario [CS] PROC11	Worker - combined, short-term - systemic			0.52342
Contributing Scenario [CS] PROC13	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC13	Worker - inhalative, short-term - systemic			0.513492
Contributing Scenario [CS] PROC13	Worker - combined, short-term - systemic			0.582063

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES7 - Use in oil field drilling and production operations. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC7 - Industrial use of substances in closed systems

Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC4
Process category(ies)	PROC4 - Use in batch and other process (synthesis) where opportunity for exposure arises
Covers concentrations up to	100%
Exposure duration	Avoid carrying out activities involving exposure for more than 4 hours
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC5
Process category(ies)	PROC5 - Mixing or blending in batch processes for formulation of preparations and articles (multi-stage and/or significant contact)
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC7 - Industrial use of substances in closed systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC4	Worker - dermal, long-term - systemic			0.020571
Contributing Scenario [CS] PROC4	Worker - inhalative, long-term - systemic			0.03081
Contributing Scenario [CS] PROC4	Worker - combined, long-term - systemic			0.051381
Contributing Scenario [CS] PROC5	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC5	Worker - inhalative, long-term - systemic			0.064186
Contributing Scenario [CS] PROC5	Worker - combined, long-term - systemic			0.067615
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.064186
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.067615
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS]	Worker - inhalative,			0.038512

PROC8b	long-term - systemic			
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.04194
Contributing Scenario [CS] PROC4	Worker - dermal, short-term - systemic			0.020571
Contributing Scenario [CS] PROC4	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC4	Worker - combined, short-term - systemic			0.225968
Contributing Scenario [CS] PROC5	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC5	Worker - inhalative, short-term - systemic			0.128373
Contributing Scenario [CS] PROC5	Worker - combined, short-term - systemic			0.131802
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - local			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.131802
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.077024
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.080452

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES8 - Use as fuel. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC7 - Industrial use of substances in closed systems

Remarks

Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)
Covers concentrations up to	100%

Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 95%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC16
Process category(ies)	PROC16 - Using material as fuel sources, limited exposure to unburned product to be expected
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor
Title	Contributing Scenario [CS] PROC19
Process category(ies)	PROC19 - Hand-mixing with intimate contact and only PPE available
Covers concentrations up to	10%
Exposure duration	Avoid carrying out activities involving exposure for more than 4 hours
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC7 - Industrial use of substances in closed systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000051
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.000908
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.012837
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.019694
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.029103
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.196944
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, long-term - systemic			0.38512
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.107083
Contributing Scenario [CS] PROC16	Worker - dermal, long-term - systemic			0.001714
Contributing Scenario [CS] PROC16	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC16	Worker - combined, long-term - systemic			0.130087
Contributing Scenario [CS] PROC19	Worker - dermal, long-term - systemic			0.042429
Contributing Scenario [CS] PROC19	Worker - inhalative, long-term - systemic			0.077024
Contributing Scenario [CS] PROC19	Worker - combined, long-term - systemic			0.119452
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.000205
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.001063
Contributing Scenario [CS]	Worker - dermal,			0.006857

PROC2	short-term - systemic			
Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.106127
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - local			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.325317
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.068571
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.077024
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.145595
Contributing Scenario [CS] PROC16	Worker - dermal, short-term - systemic			0.001714
Contributing Scenario [CS] PROC16	Worker - inhalative, short-term - systemic			0.513492
Contributing Scenario [CS] PROC16	Worker - combined, short-term - systemic			0.515206
Contributing Scenario [CS] PROC19	Worker - dermal, short-term - systemic			0.042429
Contributing Scenario [CS] PROC19	Worker - inhalative, short-term - systemic			0.256746
Contributing Scenario [CS] PROC19	Worker - combined, short-term - systemic			0.299175

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES9 - Use as fuel. Professional.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC8b - Wide dispersive indoor use of reactive substances in open systems ERC8e - Wide dispersive outdoor use of reactive substances in open systems
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Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC1
Process category(ies)	PROC1 - Use in closed process, no likelihood of exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC2
Process category(ies)	PROC2 - Use in closed, continuous process with occasional controlled exposure
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS]
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	PROC3
Process category(ies)	PROC3 - Use in closed batch process (synthesis or formulation)
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC8a
Process category(ies)	PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated facilities
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC8b
Process category(ies)	PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC16
Process category(ies)	PROC16 - Using material as fuel sources, limited exposure to unburned product to be expected
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC19
Process category(ies)	PROC19 - Hand-mixing with intimate contact and only PPE available
Covers concentrations up to	10%
Exposure duration	Avoid carrying out activities involving exposure for more than 4 hours
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC8b - Wide dispersive indoor use of reactive substances in open systems
 ERC8e - Wide dispersive outdoor use of reactive substances in open systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC1	Worker - dermal, long-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, long-term - systemic			0.000513
Contributing Scenario [CS] PROC1	Worker - combined, long-term - systemic			0.001371
Contributing Scenario [CS] PROC2	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC2	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC2	Worker - combined, long-term - systemic			0.058206
Contributing Scenario [CS] PROC3	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, long-term - systemic			0.102698
Contributing Scenario [CS] PROC3	Worker - combined, long-term - systemic			0.106127
Contributing Scenario [CS] PROC8a	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC8a	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC8a	Worker - combined, long-term - systemic			0.131802
Contributing Scenario [CS] PROC8b	Worker - dermal, long-term - systemic			0.003429
Contributing Scenario [CS] PROC8b	Worker - inhalative, long-term - systemic			0.064186
Contributing Scenario [CS] PROC8b	Worker - combined, long-term - systemic			0.067615
Contributing Scenario [CS] PROC16	Worker - dermal, long-term - systemic			0.001714
Contributing Scenario [CS] PROC16	Worker - inhalative, long-term - systemic			0.256746
Contributing Scenario [CS] PROC16	Worker - combined, long-term - systemic			0.25846
Contributing Scenario [CS] PROC19	Worker - dermal, long-term - systemic			0.042429
Contributing Scenario [CS] PROC19	Worker - inhalative, long-term - systemic			0.154048
Contributing Scenario [CS] PROC19	Worker - combined, long-term - systemic			0.196476
Contributing Scenario [CS] PROC1	Worker - dermal, short-term - systemic			0.000857
Contributing Scenario [CS] PROC1	Worker - inhalative, short-term - systemic			0.002054
Contributing Scenario [CS] PROC1	Worker - combined, short-term - systemic			0.002911
Contributing Scenario [CS] PROC2	Worker - dermal, short-term - systemic			0.006857

Contributing Scenario [CS] PROC2	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC2	Worker - combined, short-term - systemic			0.212254
Contributing Scenario [CS] PROC3	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC3	Worker - inhalative, short-term - systemic			0.410794
Contributing Scenario [CS] PROC3	Worker - combined, short-term - systemic			0.414222
Contributing Scenario [CS] PROC8a	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC8a	Worker - inhalative, short-term - systemic			0.256746
Contributing Scenario [CS] PROC8a	Worker - combined, short-term - systemic			0.260175
Contributing Scenario [CS] PROC8b	Worker - dermal, short-term - systemic			0.003429
Contributing Scenario [CS] PROC8b	Worker - inhalative, short-term - systemic			0.128373
Contributing Scenario [CS] PROC8b	Worker - combined, short-term - systemic			0.131802
Contributing Scenario [CS] PROC16	Worker - dermal, short-term - systemic			0.001714
Contributing Scenario [CS] PROC16	Worker - inhalative, short-term - systemic			0.718889
Contributing Scenario [CS] PROC16	Worker - combined, short-term - systemic			0.720603
Contributing Scenario [CS] PROC19	Worker - dermal, short-term - systemic			0.042429
Contributing Scenario [CS] PROC19	Worker - inhalative, short-term - systemic			0.513492
Contributing Scenario [CS] PROC19	Worker - combined, short-term - systemic			0.555921

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES10 - Use as laboratory reagent. Industrial.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC4 - Industrial use of processing aids in processes and products, not becoming part of articles

Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC10
Process category(ies)	PROC10 - Roller application or brushing
Covers concentrations up to	80%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC15
Process category(ies)	PROC15 - Use as laboratory reagent
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 90%
Conditions and measures related to personal protection, hygiene and	Wear suitable gloves tested to EN374 See section 8 for more information

health evaluation	
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC4 - Industrial use of processing aids in processes and products, not becoming part of articles

Remarks

Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC10	Worker - dermal, long-term - systemic			0.109714
Contributing Scenario [CS] PROC10	Worker - inhalative, long-term - systemic			0.102698
Contributing Scenario [CS] PROC10	Worker - combined, long-term - systemic			0.212413
Contributing Scenario [CS] PROC15	Worker - dermal, long-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, long-term - systemic			0.025675
Contributing Scenario [CS] PROC15	Worker - combined, long-term - systemic			0.027389
Contributing Scenario [CS] PROC10	Worker - dermal, short-term - systemic			0.109714
Contributing Scenario [CS] PROC10	Worker - inhalative, short-term - systemic			0.205397
Contributing Scenario [CS] PROC10	Worker - combined, short-term - systemic			0.315111
Contributing Scenario [CS] PROC15	Worker - dermal, short-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, short-term - systemic			0.051349
Contributing Scenario [CS] PROC15	Worker - combined, short-term - systemic			0.053063

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES11 - Use as laboratory reagent. Professional.
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC8a - Wide dispersive indoor use of processing aids in open systems

Remarks

Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of worker exposure

Control of worker exposure

Title	Contributing Scenario [CS] PROC10
Process category(ies)	PROC10 - Roller application or brushing
Covers concentrations up to	5%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Title	Contributing Scenario [CS] PROC15
Process category(ies)	PROC15 - Use as laboratory reagent
Covers concentrations up to	100%
Exposure duration	>4h
Use frequency	Covers frequency up to 5 days per week
Technical conditions and measures to control dispersion from source towards the worker	Local exhaust ventilation - efficiency of at least 80%
Conditions and measures related to personal protection, hygiene and health evaluation	Wear suitable gloves tested to EN374 See section 8 for more information
Indoor/Outdoor use	Indoor

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies) ERC8a - Wide dispersive indoor use of processing aids in open systems

Remarks
Not relevant since not classified as dangerous for the environment.

Control of worker exposure

Calculation method EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PROC10	Worker - dermal, long-term - systemic			0.006857
Contributing Scenario [CS] PROC10	Worker - inhalative, long-term - systemic			0.128373
Contributing Scenario [CS] PROC10	Worker - combined, long-term - systemic			0.13523
Contributing Scenario [CS] PROC15	Worker - dermal, long-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, long-term - systemic			0.051349
Contributing Scenario [CS] PROC15	Worker - combined, long-term - systemic			0.053063
Contributing Scenario [CS] PROC10	Worker - dermal, short-term - systemic			0.006857
Contributing Scenario [CS] PROC10	Worker - inhalative, short-term - systemic			0.256746
Contributing Scenario [CS] PROC10	Worker - combined, short-term - systemic			0.263603
Contributing Scenario [CS] PROC15	Worker - dermal, short-term - systemic			0.001714
Contributing Scenario [CS] PROC15	Worker - inhalative, short-term - systemic			0.102698
Contributing Scenario [CS] PROC15	Worker - combined, short-term - systemic			0.104413

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES12 - Consumer use in cleaning agents and de-icers (liquid products).
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC8a - Wide dispersive indoor use of processing aids in open systems ERC8d - Wide dispersive outdoor use of processing aids in open systems
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Remarks

Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of consumer exposure

Control of consumer exposure	
Title	Contributing Scenario [CS] PC4
Product (sub) category(ies)	PC4 - Anti-freeze and de-icing products
Covers concentrations up to	2.5%
Physical form of product	Liquid
Amounts used	Inhalation / Dermal 100g/5g
Exposure duration	4h
Use frequency	104 per year
Release area	5m ²
Title	Contributing Scenario [CS] PC35
Product (sub) category(ies)	PC35 - Washing and cleaning products (including solvent based products)
Covers concentrations up to	2.5%
Physical form of product	Liquid
Amounts used	Inhalation / Dermal 100g/5g

Exposure duration	4h
Use frequency	104 per year
Release area	5m2

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies) ERC8a - Wide dispersive indoor use of processing aids in open systems
 ERC8d - Wide dispersive outdoor use of processing aids in open systems

Remarks
 Not relevant since not classified as dangerous for the environment.

Control of consumer exposure

Calculation method EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PC4	Consumer - dermal, long-term - systemic			0.068493
Contributing Scenario [CS] PC4	Consumer - inhalative, long-term - systemic			0.061207
Contributing Scenario [CS] PC4	Consumer - combined, long-term - systemic			0.1297
Contributing Scenario [CS] PC35	Consumer - dermal, long-term - systemic			0.068493
Contributing Scenario [CS] PC35	Consumer - inhalative, long-term - systemic			0.061207
Contributing Scenario [CS] PC35	Consumer - combined, long-term - systemic			0.1297
Contributing Scenario [CS] PC4	Consumer - dermal Short term systemic health effects			0.240385
Contributing Scenario [CS] PC4	Consumer - inhalative, short-term - systemic			0.36724
Contributing Scenario [CS] PC4	Consumer - combined, short-term - systemic			0.607625
Contributing Scenario [CS] PC35	Consumer - dermal Short term systemic health effects			0.240385
Contributing Scenario [CS] PC35	Consumer - inhalative, short-term - systemic			0.36724
Contributing Scenario [CS] PC35	Consumer - combined, short-term - systemic			0.607625

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES13 - Consumer use in cleaning agents and de-icers (spraying products).
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC8a - Wide dispersive indoor use of processing aids in open systems ERC8d - Wide dispersive outdoor use of processing aids in open systems
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Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of consumer exposure

Control of consumer exposure	
Title	Contributing Scenario [CS] PC4 Spraying
Product (sub) category(ies)	PC4 - Anti-freeze and de-icing products
Covers concentrations up to	5%
Physical form of product	Sprays
Exposure duration	24.6s
Use frequency	365 per year
Title	Contributing Scenario [CS] PC4 Cleaning
Product (sub) category(ies)	PC4 - Anti-freeze and de-icing products
Covers concentrations up to	5%
Amounts used	Inhalation / Dermal 16.2g/0.160g
Exposure duration	60min
Use frequency	365 per year
Release area	1.71m ²

Title	Contributing Scenario [CS] PC35 Spraying
Product (sub) category(ies)	PC35 - Washing and cleaning products (including solvent based products)
Covers concentrations up to	5%
Physical form of product	Sprays
Exposure duration	24.6s
Use frequency	365 per year

Title	Contributing Scenario [CS] PC35 Cleaning
Product (sub) category(ies)	PC35 - Washing and cleaning products (including solvent based products)
Covers concentrations up to	5%
Amounts used	Inhalation / Dermal 16.2/0.160g
Exposure duration	60min
Use frequency	365 per year
Release area	1.71m2

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC8a - Wide dispersive indoor use of processing aids in open systems
 ERC8d - Wide dispersive outdoor use of processing aids in open systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of consumer exposure

Calculation method EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PC4 Spraying	Consumer - dermal, long-term - systemic			0.001813
Contributing Scenario [CS] PC4 Spraying	Consumer - inhalative, long-term - systemic			0.003517
Contributing Scenario [CS] PC4 Spraying	Consumer - combined, long-term - systemic			0.005331
Contributing Scenario [CS] PC4 Cleaning	Consumer - dermal, long-term - systemic			0.015385
Contributing Scenario [CS] PC4 Cleaning	Consumer - inhalative, long-term - systemic			0.016518
Contributing Scenario [CS] PC4 Cleaning	Consumer - combined, long-term - systemic			0.031902
Contributing Scenario [CS] PC35 Spraying	Consumer - dermal, long-term - systemic			0.001813
Contributing Scenario [CS] PC35 Spraying	Consumer - inhalative, long-term - systemic			0.003438
Contributing Scenario [CS] PC35 Spraying	Consumer - combined, long-term - systemic			0.005252
Contributing Scenario [CS] PC35 Cleaning	Consumer - dermal, long-term - systemic			0.015385
Contributing Scenario [CS] PC35 Cleaning	Consumer - inhalative, long-term - systemic			0.016518

Contributing Scenario [CS] PC35 Cleaning	Consumer - combined, long-term - systemic			0.031902
Contributing Scenario [CS] PC4 Spraying	Consumer - dermal Short term systemic health effects			0.001813
Contributing Scenario [CS] PC4 Spraying	Consumer - inhalative, short-term - systemic			0.084412
Contributing Scenario [CS] PC4 Spraying	Consumer - combined, short-term - systemic			0.086226
Contributing Scenario [CS] PC4 Cleaning	Consumer - dermal Short term systemic health effects			0.015385
Contributing Scenario [CS] PC4 Cleaning	Consumer - inhalative, short-term - systemic			0.396423
Contributing Scenario [CS] PC4 Cleaning	Consumer - combined, short-term - systemic			0.411808
Contributing Scenario [CS] PC35 Spraying	Consumer - dermal Short term systemic health effects			0.001813
Contributing Scenario [CS] PC35 Spraying	Consumer - inhalative, short-term - systemic			0.082518
Contributing Scenario [CS] PC35 Spraying	Consumer - combined, short-term - systemic			0.084332
Contributing Scenario [CS] PC35 Cleaning	Consumer - dermal Short term systemic health effects			0.015385
Contributing Scenario [CS] PC35 Cleaning	Consumer - inhalative, short-term - systemic			0.396423
Contributing Scenario [CS] PC35 Cleaning	Consumer - combined, short-term - systemic			0.411808

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES14 - Consumer use of fuels indoors (domestic/hobby use e.g in model engines, fuel cells, fondue sets).
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies)	ERC8b - Wide dispersive indoor use of reactive substances in open systems
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Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of consumer exposure

Control of consumer exposure

Title	Contributing Scenario [CS] PC13
Product (sub) category(ies)	PC13 - Fuels
Covers concentrations up to	9%
Amounts used	800g
Exposure duration	10min
Use frequency	2 per week
Release area	2cm ²

Title	Contributing Scenario [CS] PC13
Product (sub) category(ies)	PC13 - Fuels
Covers concentrations up to	80%
Amounts used	800g
Exposure duration	10min
Use frequency	2 per week
Release area	2cm ²
Risk management measures	Wear protective gloves 90%

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies)

ERC8b - Wide dispersive indoor use of reactive substances in open systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of consumer exposure

Calculation method EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PC13 (9%)	Consumer - dermal, long-term - systemic			0.247253
Contributing Scenario [CS] PC13 (9%)	Consumer - inhalative, long-term - systemic			0.000146
Contributing Scenario [CS] PC13 (9%)	Consumer - combined, long-term - systemic			0.247398
Contributing Scenario [CS] PC13 (80%)	Consumer - dermal, long-term - systemic			0.21978
Contributing Scenario [CS] PC13 (80%)	Consumer - inhalative, long-term - systemic			0.000571
Contributing Scenario [CS] PC13 (80%)	Consumer - combined, long-term - systemic			0.220352
Contributing Scenario [CS] PC13 (9%)	Consumer - dermal Short term systemic health effects			0.865385
Contributing Scenario [CS] PC13 (9%)	Consumer - inhalative, short-term - systemic			0.020961
Contributing Scenario [CS] PC13 (9%)	Consumer - combined, short-term - systemic			0.886346
Contributing Scenario [CS] PC13 (80%)	Consumer - dermal Short term systemic health effects			0.769231
Contributing Scenario [CS] PC13 (80%)	Consumer - inhalative, short-term - systemic			0.08228
Contributing Scenario [CS] PC13 (80%)	Consumer - combined, short-term - systemic			0.851511

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the Safety Data Sheet according to Regulation (EC) No 1907/2006 [REACH]

Product Name	Methanol
Chemical Name	Methanol
CAS No	67-56-1
EC No	200-659-6
REACH registration number	01-2119433307-44-0057
Pure substance/mixture	Substance

Exposure scenario

Section 1 - Title

Title	ES15 - Consumer use of fuels outdoors (gasoline additive).
Version	1
Product Name	Methanol
Revision Date	11-Dec-2015

Section 2 - Operational conditions and risk management measures

Section 2.1 - Control of environmental exposure

Environmental release category(ies) ERC8e - Wide dispersive outdoor use of reactive substances in open systems

Remarks
Not relevant since not classified as dangerous for the environment.

Section 2.2 - Control of consumer exposure

Control of consumer exposure	
Title	Contributing Scenario [CS] PC13
Product (sub) category(ies)	PC13 - Fuels
Covers concentrations up to	3%
Amounts used	Inhalation / Dermal 50kg/10g
Exposure duration	10min
Use frequency	2 per week
Release area	2cm ²

Section 3 - Exposure estimation

Environmental exposure

Environmental release category(ies) ERC8e - Wide dispersive outdoor use of reactive substances in open systems

Remarks

Not relevant since not classified as dangerous for the environment.

Control of consumer exposure

Calculation method

EasyTRA

Title	Exposure route	Calculation method	predicted exposure level	Risk characterisation ratio (RCR)
Contributing Scenario [CS] PC13	Consumer - dermal, long-term - systemic			0.164835
Contributing Scenario [CS] PC13	Consumer - inhalative, long-term - systemic			0.000054
Contributing Scenario [CS] PC13	Consumer - combined, long-term - systemic			0.164889
Contributing Scenario [CS] PC13	Consumer - dermal Short term systemic health effects			0.576923
Contributing Scenario [CS] PC13	Consumer - inhalative, short-term - systemic			0.007823
Contributing Scenario [CS] PC13	Consumer - combined, short-term - systemic			0.584746

Section 4 - Guidance to check compliance with the exposure scenario

Predicted exposures are not expected to exceed the applicable exposure limits (given in section 8 of the SDS) when the operational conditions/risk management measures given in section 2 are implemented. Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Basic Health and Safety Study

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1. Basic Health and Safety Study

1.1 General information about the works

1.1.1 Justification for the Basic Health and Safety Study

The Royal Decree 1627/1997 of 24 October, which regulates the minimum safety and health requirements in the construction works, imposes the obligation to elaborate a Health and Safety Study during the writing of projects with a contracted operation budget higher than 450759.08 €, with an operation period higher than 30 working days and with more than 20 workers hired, with an estimated work force higher than 500 or with projects with underground works like tunnels, dams, etc. The writing of this study shall be obliged in agreement with the article 4 of the previously named royal decree and this article content is established in accordance with the minimum guidelines indicated in the article 6. The current project for the poly (lactic acid) production, due to its characteristics, must elaborate a Basic Health and Safety Study.

1.1.2 Objective of the Basic Health and Safety Study

A Health and Safety Study, in agreement with the information provided in the article 5 of the Royal Decree 1627/1997, consists of the following documents: descriptive report, solicitation document, engineering plans, measurements for the equipment and safety features and a budget. The Basic Health and Safety Study only includes the descriptive report. Accordingly, this document has to accomplish a detailed analysis of the execution methods of this project, its materials and equipment as a main goal, so safety risks associated with all of this items can be identified. Once this risks are detected, some preventive, reduction and disposal measures are indicated. The objective of this action is to guarantee the health and integrity of the workers, so as the detection of risks associated with the constructive process and detection of other dangerous accidents that may happen.

1.1.3 Project data

The Basic Safety and Health Study referred to the project “Production facility of polylactic acid (PLA) from lactic acid” has the general data indicated in table 1.

Table 1. Project general data. (Own authorship)

Project name	Construction of a poly (lactic acid) facility
Type of work	Mayor new construction of a facility.
Location	Parc Sagunt I, plot I-6.5
Population	Sagunt (Valencia)
Promoter	Universidade de Santiago de Compostela, Escola Superior Técnica de Enxeñaría (ETSE)
Engineer designer	Sofía Estévez Rivadulla

1.2 Information of the construction works environment

1.2.1 Location description of the work site

The industrial facility for the production of poly (lactic acid) from lactic acid is located in the Parc Sagunt I (Sagunto, Valencia), and, more specifically, in the land plot I-6.5. The chosen land plot has a total surface of 15,553 m² and the polygon has all the allocations required for industrial activity. Some of them are shown in table 2.

Table 2. Site conditions.

Accesses for the works	Public road
Land topography	Flat floor
Soil type	Industrial soil
Adjacent constructions	No
Electricity supply	Yes
Water supply	Yes
Natural gas supply	Yes
Sanitation system	Yes

1.2.2 Repercussions on third parties

The repercussions on third parties of the construction works may be caused by the execution of the project activities outside the perimeter of the work site. The repercussions are related to vehicle traffic in roads allowing the access to the polygon, which clearly increases the motor traffic in the area. The vehicles in circulation are mainly associated to the loading and discharge of material. The private vehicles belonging to workers are not considered for the repercussions assessment.

Unauthorized personnel access to the work site must be impeded through signage such as enclosure tapes. Warning signals for the arrival and departure of trucks must be placed in the construction works area and the speed of vehicles must be controlled, although the traffic must not be restricted. [1]

1.2.3 Land characteristics

The conditions for the development of works of construction are very positive in the selected land plot, although some hydrological or geotechnical problems may show up due to an average land load capacity and negative drainage.

Table 3. Characteristics of the land ground. [2]

Characteristic	Assessment
Load capacity	Average
Instantaneous land settlement	Average
Edometric land settlement	Null
Total land settlement	Low
Cohesion	Null
Corrosion	Null
Land movement	Simple
Drainage and run-off	Unfavourable
Problems	Scours with collapse problems
Recommendations for construction works	Elimination of the underground waters in order to avoid the collapse problems. Take care of the earth dams because of the null cohesion.

The lithology is pretty monotonous and consists of washed silica sand and traces of polygenic compounds from the dismantling and dragging of secondary rocks from the mountains. The ground has the characteristics indicated in table 3 due to the composition previously explained.

The permeability of this materials is variable and some of them may be used as raw materials in the construction works.

The geotechnical region is a large lowland, with a slope between 0-7 percent located, close to the coast and to urban cores. The geomorphological phenomena have little interest. There is little erosion and the land is stable to human actions. [2]

1.2.4 Accesses to the work site and internal traffic

The access to the work site is via the roads indicated in figure 1.



Figure 1. Access route to the work site in the land plot purchased.

The vehicle traffic is restricted to the freight transport, required for enterprises located inside the polygon and for other possible near construction works areas, and to the vehicle movement of civilians and workers from near facilities. There are few pedestrians in the area because the land plot where the constructions works are going to be conducted is located in an industrial polygon relatively isolated from the population core of Sagunto. Nevertheless, measures has been taken in order to avoid possible damages related to the road traffic and pedestrians.

There are several escape routes for emergency, traffic lanes and dangerous restricted areas inside the construction site. The escape routes are regulated by the Royal Decree 485/1997 and will flow until the safety area. The size of this routes must be adequate to the dimensions of the construction works and the number of workers and must not be obstructed by objects or equipment. Moreover, the routes must be well illuminated.

The traffic lanes are characterized by: dimensions (which depend on the volume of personnel circulating), the activities to be performed, the safety clearances and means of protection for people located in the area, the signs on the road and their location, so as other devises to confine the restricted areas.

1.3 Execution order of the works

1.3.1 Previous operations to the execution of the works

The following activities must be considered before the construction works can start.

- Previous organization of the activities to be performed during the construction works and the most important ones must be highlighted.
- Positioning of the signs of the works, delimitation of the work site with fencing and the access road indication.
- Creation of provisional service lines for sanitary services, water, electricity, etc.
- The placement of the health and welfare facilities because they must operate when the works start.
- Suggest and refurbish of areas designated for the collection and storage of materials.
- Elaboration of safety instructions for the movement of people inside the work site and establishment of emergency measures.
- Take care of administrative formalities to certify the activity in accordance with the applicable law related to the prevention of occupational risks. The named formalities are:
 - The security coordinator must be designated by the construction developer during the project phase.
 - Draft and the visa of the Basic Safety and Health Study.
 - Writing of the Safety and Health Plan.
 - Approval of the Safety and Health Plan.
 - Initial notification of work processing.

- Processing of the opening of the work centre.
- Subcontracting book in agreement with law 32/2006.

1.3.2 Operations during the construction process

The activities of the construction process may begin once the previous execution operations have finished. A simple program of the general activities to fulfil during the works execution are highlighted in this section of the Basic Security and Health Study. The named activities are indicated below in order. The projected long-term labor and the machinery required for the operations of the works will be described in next sections for each operation.

1. Grubbing and cleaning
2. Diggings and foundation construction
3. Structure reinforces
4. Principle and auxiliary equipment installation
5. Building construction for services and others.

The activities previously named have a strong relationship with the activities a, b, c, y d considered in the Annex I of the Royal Decree 1627/1997. The activities e, f, i and j (refurbishment, transformation, decommissioning and demolition) are not taken into account because the project is new building construction work with a flat land. The activities g, h, k, m and l (remediation, rehabilitation, preservation, sanitation and conservation) may be contemplated for future activities.

1.4 Preventive analysis of the activities

The different constructive and auxiliary activities were named in the section 1.3.2 of this Basic Safety and Health Study. All of them are going to be assessed in this section in order to identify and prevent the avoidable and unavoidable risks.

1.4.1 Description of the work units

The different activities must be first described. All of the actions associated with the activity are indicated below:

- Grubbing and cleaning: This unit includes the removal of wastes and obstacles, the withdrawal of vegetation (bushes, herbs and threes), the burning of combustible materials, loading and unloading of materials in an authorized landfill after the provisional storage of materials in the work site, the placement of fencing as collective protection measures, etc.
- Diggings and foundation construction: This activity can be defined as a collection of operations conducted to dig and levelling the land where the industrial facility is going to be built. This unit includes the reconsideration of the geometric characteristics of the land, settlement of the access roads for diggings areas, removal of materials, etc.
- Structure reinforces: This unit is the group of operations for the installation in the work site of structure reinforces such as steel armours or reinforces concrete structures adequate for the reinforcement of production process equipment and auxiliary buildings.
- Principle and auxiliary equipment installation: This work unit includes all the operations related to the installation and assembly of the chemical industry equipment in order to fulfil with safety, quality and environmental conditions.
- Building construction for services and others: This unit of the works can be encompassed inside the civil construction industry. This unit does not considered chemical engineering structures, but other structures or buildings with other purposes like: laboratories, control room, canteen and meeting rooms, etc.

1.4.2 Implementation procedure

The work units were previously described in section 1.4.1. However, in this section, the description of the actions to be taken in order to carry out the activities is going to be explained. How the activities performance is expected to be conducted is indicated.

- Grubbing and cleaning: The activities related to this unit can be carried out with equipment or by hand. First of all the land must be submitted to inspection to detect possible geological abnormalities and prevent accidents or to detect species in danger. The boundaries of the area where the grubbing and cleaning activities are taking place must be delimited. Next the withdrawal of scrub with the storage of wastes in the

restricted area indicated for such purpose. Finally, the materials are burnt or transported to a landfill or sent a disposer company.

- Diggings and foundation construction: The activities related to this unit can be also carried out with equipment or by hand. The diggings are performed to open sky and three types of excavations can be considered: superficial solid ground removal, emptying and terracing. The main goal of this activities is to reach the height for the foundation construction. This foundations requires of activities like the positioning of pilotage or protection of the emptying walls.
- Structure reinforces: The armour reinforces are manufactured in the facilities of the subcontracting enterprise and then, transported to the work site for installation. The concrete is also transported by truck and supplied as required in the construction works. The armour reinforces must be unloaded and installed carefully. The complexity of the installation of armours and prefabricated components such as steel screens is a reason why this activity must be carried out by specialists. The activities for the installation includes cutting, positioning of moorings, separators and supports, placement of protections and coating of the structures. The protection of the structures is especially important for concrete structures because the cement must mature, so the protection against rain is imperative. Finally all the structures must be examined. [3]
- Principle and auxiliary equipment installation: The structural assembly of equipment is usually performed in the licensor's facilities, although, when the dimensions of the equipment to be assembled are too big, the assembly is completed in the work site. All equipment delivered must be check before its installation in the land plot chosen for the process facility. The delivery can be made in full or with installments. The equipment installation includes anchors for the foundations and other structural elements previously describe for the unit work explained before. The installation also includes de welding of the different parts, the joins between parts and pipelines, the installation of the electrical system, the control and security system, so as the construction of contingency systems. The installation is performed outdoors and must be carried out in agreement with engineering plans and mechanical equipment specifications, where the positions of the different parts of the equipment are indicated. Finally, an analysis of the assembly must be conducted.
- Building constructions for services and others: This construction unit is going to be developed at the same time that the previous explained unit work. Although, this unit has diggings, foundations and installation of structures as construction activities, it focuses in other operations related to the carpentry, plumbing, assemblage of internal partition walls, placement of coatings, roofs, installation of inside elements, etc.

1.4.3 Means employed: human and material means

The construction activities are performed through the intervention of humans and materials. The human means are the workers and their functions in the construction works while the material means are including machinery and auxiliary equipment. All the equipment by unit work is compiled in table 4. The machinery must fulfil with the specification indicated in the Annex IV of the Royal Decree 1627/1997 and must be handled by authorized qualified personnel. According to the regulation, the machinery must be submitted to regular evaluations in order to assure a good use, maintenance and preservation in agreement with the indications of the manufacturer. The revisions will take care of the protection elements because they must have a proper functioning when require.

Table 4. Some of the main material means in the construction works. (Own authorship)

Work unit	Material means/ Equipment
Grubbing and cleaning	Backhoe, bulldozer, dumper, loader, compacting unit, dump truck, forestry cutter, ...
Diggings and foundation construction	Backhoe, dump truck, loader, drilling carriage, dumper, debris dumpster, drill, ...
Structure reinforces	Bolt cutter, cold chisel, shears and guillotines for elements of reduced diameter. Motorized shears for elements of greater diameter. Mobile cranes, transit-truck-mixer, ...
Principle and auxiliary equipment installation	Welding equipment, mobile cranes, ...
Building constructions for services and others	Circular saw, drill, hammer, mitre saw, polisher, ...

Some professional job posts involve in the construction works as human means and whose participation is object of prevention of risks are shown below: bricklayer, tile, surveyor and surveyor assistant, construction foreman, carpenter, locksmith, electrician, supervisor of the construction works, formwork, specialist for anchors, stuccoes, plumber, air conditioning installer, sanitation services installer, telecommunications installer, electrical installer, construction manager, machine operator, painter, pawn, welder, glazier, scaffolding assembler, gas pipeline installer, architect, engineer, among others.

There are also auxiliary means like: scaffolds, wheelbarrow, tube for wastes disposal and other hand tools.

1.4.4 Avoidable occupational risks

An avoidable risk is defined as a possible risk which may be eliminated with the application of previous measures to the start of the works or with modifications in the construction project.

[4]

Some occupational risks might be avoided by taking appropriate measures. Some of these measures are related to the good use and maintenance of the machinery, which minimizes inherent risks, increases the useful life of the machinery, improves the efficiency of the work and decreases costs. All of these measures are contemplated in the Royal Decree 1215/1997, the Royal Decree 1435/1992 and the Royal Decree 56/1995.

The following list enumerates some of the avoidable risks to be removed before and during the construction works:

- Overlapping between several activities of the construction work program, which may cause disagreements among workers and general chaos. This risk has been removed with a previous study of the execution program.
- Risks related to a machinery without protections for its mobile parts.
- Risks related to machinery without protections against electric contacts. These risks are eliminated with a better isolation of the metal casing.
- Risks associated with breakdown of the facilities or equipment for bad used. Some instruction manuals and training courses can be provided to the workers in order to avoid this type of risk.
- Risks from the specific job post, which has been solve with the application of safety procedures and collective and individual protective measures.
- Risks arising from lack of machinery maintenance. This risk is avoided with a control of the maintenance recording books.
- Risks derived from auxiliary means and protective measures deteriorated or aged.

1.4.5 Unavoidable occupational risks

An unavoidable risk is defined as a possible risk which may be not eliminated with the establishment of preventive measures such as equipment or individual and collective protections. Some of the unavoidable risks for this Basic Safety and Health Study are explained below in table 5 for each of the unit works.

Table 5. Unavoidable risks in the construction works. [5]

Work unit	Unavoidable risk
Grubbing and cleaning	<ul style="list-style-type: none"> ○ People falling at the same level and at different level during the accessing to the machinery. ○ Falling objects with a significant probability of crashing with people. ○ Treading on objects and collisions against immobile and mobile objects. ○ Vibrations, noises and overstrains. ○ Projection of particles and fragments ○ Exposition to electric contacts. ○ Hit someone with a machinery and entrapment due to the movement of the mobile parts of the machinery.
Diggings and foundation construction	<ul style="list-style-type: none"> ○ Landslide due to overloads in the edges of the excavation, changes in the land humidity, filtrations, vibrations, changes in temperature, disruptions in the land, excavations under the groundwater level and due to the lack of appropriate embankments. ○ Hit someone with a machinery, collisions, wrong operation of the machinery due to land movements. ○ People falling at different level. ○ Caídas de personal a distinto nivel. ○ Risks associated with adverse meteorological conditions. ○ Risks related to the poor condition of the access roads. ○ Insect bites, environmental dust, vibrations, noises and electric contacts. ○ Vehicle and machinery traffic problems. ○ Risks from works in wetlands. ○ Risks due to prolonged forced postures. ○ Collapse of caissons. ○ Overturning of material stacks. ○ Risks derived from the store of materials due to its temperature, humidity or chemical reactions.

Table 6. Unavoidable risks in the construction works (Continuation). [5]

Work unit	Unavoidable risk
Structure reinforces	<ul style="list-style-type: none"> ○ Projection of particles during the works and fall of materials. ○ People falling from high levels. ○ Risks due to electric contacts and prolonged forced postures. ○ Risks derived from the access to the construction work areas. ○ Risks associated from the load and reception of heavy materials.
Principle and auxiliary equipment installation	<ul style="list-style-type: none"> ○ People falling at high levels. ○ Cuts, prick, stumbling block and blows. ○ Risks associated with adverse meteorological conditions. ○ Slipping hazard. ○ Risks to third parties due to falling objects. ○ Risks related to prolonged forced postures. ○ Electric shock. ○ Ocular and dermic damages.
Building construction for services and others	<ul style="list-style-type: none"> ○ People falling at the same level and at different level. ○ Risks related to prolonged forced postures. ○ Treading on objects and collisions against immobile and mobile objects. ○ Vibrations, noises and overstrains. ○ Exposition to electric contacts.

1.4.6 Special occupational risks (non-exhaustive list)

The work units considered in the section 1.3.2 of this Basic Safety and Health Study may have special risks in agreement with the Annex II of the Royal Decree 1627/1997. The work units named as diggings and foundation construction, structure reinforces and principle and auxiliary equipment installation have the following special risks:

- Particularly severe health risks due to people being buried, collapse of the digging structures and people falling at different level during the work activities.
- Activities where pre-manufactured heavy elements must be assembled and dismantle.

1.5 Preventive measures for the activities

The preventive measures are prescriptions and actions to be taken in order to reduce, prevent and eliminate the occupational risks associated with a unit work. The occupational risks were introduced in previous sections. This section presents some measures because risks can be reduced with collective and individual protective equipment, with an initial training of the workers, with information provided to the workers, with a regular examination of the health and with specific signalling.

1.5.1 Collective protections

The collective protections are devices or equipment appropriate for the prevention of accidents where a group of people is involved. The equipment considered as collective protection has an established service life and must be disposed at the end of its life.

Some protective collective measures for the construction works of the production poly (lactic acid) facility are:

- Placement of signals in the work site in order to inform about possible hazards.
- Placement of signals for the vehicle and machinery traffic inside the work site.
- Fencing for the demarcation of areas, both, the global work site and the different areas inside the work site.
- Temporary installation of pre-assembled modules for the protection of the digging cavities.
- Beaconing for the signalling of the slope of the excavation.
- Rigid edge protection in order to indicate the boundaries of the digging holes.
- Edge protections in order to avoid people falling from heights higher than two meters.
- Safety nets to prevent people falling at very elevated heights in agreement to standard UNE-EN1263-1.
- Bracing structures examination and protections for ditches.
- The machinery must include an insulation coating.
- Irrigation systems to prevent the formation of excessive amount of air particles.
- The machinery must include all de collective protections.
- The access to excavation areas must be free of obstacles.
- Placement of protection shelters and perimeter scaffolding.
- Protective screen for the loading and unloading of materials.
- Examination of ladders.
- Order and cleanliness conditions of the access roads.

- Order and cleanliness conditions of the work post.
- Sufficient lightning.
- Minimum safety distance of one meter to low voltage power lines.
- Continuous removal of debris.
- Information courses and training for the workers individually and as a group.

1.5.2 Personal protection

The individualized protection of the workers against risks may be prevented with the used of personal protective equipment. These equipment is used to minimize and limit the unavoidable occupational risks, which the collective protections or other procedures could not reduce. The selection procedure of the personal protective equipment must be associated with the risks of the activity that the worker must perform. The use of this equipment is contemplated in the Royal Decree 773/1997 of 30 May, concerning minimum safety and health requirements related to the use of personal protective equipment. Accordingly, the equipment must have a CE label, an expiration date and usage rules in agreement with the recommendations of the manufacturer, among other aspects considered in the named legislation.

The selection on the appropriate individual protection equipment must follow the next indications:

1. Identification and assessment of risks: Previously explained in other sections of this Basic Safety and Health Study.
2. Definition of the required equipment: identification of the characteristics of the work, the health aspects of the worker, the CE labelling and other harmonized standards.
3. Comparison between different individual protection equipment for the selection of the appropriate one.

There are different personal protective equipment depending of the parts of the body to protect: head protectors, ears protectors, eyes and face protectors, protections for the airways, protections for hands and arms, protections for feet and legs, skin protectors, chest and abdomen protectors and total protections for the body.

Accordingly, the selection of the type of personal individual equipment depends on the risk type (physical, chemical or biological) and the part of the body to be protected. Chemical and biological risks, as indicated in section 1.4.4 and 1.4.5 are not considered for construction works. However, mechanical, electrical and thermic are important risks in this kind of works.

Some personal protective equipment needed for the activities performed for each work unit is shown in table 7.

Table 7. Personal protective equipment for some construction work units. [6]

Work unit	Personal protective equipment
Grubbing and cleaning	Safety globes, safety boots, safety helmet, waterproof boots, adequate clothes for work, filtering unit such as protective dust mask, ear plugs for noise abatement, reflective vest, safety goggles, etc.
Diggings and foundation	Safety helmet, safety boots, safety waterproof boots, rain suit, filtering unit such as protective dust mask, safety globes, gloves of rubber, hearing protectors, safety harness, vibration insulation harness, etc.
Structure reinforces	Safety helmet, steel toe range of safety footwear, leather gloves, aprons, safety harness, welding shades, reinforced glasses, lifelines, etc.
Principle and auxiliary equipment installation	Safety helmet, safety boots, protection goggles, rain suit, protection clothes, protection gloves, safety harness, etc.
Building constructions for services and others.	Protection glasses, protection gloves, etc.

The equipment indicated in table 7 must fulfilled some of the instructions explained below.

- Head protectors: Safety helmets and safety against impacts. Their main function is to prevent blows in the head. The upper part of the head is protected. EN 397:2012+A1:2012 and EN 812:2012 are examples of standards indicating the characteristics of this individual equipment.
- Ear protectors: Hearing protectors such as plugs, earmuffs, and noise protection helmets, noise protectors depending on the noise level and with communication systems. Some standards are UNE-EN 352-1:2003, UNE-EN 352-2:2003 and UNE-EN 352-3:2003.
- Hand protectors: Gloves against mechanical aggressions made of leather or elastomers, protection gloves against cuts and pricks made of leather or with metal mesh surfaces, protection gloves against the cold, protection gloves against heat and against electrical risks. Some standards are UNE-EN 388:2016, UNE-EN 1082-1:1997, UNE-EN 1082-1:1997, etc.
- Feet protectors: Safety boots and protection boots with or without protection for toes. The boots must be provided with non-slip sole and for works in the outside must be manufactured in rubber or in polymeric material. The safety boots must be designed for impacts with an energy level of 200 J and with a compression load of 15 kN while

the protection boots are designed for 100 J and 10 kN, respectively. These protectors must follow with the UNE 20345:2005 and UNE 20346:2005 standards.

- Protections for the airways: The main equipment used in the construction works is the filtrating equipment against particles, which supply breathing air with the elimination of the particles in the air. The selection of the protections for the airways must be made in agreement with the UNE-EN 529:2006 standard. UNE-EN 149:2001+A1:2010 for filtrating equipment.
- Protections for the body: Most of this protections are related to people falling risks at different levels. There are different protection systems like restraint systems, attachment systems, access systems with ropes like lifelines and fall arrest systems like harness. There are different types harness indicated in UNE-EN 361:2002. Other standards for falling risks are: UNE-EN 353-2:2002, UNE-EN 354:2011, UNE-EN 363:2009, etc. [6]

1.5.3 Information and training

All the workers must be informed about the measures approved for the construction works related to items like safety and health in agreement with the article 15 of the Royal Decree 1627/1007 and the article 8 of the Law 31/1995. The information imparted must contain the risks of the activity to be carried out for the worker (in accordance with all the risks presented in this Basic Safety and Health Study), the preventive and protective measures to be follow and the emergency measures explained in the emergency Plan written for the construction works.

The entrepreneur, via the contractor and the subcontractor, must guarantee the practical and theoretical training of the worker, including a specific training for each job post. The transmission of information is assured when this action is performed correctly. The training shall be given previously to the construction works starting and within a normal working day. Moreover, this training is established as mandatory in agreement with the article 9 of the law of the prevention of occupational risks. This preventive training will be accredited such as is indicated in the law 32/2006, which regulates the subcontracting in the construction industry.

The specific and initial training for each worker is established in the September 21 resolution of 2006, from the Directorate General Employment, alleging the registration and the publication of the Collective Agreement for the Construction Sector. On the article 137 of this resolution is indicated two kind of training courses related to the prevention of occupational risks. The first course must contain basic information about risks in the construction industry and will last a minimum of eight hours for all workers. This course basic content in shown in the Annex XII section 1 of the named resolution. The second course allows for more specific knowledge transfer

in relation to the job post and its content is appropriate, in accordance with the Annex XII section 2. The second course duration depends on the job function, although there is a common part with a length of fourteen hours, and other more specific of six hours. [7]

1.5.4 Additional measures: Signage

The signage must be in position inside the work site before the construction activities begins. The signal must be posted in access and in action areas, so as inside other sites of the works. The intrinsic risks and hazards associated with the activities of the works are known through the signage. In such way, the location of signage allows for the identification of falls on the same level, blows and cuts when using tools, treading on objects, etc.

The Royal Decree 485/1997 of 14 April about minimal requirements of safety and health signage in the works indicates some of the characteristics of the signalling, such as the typology, the dimensions, the colours, etc.

The following means of signalling are considered in the construction works:

- Fencing: The main function is the demarcation of the boundaries of the storage areas, dangerous areas and vehicle and heavy machinery traffic areas.
- Beaconing: Accidents are avoided because the obstacles become more prominent.
- Signs: Their main function is to prevent accidents through the interpretation of their information. The signs advise of the dangers of an activity or a work area. The signalling may be classified in agreement with the information provided: warning signals, prohibition signals, obligation signals and others related to the fire fighting and rescue equipment. The dimensions of the signals is indicated in the Annex III of the Royal Decree 485/1997 and the visibility, location and lighting must be considered for the selection of the dimensions.
- Adhesive labels: They have an analogous function to the signs, but they are located in storage vessels or containers.

1.5.5 Health monitoring

The regular surveillance of the health conditions of the workers is compulsory, as the General Social Security Law indicates on its article 196. An obligatory assessment of the health of the workers helps to identify possible consequences of the works and to detect all the workers with a certain sensitivity to the risks of the job post, so the works can be adapted to every person

(indicated in the article 25.1 of the Occupational Health and Safety Law). A regular surveillance, with subsequent data gathering, allows the scheduling of preventive actions. Accordingly, some action measures are taken. The health of each worker must be examined before the admission for employment and after the assignment of activities which may have negative effect on the health. The health of the worker must be evaluated periodically when the worker is under risky conditions which may be a danger after a long period of time.

1.6 Plans for emergency response

The emergency measures to be considered during to execution of the construction works of this project are explained in the article 20 of the Law 31/1995 for the prevention of occupational risks. The possible emergency situations can be identified and a self-protection plan can be written in agreement with the Royal Decree 393/2007 and the document against fire of the Technical Code for Building.

1.6.1 Identification of emergency situations

An emergency is an unforeseen event which produces harms and damages to people, facilities and processes. There are different emergency situations in a construction work and all of them can be classified in agreement with the risk and the severity. The main risks generating an emergency situation are the accidents at the work site due to heights, electricity, reduced spaces, etc. Other risks are the fires due to the use of machinery or explosions due to the storage of materials. An emergency situation can also be classified in accordance to its severity: attempted emergency, partial emergency and general emergency. The last one is the most significant because external materials (human and material resources) are required for the control of the emergency situation.

An emergency is declared as general emergency state when there are uncontrolled fires inside or outside the construction works, fires in dangerous areas, a fuel scape, serious occupational accidents, a natural phenomenon which endangered the construction work facilities and the buildings, explosions and other significant events. [8]

1.6.2 The emergency team: human and material resources

The human resources are required to ensure the policy-making when emergency situations happen. They are part of an emergency team. The human resources face the emergency, notify the public bodies the situation and oversee all the activities required in order to achieve a successful conclusion of the emergency, among other functions. The emergency team consists of the team members shown in table 8. The position of each member of the construction work is also indicated in this table.

Table 8. Members of the emergency team. [8]

Emergency team	Job post in the works
Chief of emergencies	Site Assistant
Chief of intervention	Construction Manager
First emergency intervention team	Workers
Second emergency intervention team	Foreman
Alarm and evacuation team	Foreman
First aid equipment	Workers

There are several material resources like: first aid materials, fire detection and alarm systems, fire fighting (such as extinguishers), rescue systems and protection equipment and exhaust systems. All of this material resources must be located in the construction works site all the time. External materials can be requested for emergency cases and are supplied for fire-fighters, police, etc.

1.6.3 Plans for emergency response

The proceedings required for an emergency situation in the construction works will depend of the characteristics of the situation and the associated risks. A general proceeding for the emergency state is described as follows:

1. The worker must call 112 in the nearest SOS location.
2. The worker will provide data about the location of the accident and other more personal information.
3. One of the workers must wait for the emergency services in the SOS location in order guide them to the location of the accident.

Some guidelines are indicated in table 9 about three possible emergency cases and the general proceedings to follow.

Table 9. Emergency proceedings. [8]

Detection of an accident	Detection of a fire	Evacuation alarm
✓ Provide help to the injured	✓ Warn about the possible problem	✓ Keep calm and pay attention to the indications of the evacuation team.
✓ Warn the first aid team.	✓ Provide private information and identify. Give information about the event location.	✓ Do not lag behind and get out of the work site peacefully and without taking unnecessary risks.
✓ Give information to the Emergency Chief.	✓ If required, an extinguisher must be used before the intervention team arrives.	✓ Do not talk during the evacuation.

1.6.4 Emergency drills

The main goal of an emergency drill is to check the effectiveness of the response to the emergency, the performance capacity of the workers to the response, the suitability of the resources used for such purpose and the adaptation to the acting proceedings. This emergency drills must be performed once a year, although the frequency will depend on the written emergency plan.

The emergency drill consists of three different parts: preparation, execution and assessment. The first parts refers to the scheduling of the emergency drill because the dangerous situation must be avoided. The second part involves the authorities and the public services and the last one involves data gathering and correction of mistakes.

1.7 Hygiene and welfare facilities

Temporary installations for construction works must include hygiene and welfare facilities, in agreement with the Royal Decree 1627/1997. These installations must incorporate changing rooms for the workers, where they can change their clothes and store their personal effects. Therefore, the changing rooms consists of lockers, washbasins, showers and toilets. The facilities of these restrooms are covered by the Annex IV section 15 of the Royal Decree 1627/1997.

The changing rooms have the following characteristics: dimensions of 2 square meters for each worker who desires to used simultaneously the room with other workers, the high is 2.5

meters, there is a shower and a washbasin for every 10 workers and the shower has a 40 cm² shower tray, there is one toilet for every 25 men and one toilet for every 15 women. The changing rooms for men and women are separated and they are located far from the loading and unloading areas.

An interim canteen and resting room are also installed in the construction work area. Moreover, and in agreement with the section 14 of the Annex IV of the Royal Decree 1627/1997, a first aid centre has been located inside the work site.

Table 10. Some first aid medical assistances for the construction work staff. [9]

Medical assistance	Location	Average distance
First Aid	Local first aid	Construction area
	Centro de Salud Puerto de Sagunto/ Sagunt I	5 km
Primary Health care	Consultorio local de Puerto de Sagunto/Sagunt el Baladre	6 km
	Consultorio Auxiliar de Sagunto	9 km
Specialized care	Hospital de Sagunto	5,5 km
General observations:		
Centro de Salud Puerto de Sagunto/ Sagunto I. Periodista Azzati, s/n - Puerto de Sagunto. Tel: 96 261 76 50		
Consultorio local del Puerto de Sagunto/Sagunt Baladre. Generalidad, s/n – Baladre. Tel: 96 261 76 00.		
Consultorio Auxiliar de Sagunt. Catarroja, 9B- Almardá. Tel: 96 261 74 00		
Hospital de Sagunto. Av. Ramón Y Cajal, s/n, 46520 Sagunto, Valencia. Tel: 962 33 93 00		

1.8 Prospects and information for future works

The production facilities of poly (lactic acid) requires a maintenance and preservation after the delivery of the construction works. For such purpose and in agreement with the articles 5 and 6 of the Royal Decree 1627/1997, this section of the Basic Safety and Health Study provides information about the works to be carried out. Then, some constructive measures are indicated below for the maintenance, preservation and repair of the facilities.

- Cleaning, preservation and maintenance of external facades, roofs, drainage networks and other components.
- Cleaning, preservation and maintenance of the operation equipment such as distillation columns, heat exchangers, pumps, etc.
- Maintenance of the facilities where the raw materials and products are stored, loaded and unloaded.
- Maintenance of facilities and equipment with high heights or located at elevated heights.

The Annex B of the article 5.2 of the Royal Decree 1627/1997 includes some unavoidable risks for work activities to be carried out after the initial construction works. The possible risks associated with this risks are: people falling to different levels, people falling to the same level, people falling due to impact with objects, objects falling while being handle, falling objects due to detachment, treading on objects, collisions against immobile objects, being struck by objects or tools, projection of fragments or particles, entrapment due to objects, explosive hazards at elevated temperatures, exposition to electric contacts, non-traumatic pathologies, overstrains and fires.

The main individual protections for the subsequent activities of repair, preservation and maintenance can be: safety helmet, safety harness and appropriate working clothes.

1.9 Conclusions of the Basic Health and Safety Study

This Basic Health and Safety Study includes all the associated risks to each of the considered work units for the construction of the facilities of poly (lactic acid) manufacturing. These risks have been treated during this study in order to prevent accidents or possible damages to workers, structures or third parties. Accordingly, some preventive measures have been proposed in agreement with the named risks. Moreover, others actions have been listed for possible emergency situations.

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DOCUMENT IV

Solicitation document

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1. General solicitation document

1.1 General provisions

1.1.1 Project title and author

Project title: “Production facility of polylactic acid from lactic acid”.

Author: Sofía Estévez Rivadulla

1.1.2 Solicitation document objective

A solicitation document is a contractual document of comprehensive and mandatory character. The main objective of this document is to present a general description of the work environment of this project at the same time the materials conditions, the execution instructions, measurements and payments for the building work items are being fulfilled.

This document gathers some requirements of technical and legal character to be follow during the project’s execution. For this reason, the document here shown acts as a handbook for the successful bidder. In this sense, the solicitation document is a collection of standards, specifications, prescriptions, and instructions which, in concert with other documents of this project, defines some of the requirements needed for the building works of a production facility of polylactic acid from lactic acid.

1.1.3 Tender

Invited enterprises (when the Employer considers such an action appropriate), equipment supply, materials and services defined on this solicitation document can be subject to restricted tender.

This project’s owner reserves the right to introduce detailed modifications or demand supplementary services that the successful bidder can render. The successful bidder can propose modifications in the supplies specifications as long as (these modifications are related to patent use effects or other reasons) it considers it technically of economically advisable.

Specification and description of the supplies are not constraining. The successful bidder must facilitate essential data and information in order to fully achieve the contract purposes. The contract will give priority, on equal terms, to material or services of Spanish origin.

The successful bidders must submit the following information:

1. Table of Unitary Prices, outlining each and every one which locates in the preliminary project.
2. The corresponding general and partial budgets.
3. A description of the organization which contains a list of the technical staff for the completion of the work.
4. Detailed list containing the necessary equipment and available means. The equipment and means requirements and capacities are needed to meet the target dates.
5. Deadline for receipt from the Employer the necessary complementary information in order to develop the works according to the expected plan construction.

The Unitary Prices Table will be perceived as a document of fundamental importance to the tender awarding. Possible mistakes in the budget documents can be rectified by the Employer or its legal representative when studying bids. These bids are examined with the previously named table and measurements from the preliminary project.

The unitary prices will be taken as updated prices until the date of the bid submission shown in the invitation letter. In these prices are included the general expenses, facilities, profits, etc., so as the possible direct and indirect expenses in relationship with the previous ones. The project drawings help strictly for the writing of the Tenderers' proposals.

A bid can be considered as invalid when is submitted after the expiration of the bid validity period indicated in the invitation letter or is not included in the solicitation document. The Tender final result will be notified to the different Tenderers by the Employer. If any Tenderer was no received the notification in time according to the invitation letter, then, the Tenderer could advise the Employer of its resignation to participate in the tender.

The Employer will communicate to the successful bidder the award of the works. The starting date is available in the work's program. The contract, provided by the corresponding section of this solicitation document, comes into effect in the period between the award of the work and the starting date of the work. The contract shall be made between the Employer and the successful bidder.

1.1.4 Contract

The ownership of this project belongs to “Escola Técnica Superior de Enxeñaría” of the “Universidade de Santiago de Compostela” and has been written by Sofía Estévez Rivadulla.

The facilities to be described are the ones shown in *Document I: Memory* and they should be implemented according to the information contained in *Document II: Drawings*.

The successful bidder will be obliged, in the moment of the work’s execution, to comply with current work legislation, take out a compulsory insurance and to comply with current regulations of social character.

The contract must meet the standard UNE 24042: “*Contrataciones de obras. Condiciones generales*”, unless otherwise specified on this solicitation document.

The successful bidder will take care of the tax expenditures related to the contract completion. Any of the parties engaged in the contract can request the recording in public deeds of the awarding contract. The expenses related to this recording in public deeds are paid by the part asking for this request to be done.

The successful bidder is liable of the totally of the supplies and services indicated in the contract, on compliance with the contractual provisions of the standards of good practice. The previously explained points out that modifications, redresses and essential replacements in respect to the strictly contract’s fulfillment will be paid by the successful bidder, so as justified compensations for damages caused by deficiencies, mistakes or delays in the work.

If necessary, the Employer may discontinue payments to the successful bidder and request for compensations according to what is established in the contract, without prejudice to the application of penalties related to the termination of the contract.

The Employer will assign staff or entities to establish a relationship with the successful bidder and this same Employer can be depicted by chosen consultants or other entities in order to cooperate with studies, manufacturing, assemblies and tests.

The successful bidder representative will be appointed according to an agreement with the Employer. During the stand set up, the representative will be in charge of the assembly team and will be present in the moment of the assembly process.

The contract should be provided to the owner of the project and to the installation technician. Moreover, in this contract are specified the execution periods and the forms of payment.

The solicitation document comply is mandatory for the Technical Department, the installation technician and the Employer. None of them cannot claim ignorance of the aforementioned document. If there are contradictions between the contract and the solicitation document, then, this last document has priority over the other one.

The Construction Management of the Works could cancel the contract for works and supplies if the contract implementation were not appropriate, if the supplies were not be able to meet the deadline or if the legal work conditions for staff members, including the contractor, were not fulfilled.

In case the installation technician refuses to follow the instructions given by the Technical Department, then, the installation technician will be cautioned and, if the behavior does not change, the Technical Manager will make a record of the proceeding behavior. At that time, the existing contract between the owner and the installation technician will be cancel and the installation technician will not have any right to compensations.

Previously to the cancel of the contract, the limit time required to rectify the observed irregularities will be fixed and communicated to the contractor. The main reason is the restoration of the obligations. The contractor has to acknowledge receipt to the Construction Management of the Works due to the notification of the aforementioned released.

In the event of termination of the contract, the Technical Department would determine the capital goods to hand over to the installation technician for the work already done.

The successful bidder needs to be in the meetings convened by the Employer. The meetings are established within a time limit, which shall not be less than eight days. Moreover, during the meetings is required the presence of specialized technicians according to the main objectives to be treated.

The modification of the key list of suppliers or successful bidder partner companies (as set out by the Employer) cannot be made without a written approval of the Employer. This approval will not determine the successful bidder responsibility.

The successful bidder may not assign or transfer any rights or obligations to third parties, nor the use for the execution work of any other enterprises (named in the contract and accepted by the Employer). The successful bidder is completely responsible of the contract to the Employer, the staff members and third parties. In case the successful bidder assigned or transferred any rights or obligations to third parties without the previous written approval of the Employer, so as the execution works where carried out by any other organization, then, the Employer will be allowed to apply the appropriate punishment and, if necessary, the contract will be cancelled. When a contract is cancelled, the information contained in section 9 of this solicitation document can be considered.

The Employer may introduce in the tender invitation letter the initial deposit and the guarantee retention to be discount from certifications. This capital, which is retained by the Employer, is coming from the successful bidder obligations fulfillment. If the successful bidder leaves the work, the initial deposit will be as a profit to the Employer.

The successful bidder is responsible of the obligation's fulfillment, the support facilities, the equipment and material which are in the site work. All of these items cannot be withdrawn without the Employer's written authorization.

The successful bidder is also the person responsible of the right technical execution of the works without entitlement to compensation in case an overrun is generated, no necessary operations are carried out at the time the work is being fulfilled and the Construction Management

Works indicates new modifications (on its own risks) which are independent from the technical management inspections.

1.1.5 Program

The general program of work (studies, supply, manufacturing, transport, assembly and tests) must follow the guidelines shown on these standard and additional information provided.

The program should be developed, according to these standard specific conditions, in other more detailed program document in where the termination dates for the appointed works in the general work are indicated, as well as the progress dates. Noncompliance with such dates may lead to the application of penalties. The deadline for the submission of this detailed program document will be within thirty days of grating the award.

The program referred to in the preceding paragraph must indicate the essential deadline supplies delivery to make sure the works can continue, as well as data related to the beginning or continuity of other third-party works.

The order of the works will be an elective competence determination of the successful bidder, except in those situations of technical point in which the Technical Engineer considered the modification appropriate. The works will be executed in terms of a close follow-up of the base Project, of the approved project's modifications and the orders and instructions delivered by the Chief Engineer to the successful bidder, as long as the approved total budget is not exceeded.

The contract program for the works cannot be altered without express agreement of the Employer and could be modified in case the Employer decides to do so. The successful bidder is compromised to do everything feasible to meet the Employer desires.

The works will be initiated by the successful bidder in the time limits indicated and will be implemented to complete the work execution within the request deadlines by the contract sign with the Employer. The successful bidder gives, compulsorily, in writing and twenty-four hours before the initiation, an account of the work starts to the chief engineer.

Penalties or sanctions are applied if the works are running later than planned in the approved program. If such delay occurs owing to circumstances beyond the control of the successful bidder, then, the successful bidder may request the Employer an extension of the work execution deadline. The postponement of the deadline will be equal to the time wasted, unless the successful bidder request for the reduction of the previously named deadline. The successful bidder extension request should take place within a minimum period of one month following the day the delay cause was produced. The successful bidder must enumerate the reasons why he/she is not responsible of the delay and indicate the recommended duration, so the Employer, before the

contract termination period, might solve the issue of the extension and once the cause of delay disappears the deadline can be adjusted to the wasted time.

If the successful bidder does not request the extension, the resignation to the right of doing so is understood and, according to contract purposes, the responsibility of any delay in relationship with the program is attributable to him/her.

The successful bidder will be submitted to the current laws, regulations, municipal regulations, so as other standards prescribe during the work execution.

The successful bidder is bounded to comply with current regulations related to accidents at work at the moment he/she is in charge of the hired work organization.

1.1.6 Studies. Technical documentation

The successful bidder acknowledges receipt from the Employer all necessary data and documentation for the studies and projects conduct. Moreover, the successful bidder must request for required complementary and detailed information for an appropriate supply execution.

Contractual documents and other official papers provided by the Employer during the contract implementation must be carefully examined by the successful bidder because convenient amendments can be suggested for possible mistakes or omissions.

The successful bidder will provide data, process and construction conditions according to standards and documents (descriptive report, supporting calculations, materials characteristics, materials specifications, diagrams and maps and complementary technical documentation) ordered by the Employer. The information will be given on the date set in the general construction execution calendar. The equipment and the contracted services can be defined in agreement with all of this information. The Employer will be able of:

- Be aware of the magnitude of the stretching forces the equipment can withstand in the different conditions simulated for different calculation assumptions. There must be taken into account the equipment materials guarantee, welding, operation, maintenance, etc.
- To conduct manufacture and assembly inspections
- The study and design of works which are not the responsibility of the successful bidder.

All documents provided by the successful bidder, as well as legends and annotations, must be written in Spanish or other Spanish recognized languages. The employer may accept documents written in English or French, reserving the right to demand translations to Spanish, which will be considered as the only valid documents.

The Employer will report to the successful bidder the documentation approval, so as the qualms, in the deadline indicated in general programme of work. The previously named documentation will define the equipment and contracted services.

The successful bidder will look through all those documents in which the Employer has shown misgivings before the indicated date. Then, the documents will be summited again to the Employer approval accordingly to the dates established on the general construction execution calendar. In case of rejection, the Employer would set up a meeting for further discussion and final decision within a deadline of eight days.

The successful bidder will send to the Employer, in quintuplicated and within a period of fifteen days, copies for each of the approved documents, which cannot be modified without the Employer written approval. The successful bidder responsibility is not restrained by the drawings, calculations and documents authorize by the Employer, the responsibility is complete.

All documents and diagrams received by the Employer as part of the provision, so as the ones sent to the successful bidder from the Employer, will be handled as own property. However, the successful bidder will be not allowed to communicate to third parties the documentation content without the Employer written approval. In addition, the successful bidder will deliver at least three copies of the equipment instruction manuals, whose minimum content is the following:

- Equipment description.
- Nominal design and testing characteristics.
- Materials composition and characteristics.
- Operation principles.
- Operation guidelines.
- Maximum condition variations, limits, working conditions other than nominal.
- Spare part list including identification number, baseline designs, pieces names and characteristics (materials, dimensions, etc.).
- Periodic inspections and tests.
- Spare part lists.

1.1.7 Specifications, applicable standards and guidelines

The general instructions and standards shown below are implemented for the materials and the construction works execution as long as they do not modify or disagree with the scope of the indications included in this solicitation document.

- Article 1.588 and the following articles of the Civil Code, where applicable.
- Low Voltage Electrotechnical regulation and Complementary Technical Instructions (CTI) 01 to 51.

- Regulation of pressure equipment and its Complementary Technical Instructions. (Royal Decree 2060/2008)
- General Technical Specifications for the Reception of Cements (Royal Decree 956/2008).
- Instruction for the manufacture and supply of prepared concrete (Royal Decree 1247/2008).
- Regulation of Storage of chemical products and its Complementary Technical Instructions (Royal Decree 379/2001).
- Earthquake-resistant construction standards (NCSR-02) (Royal Decree 997/2002).
- Regulation of industrial safety development of Law 12/2008 (Royal Decree 30/2010) (Law 12/2008 of 31 July) on Industrial Safety.
- Safety and Hygiene in the Work contain the Labor Ordinances.
- Regulations, Collective Agreements and Internal Regime Regulations in force.
- Technical Building Code (Royal Decree 314/2006).

The general programme of work must be developed and complied with the previously mentioned regulation. It must be submitted within thirty days from the day of grant and be specified the deadlines for each of the works, so as the intermediary deadlines from which penalties can be applied.

1.1.8 Security and work accidents

The contractor is compelled to elaborate a safety plan, which must adjust to the Health and Security Study and be submitted to the Employer. A supportive report written by the safety and health coordinator is also sent with the plan to the Employer for approval.

The successful bidder must meet with the regulations related to the Security and Health Study in the work and listed in the Royal Decree 1627/1997 of 24 October establishing the minimum safety and health requirements for construction sites. This regulation was amended by Royal Decree 604/2006 and by Royal Decree 337/2010.

The construction company will provide a self- Company Medical Service or rallied.

All equipment, machinery, tools and auxiliary means used by the successful bidder during the works execution must have the maximum security and endurance conditions, so as comply with known official standards.

The successful bidder staff is forced to use personal protection equipment in order to eliminate and reduce professional risks. The engineer can suspend works if the staff is exposed to hazards.

The successful bidder is free to demand the convenient scaffoldings installation in order to enforce the security legislation and standards for the staff in matter of Safety and Hygiene or Accidents at Work.

The Chief Engineer may require to the successful bidder the submission of documents evidencing the social security systems formalization accordingly to the legislation. The files can be required at any time, before and after the construction works beginning. Moreover, the Chief Engineer can demand in writing the cessation of the construction activities for any worker which by might cause an accident due to recklessly and endanger the physical integrity of other workers.

All responsibility for accidents occurring during the construction works caused by defective materials, recklessness and the non-compliance of the above-mentioned aspects will rest on the successful bidder. In this case, the successful bidder will pay the penalties due to official dispositions violations and all damages caused to third parties, goods or buildings.

1.2 Quality of the materials

1.2.1 Materials

All the materials supplied by the successful bidder, whether indicated or not on this project, must satisfies the minimum quality conditions required in the best construction practices.

The successful bidder must meet with the above-mentioned prescriptions whatever the brand, factory or extraction site the Employer approves. In case these prescriptions and applicable laws for a certain material are not written in the current solicitation document, then, European standards like DIN, NF or UNE must be follow. The selection of one of these standards depends on the type of material and the usage range.

The Chief Engineer or the Deputy Director of the Works must recognize and approve the materials samples previously offered. Without one of this two work managers approval, the material cannot be used or installed and a subsequent removal will take place for materials of off-label use.

Reject materials must be removed immediately at the successful bidder own's risk and expense and then deposit in the site indicated by the Work Management.

The Employer will inform the successful bidder the replacement of materials, although the costs increases at his own expense, when the materials do not fulfill certain minimum quality specifications required in this solicitation document, the materials all not well manufactured enough or the materials are not appropriate for their purpose.

The successful bidder, at his own expense, will transport and dispose the unusable materials, grouping them together in the designated site in order to avoid annoyances during the works execution. The materials coming from diggings, demolitions, etc., and with no use in the construction works will be remove to a landfill.

Despite the previously explained, an approved material with defects noted before its installation can be withdrew to the successful bidder expenses.

1.2.2 Steels

The successful bidder will mention the mechanical characteristics of the following steel items used in the works:

- Steel castings
- Cold rolled steel structures

1.2.3 Other materials

For the rest of materials used in the manufacture of the supply, the mechanical characteristics as well as the chemical composition shall be indicated.

1.3 Design Standards

Hydraulic Steel Works calculations must be done applying DIN standards or other similar design rules. Some important design calculations for equipment and buildings are related to the stress forces. The successful bidder must indicate this forces, simple and compound stresses, to be apply on the materials that form part of structures. Apart from that, the maximum allowable stress/ working stress should be indicated for further calculations:

- Allowable tensile and compressive stresses, including bulking testing.
- Admissible shear stress.
- Comparison between forces.

The breaking strain, in other words, the working stress, is an absolute limit which must not be exceeded at any case, even by: accessory parts exposed to wear and shocks, dynamic stresses, local stresses, vibration and corrosion.

The maximum loads transfer to the concrete by fixed and operating parts will also be appointed. Compressive stresses for concrete will adjust to the information indicated in DIN standards and will never exceed the breaking strain.

Armored pipelines and coatings will be properly size for adverse loading conditions without taken into account the concrete which encapsulates them.

The successful bidder will provide the calculations for the most important items of the supply and will indicate the safety coefficients of elements like cylinders, chain mechanical components, wires, etc.

1.4 Building general provisions

1.4.1 Insurances and medical assistance

The successful bidder is compelled to facilitate to the work direction the documentation which accredits the Projects reformulation verification and the work start, so as the affiliations to the Social Security system and insurances:

- Insurances against damages to third parties as a result of the Project's execution.
- Workplace accident insurances in the corresponding Mutual Society.
- Automobile insurances for all the vehicles that the successful bidder have access.
- Insurance for machinery and equipment used by the successful bidder in the construction works.
- Fire insurance for construction works, in companies of recognized solvency registered with the Ministry of Finance under the Insurance Act in force.

The successful bidder is not allowed to start the construction works without justifying in front of the Employer being covered by insurances for accidents and diseases in accordance with the current legislation.

The successful bidder will insure by himself or by an insurance company the healthcare provision and will be responsible of the security conditions during the works performance. The successful bidder is obliged to apply on his own expense all the requirements related to this topic, so as the actions prescribed by the work inspections and other competent authorities.

1.4.2 Reassessment of the construction works

The Faculty Management of the Works will point out the exact location and height of the key points before the construction works ever begin.

The contractor and his representative, which are under the construction manager commands, will reformulate the layout for wires and pipelines indicating the alignments with the necessary points in auxiliary diagrams and drawings. The main reason is the proper execution of the works.

The project's reformulation must be carried out in front of the construction manager who is the person the installer will demand the preparation of the subsequent report. The installer is responsible of the non-compliance of the new aspects of the works after the reformulation and

shall be obliged to guard and replace the signposts indicated. Moreover, the contractor must supply all necessary material and staff for the execution of the reassessment operations.

The main references are shown in a sketched for the daily check of the works progress. The contractor and the Faculty Management of the Works will be in possession of this document.

1.4.3 Subordinates in the construction work

The successful bidder is the person with the responsibility of the personnel recruitment, both professional and technical staff, needed for the assembly operations. He is also in charge of the substitutes hiring and the salary costs control.

The successful bidder is forced to hire the technical staff fixed in the tender. The workers must be trained professionals with a good reputation and the number of workers hired should be proportional to the construction works extent in accordance to the determine deadlines. The successful bidder must report to the Employer, whenever requested, a file containing the current staff in the works and their professional category.

The staff have to take orders from the work management. In case of disobedience and events that might disturb the work progress, the work management is allowed to forbid the permanence in the works. The successful bidder might appeal to the work management commands if the reason for the forbidden is lack of justification.

Regardless the successful bidder nationality, the legislation related to the personnel recruitment must be comply. In case of recruitment of foreign personnel, the successful bidder is liable of the necessary documents and conditions received from this staff to be able to work at Spain. Moreover, all staff member, regardless the nationality, must abide the labor laws on the subject of service hours, social insurances, etc.

All staff employed by the successful bidder and the corresponding deputy successful bidder in the works execution must be affiliated to the general social security system and must keep all supporting documents in the construction office, TC1 and TC2 validating the situation. In addition, the successful bidder is obliged to meet with the public procurement law and the current labor legislation for the works performance.

The successful bidder must enable an office in the worksite in where there will be a copy file of the Project information given by the Chief Engineer, so as other documentation in relation to equipment and materials characteristics. The successful bidder might be allowed to copy the original documents of Project when the Chief Engineer authorizes so.

The successful bidder and his representatives must be present on site during the working day and will accompany the Chief Engineer, or other persons in charge, to worksite visits. Accordingly, the successful bidder will give professional opinions and necessary knowledge; will

facilitate data, means for the implementation and approval of measurements, checks and settlements.

The successful bidder and his representative will keep an eye on the scaffolding's installation works and the auxiliary means. Moreover, the successful bidder is responsible for accidents arising from violations during the verification of the manufacturer warranty of the materials or failures when the proper precautions are not taken into account.

Before the building works begins, the works must be reformulated by the work manager and the deputy work manager with the subsequent writing of the document verifying readiness for construction. This document will be published in Building Diary and the start date for work will be recorded.

All operations and auxiliary means required for the works reformulation will be on the successful bidder own expense and can be monitored and cancelled by the technical direction.

The successful bidder cannot claim for compensations when there is subtraction, loss, breakdown and other prejudices during the works performance. Similarly, he will be responsible of material losses to be delivered on his custody and discounting the costs of the received quantities. He also assumes liability for damages to adjoining properties and is forced to return the buildings to its original state.

1.4.4 Implementation period

The compliance of the execution period, both partial and final periods, is mandatory and non-renewable. The periods start to run on the day of the project's reformation or since the Employer reports the authorization to commence works.

Nevertheless, these deadlines can be postponed when the Chief Engineer requires for modifications in the Project, which are also approved by the Employer. For this case, the changes must have strong influence on the deadlines appointed on the contract.

If the construction works do not start in the date agreed or were interrupted once initiated (taken into account the successful bidder is free of all responsibility), the Chief Engineer will extend as necessary the deadline.

1.4.5 Reformation of the project

Possible improvements and changes in the Project shall not be deemed if there were not requested in written documents by the Chief Engineer.

If before the date construction works started or along the development of works the Property, in agreement with the Chief Engineer, determines to perform part of the works included in the contract or introduces changes in the Project in relation the increasing, reduction and abolition of the quantity of material specified in the budget, the successful bidder must comply with this requirements without any right to compensation despite the possible profits obtained from the abolished works.

If, along the development of the works, the Chief Engineer conveniently introduces changes in the Project, the successful bidder must execute it as long as the solicitation document is not modified. In case of modification, the successful bidder will have the right to request for a Projects extension and a new termination deadline given by the Chief Engineer.

1.4.6 Contradictions, omission and mistakes in the documents

The different sections of this solicitation document are interrelated, so as the prescriptions explained on any of them. For this reason, a prescription which is shown in one section and which is affecting other sections is considered to determine the remain sections of this document.

The contradictions and doubts related to specifications will be interpreted by the Chief Engineer. Contradictions, omissions and mistakes identified in these documents both by the Chief Engineer and the successful bidder must be present in the document verifying readiness for construction.

1.4.7 Faulty or unauthorized works

After having detected shortcomings in the works performed or materials and equipment not satisfying the stipulated conditions, the Chief Engineer and his representative may prescribe the demolition of the faulty parts and a new rebuilding according to the contract at the successful bidder expenses. In case of complaint and the demolition and rebuilding denial as commanded, above are shown some steps:

- The materials and equipment do not satisfy the required quality or they are not absolutely ready. Then, the Chief Engineer will request the successful bidder the materials ‘replacement for others fulfilling the needed conditions according to the solicitation document or the Chief Engineer demands (when there is no documentation).
- The Chief Engineer might allow the use of higher quality materials as previously agreed if the construction works circumstances advise so and the successful bidder has the possibility of supply materials with the indicated quality. In this case the price of the

faulty material will discount from the required material price. If the successful bidder does not have the required material, then, he will not entitle to any compensation.

The successful bidder is employed in order to be the person responsible of the construction works execution. The faults and shortcomings consequence of the incorrect execution of the works and materials quality deviations are also part of the successful bidder responsibility. His behavior has no excuses, although the Chief Engineer and his representatives drew attention to precautionary statements.

1.4.8 Suspension of the works

The successful bidder must be notified at least one month in advance when the Employer wishes to suspend the construction works. In this case the successful bidder must cancel the works without any right to compensations as long as the work already done and the material accumulated on site were paid. For termination for cause the action procedure is the same.

If the suspension of the works was caused by the successful bidder, the Employer has the right to cancel de contract. In this sense, the Employer must credit to the successful bidder the corresponding payments for the works already done and losses the warranty as compensation for the prejudices originated to the successful bidder.

In the event of the successful bidder bankruptcy or death the contract is cancel, unless the bankruptcy heirs offer the same agreed conditions. The Employer can accept or decline the offering without any right to compensation for the successful bidder heirs. If the contract is canceled, the successful bidder belongings, such as tools, must be collected within eight days and is understood the belongings abandonment if it is not done.

Causes for the contract termination:

- Do not implement the works in accordance with the Project and reformulations.
- The materials deficient use in the works or misplacement in the worksite forcing the its demolition and abandonment.
- The works are not carried out as indicated in the schedule.
- Inability of the hired staff, both professional and technical, to carry out the works properly.
- The successful bidder bankruptcy or payments suspension.
- The delay of the construction works beginning in contrast to the indicated start date in the contract.
- Non-compliance with the contract conditions due to carelessness or bad faith and prejudices the works performance and interests.
- Deadline end-date conclusion without the total completion of the construction work.

- The successful bidder death or legal incapacitation.
- Modifications in the contract which induces to changes in the Project or the equipment needed for construction. The 25% and 50 % of the contract and the equipment costs are modified respectively.
- The suspension of the already started works or delay in the works beginning within 3 months from the assignment date due to causes beyond the contract indications.
- Any cause of force majeure forcing the suspension of works indefinitely.

The bond will benefit the Property, in exception of the last four cases. The Employer has the right to decide the continuation of the works, both by himself or by third parties.

1.5 Tests, evidences and protections

1.5.1 On-site test supervision

All welded joints shall be inspected with radioscopic control. The monitoring shall be carried out in front of the Employer and successful bidder representatives.

Several test pieces made of the construction work materials shall be mechanically tested. For storage tanks, a 10% of the welding seams shall be examined in accordance with the ASME standard section VIII. For heat exchangers and pressure vessels, tests are made for every single welded joint.

The servomotor cylinders and other moving parts containing oils under pressure, such as oil pump bodies and the subsequent valves, shall be subjected on-site to a test pressure equal or higher than a 50% of the operating pressure. The stresses shall not exceed a 40% of the breaking load or the 80% of the yield strength during the tests and appreciable deformations, leakage or filtration cannot be produced.

For water pumps, all necessary tests will be performed in accordance with standards for the determination of the pump's characteristic curves, the delineation of the curves of suction lift, power and efficiency. The last three aspects must be tested considering at least five points starting with a zero-flow rate to the nominal maximum flow rate.

1.5.2 On-site presentation

The Employer may require the construction works elements on-site in order to anticipate potential difficulties which may appear during the construction works performance.

The successful bidder will point out in his offer the economic impact for the presentation on-site of the supply agreement.

1.5.3 Protection against corrosion

The successful bidder must suggest an advisable protection for the Employer's approval. A protection layer must be administered to the manufactured elements surfaces made of oxidable materials in order to avoid their contact with water and the environment. The administration of a protection layer consists of a zinc metallization after a sand blasting cleaning. The zinc layer needs to have a 12 mm thickness and must be covered by three layers of paint depending of requirements.

Nevertheless, the Employer decides by right the application and the protection type (total or partial) against corrosion for the supplies. The successful bidder must explain carefully in the budget the costs of the protection operations and the expenses must be broken down to consider the possibility the Employer carried out these actions on his own account.

The mechanized parts of the supply must be degreased and will be protected with colorless vinyl paint of bootable type. The time elapsed since the metal surface was treated up to the painting application cannot be higher than 24 hours.

The protection system for surfaces using paint in different metallic surfaces must be adequate for weather conditions, the characteristics of the raw materials and products and the operating conditions of the process.

1.5.3.1 Heat exchangers

The heat exchanger surfaces will be treated taking into account different methodologies for the preparation of the surface for each type of painting. The paint is sprayed with pressure and without air with a paint gun when environmental conditions allows to do so. The most external surfaces are protected with several layers of:

- 75 microns thick dry film yellow chromate primer coat.
- 80 microns thick dry film zinc epoxy-chromate primer coat.
- Two coats of 35 microns per layer of aliphatic polyurethane enamel.

The metallic surfaces will be cleaned before the paint application in accordance with the National Association of Corrosion Engineer (NACE) and other standards like the Corrosion Committee of the Royal Swedish Academy of Sciences (RSAS).

Metallic complementary elements will be cleaned with a brush when the sand blasting cleaning is not possible. The external carbon steel mechanized surfaces will be protected with a corrosion inhibitor, which can be removed by water and solvents. The inhibitor must be tested, so as the disposal method.

Metallic structures and supports for heat exchangers will be treated with:

- Shot blasting
- 75 microns thick dry film organic zinc primer coat.
- 80 microns thick dry film epoxy resin as second layer.
- Two coats of 35 microns per layer of aliphatic polyurethane enamel.

1.5.3.2 Pipelines

All pipework must be pre-blasted in accordance with standards of the Royal Swedish Academy of Sciences. The sand blasting must be carried out in the workshop to prevent dust from spreading through the rest of the facility.

The paint applied on the pipelines is:

- 40 microns minimal thick chlorinated rubber primer coat.
- 80 microns thick chlorinated rubber primer coat for the bottom.
- Two coats of 25 microns thick pure chlorinated rubber paint.

1.5.3.3 Tanks and pressure process columns

All tanks and pressure process columns must be pre-blasted in accordance with standards of the Royal Swedish Academy of Sciences. The paint applied on this equipment after the surface treatment is:

- 25 microns thick epoxy paint layer.
- 25 microns thick epoxy paint layer for the bottom.
- Two coats of 40 microns thick epoxy paint layer.

1.5.3.4 Pumps

The pumps surface treatment and finishes will depend on the facility's surrounding environment. The surface cleaning will be performed following the procedures indicated below. The procedure selection will depend on the supplier's recommendations.

- Metal blasted with shot peening.
- Silica sand blasted sprayed with compressed air to the surface.
- Chemical pickling for the oxide layer removal and other impurities by acid dilution immersion removal.
- Preparation of the superficial layer with a Wash Primer layer in order to increase adherence.

The next paint layers are applied on the pump surface:

- 75 microns thick epoxy primer coat.
- 75 microns thick epoxy paint for final coating.
- Two coats of 40 microns synthetic enamel.

1.6 Inspection, receipt and guarantee deadline

1.6.1 Industrial inspection

The Employer reserves the right to make directly or by an institution the inspections for the manufactured equipment in order to comply with deadlines, materials quality and applied technologies. The inspection covers the production, the successful bidder and the supplier's facilities.

The successful bidder is forced to ensure the free passage into the facilities at any time the Employer's representatives decided so and is also compelled to facilitate their works.

The successful bidder must report to the Employer in sufficient time the date for test performances, raw materials receipt and the most important manufacturing and assembling operations. In this sense, the Employer could prevent the representatives to be present at these moments. The successful bidder must deliver three copies of the corresponding documents explaining the tests results and the delivery must be done although the representatives do not witness the tests.

1.6.2 Assembly, inspection

The technical personnel will take care of the assemblies. A nominal technical personnel list must be submitted for approval. The staff functions and the technical capacity for the development of the works are the main aspects included in this list.

The Employer may decide the insufficiency of the technical staff members appointed by the successful bidder. In this case, the successful bidder must complete the list as required by the Employer. Besides, the Employer's personnel for inspection might command the works suspension when they were not executed with the conditions and specification agreed in the contract. The order of suspension will be sign in written paper.

The Employer may challenge the successful bidder representative, or any other member in charge of the works in his behalf, when the assembly operations development is not appropriate according to his criterium. The Employer, then, can force the successful bidder the equipment replacement within thirty days.

The materials and equipment risk during assembly operations may be assessed with insurances companies hired by the successful bidder.

The Employer may establish the obligation of having an equipment and materials insurance during the assembly works. The insurance will be extended to cover third parties and the Employer losses caused during assembly operations. The equipment or piece return to the manufacturer due to malfunction will be at the successful bidder own expense including transportation, insurances and other things. Expenses, assignments and other formalities for the temporal tools, instruments and materials importation and re-exportation for supply will be at the successful bidder own expense.

The Employer will oversee through the representatives the assembly operations. The successful bidder will ensure the free passage at any time to stores and office spaces for inspections required by the Employer and will facilitate and clarify data.

1.6.3 Controls

The successful bidder will make sure with appropriate controls of the good quality of the materials handed over. The control results must be approved by the Employer who may require further control tests.

1.6.3.1 Heat exchangers

The Employer must approve the welding procedures (WPS) for the heat exchangers before the Supplier starts the manufacturing process.

The welding methods must be duly backed up by the qualification certificates (PQR) and the type-approval certificates for welders, both issued by a Collaborating Entity of the Administration (ENICRE).

A visual examination for the heat exchanger physical aspect will be undertaken in order to identify defects as a result of the manufacturing process and transportation. Furthermore, tests and supporting documents according to legislation may be demanded.

1.6.3.2 Pipelines

The pipes must be handled without abrupt movements and material's drag on the ground. Some control measures for pipelines are:

- Visual examination of the physical aspect in order to identify defects as a result of the manufacturing process and transportation.
- Gathering of copies for the material's supply solicitation and acceptance by the successful bidder and supplier respectively. The delivery note for the goods receipt is included.
- Manufacturing certificate and control/tests documentation for the supplied materials.
- Pipes identification with longitudinal recording including sales description, material, diameter, thickness, working pressure, standards and manufacturing year.

1.6.3.3 Tanks and pressure process columns

The equipment is supplied according to a capacity criterion. There must be in a fully finished condition and superficial effects must not be identify. The solicitation and acceptance copy for the material's supply must be gathered by the successful bidder and the supplier, respectively, including a delivery note for the goods receipt.

There must be included:

- Manufacturing certificate and control/tests documentation for the supplied equipment batches.
- MINER Type-approval and Stamp certificate.

The tanks are identified with a metal label located close to the tank manhole in which is included the sales description, manufacturing and register number, pressure tests, pressure drop, external surface, capacity and tests data. Moreover, there will be a visual examination of the physical appearance of the tank in order to detect defects as a result of the manufacturing process and transportation.

1.6.3.4 Pumps

Verification of the installation conditions, if there is something missing or if the lubricating system is filled with oil. Besides, the engine and pump examinations are mandatory because all cleaning system components must be correctly installed and clean.

1.6.3.5 Hydrostatic test

The Employer may require the performance of hydrostatic tests. The successful bidder must have sufficient closure funds to carry out the tests. The pressure tested should not be lower than 1.5 times the maximum design pressure.

If the test results expose some inadmissible defects such as leaks or malformations, the successful bidder will submit for the Employer's approval the repair procedure. Once the piece or equipment is repaired the tests must be performed again.

1.6.4 Deadline installation agreement

The successful bidder will report the Employer in writing form once the equipment is considered to be ready for operation. Then, the equipment's assembly will be examined and a deadline installation agreement will be signed by representatives of both parts.

1.6.5 Adjustments, tests and experimental services

After completion of the installation, adjustments, tests and several experimental commissioning will be accomplished in accordance to the agreed conditions of operation.

The equipment and supplied materials are consigned in the date of entry into industrial employment, unless otherwise is agreed.

The equipment imported by the Employer will be transferred with the bill of landing documentation delivery. The risk and warranty are the successful bidder own expense until the equipment entries into industrial employment.

1.6.6 Provisional acceptance

After the experimental commissioning tests and simultaneously with the industrial service beginning, a Provisional Receipt Minute signed by qualified representatives of both Employer and successful bidder will be drawn up previously to the performance of the corresponding reception tests. If the acceptance test cannot be performed for reasons beyond the successful bidder control, provisional acceptance is considered done within 120 days after the tests starting date. However, the successful bidder must comply to carry out the tests before the final acceptance date.

The technical management shall draw up with three copies a Certificate of Acceptance. These documents include the shortcomings of the works and the deadlines for the fault's rectification.

If the works are performed properly in accordance to agreed conditions explained in the contract, the construction works will be considered as receipt. The warranty period indicated in the contract starts in this moment and the period will last at least three months.

If the construction works are not considered as receipt, the Certificate of Acceptance will include it and detailed instructions will be given to the successful bidder in order to overcome the detected defects. The faults will be remedied according to a fixed time period. The repair works are at the successful bidder own expense. If the contract requirements are not fulfilled, the contract can be cancelled and the bond lost.

1.6.7 Guarantee period

The Provisional Receipt Minute Act date will indicate the beginning of the warranty period. The successful bidder can keep the technical staff in the work site as required, although he must facilitate and command the staff member to be on-site when the Employer requires so in order to repair malfunctioning and shortcomings.

The length of the warranty period is agreed between the Employer and the successful bidder when the contract is written and will start in the day of signature of the Provisional Receipt Minute.

The successful bidder must replace any defective devise or piece due to malfunction, poor design, inadequate quality raw materials, manufacturing defects and assembly errors during the warranty period. All the replacements and construction works must be performed as soon as possible and are at the successful bidder own expense. During this period, any piece replaced by other of the same quality will have the same warrantee period that the substitute piece or equipment.

If the equipment did not work during part of its warrantee period as consequence of accidents or defects from what the successful bidder has responsibility, the time the equipment is not working will be added to the warrantee period of the new equipment replaced.

1.6.8 Final acceptance

The final acceptance of the works takes place after the warrantee period completion, regulatory process development and the works examination. After verifying the construction works are in perfect conditions for operations works, the Final Certificate Acceptance is signed. This document reports the incidents during the warrantee period and must be signed by the Employer and successful bidder representatives.

The successful bidder will be liable for the damages produced (although if they were the result of the Employer commands with the successful bidder agreement) until the Employer signed the Final Certificate Acceptance.

The successful bidder will conduct necessary tests for correct operation verification, production capacity, etc. to the final acceptance of the works and will bear the costs, except the costs where included with the Employer obligations.

All warrantee periods for replaced equipment, devises and pieces must have finished and all complaints solved previously to the works final acceptance. Partial final acceptances might happen for specific considerations. Once the works are finally accepted the warrantees for supplies comes to an end.

1.7 Storage, transportation and insurances

1.7.1 Storage

The Employer will point out the stores and forecourts for stockpiling capacities available for the successful bidder needs during the construction works and also indicate the date from which they are available.

The materials stocking, whatever their characteristics are, is strictly forbidden in areas where works can be delayed, except the Chief Engineer gives a written authorization.

The materials must be stocked allowing their correct preservation for the subsequent used in the construction works, which is a condition to be examined prior to the application.

Material stock locations must be refurbished once the materials are consumed and removed from the area. The area must recover the original appearance.

All costs for storing, maintenance and control are at the successful bidder own expense.

1.7.2 Transportation

The successful bidder must command the material and equipment supplies transportation from the manufacturing facilities to the final facilities in construction, unless the Employer indicate otherwise. The materials must locate in suitable areas indicated by the Employer and must put in positions with good handling conditions, preservation and security.

The successful bidder must prevent expeditions or transportations from his facilities or his suppliers without the Employer's prior approval and taking into account the following:

- The dates foreseen in the work programme will be respected.
- The deliveries staggering during most favorable dates for the good progress of the works and the optimal use of the areas reserved for parks.
- Possible inspection for packaging and other working conditions.
- The possible Employer collaboration in resolving transport problems as a result of excessive volumes or weights, in especial when the resolution depends on Official State Bodies.

The packaging, conditioning and transport means approval by the Employer does not absolve of responsibility the successful bidder, in especial when it comes to transport, malfunctioning and equipment and material supplies lifespan.

The materials and equipment delivered packaging will fall into the Employer domain before their application.

The successful bidder must prevent the reception of each transport in time including for a correct identification a packaging list with indications for content, weights, size and brands.

1.7.3 Transportation locks

The successful bidder will take out insurance against damages for materials and equipment in transit, unless the Employer record in writing his wishes to take out insurance on his own account.

1.7.4 Materials and equipment importation

Equipment and materials from abroad may require customs formalities to be accomplished by the successful bidder on behalf of the Employer.

The successful bidder will receive on time the required documentation to proceed with importations and for transit for another third country.

If the successful bidder cannot proceed with de procedural formalities previously mentioned in the preceding clause, the Employer must succeed in meeting all necessary procedures in customs authorities for all the imported materials.

The successful bidder must report in writing to the Employer for every overseas manufacturer and imported equipment the following information: sales description, fluid weight, value, origin and payment currency.

The successful bidder will seek for necessary information in order to accomplished the customs formalities in the best possible conditions and independently to the Employer's customs exemption management.

1.8 Construction work organization

1.8.1 Construction work management and successful bidder representation

The construction works management will be in charge of the Employer's technical staff. The successful bidder should know the identity of the engineer in charge of the works or the Technical Director of the works whose main functions are:

- Requiring the successful bidder, the compliance with contractual conditions through the staff.
- Take measures to ensure the proper executions of the works in agreement with the approved project or the authorized changes. The schedule must also be fulfilled.
- Determining the technical conditions that this solicitation document does not restrict.
- Solve technical equations required for the drawings, materials conditions and works executions interpretation as long as the contractual conditions are not modified.
- Incidents and problems review showed up during the works and preventing the contract fulfillment or the contract modifications (including propositions in this case).
- To suggest applicable actions for the licenses and authorizations, required for the construction works and land occupation, obtention. It is also needed the troubleshooting for services related to the licenses.
- Take personal responsibility for the direction of urgent or seriousness operations. The successful bidder must make available the staff and materials for such purpose.

- To participate in the provisional and final acceptance of the works and to write the works clearance in accordance with the current legislation.

The successful bidder is forced to cooperate with the Chief Engineer in order to comply with mandated functions.

The successful bidder must indicate the Employer the name of his representative before the beginning of the works. The representative will be the technical supervisor for economic and technic aspects.

The powers of the assembly supervisor must be broad enough to receive and solve the orders and commands of the Employer. Under no circumstances the absence in the works of the representative of the successful bidder will be accepted as an excuse. The successful bidder must submit the nominal technical employee list for approval before the construction works beginning. This technical staff shall be responsible of the equipment and building assemblies and in the previous indicated list is shown the functions to be develop for everyone.

The Employer deserves the right to reject the supervisor or any other technical personnel appointed by the successful bidder during the development of the works and the successful bidder can be forced to replaced him in a thirty-day time.

If the technical staff appointed by the successful bidder is considered by the Employer not being enough for the proper conduct of the works, the successful bidder is then complied to reorganized the number of technicians according to the Employer criteria.

1.8.2 Necessary land for the construction works

The Employer will specify the land boundaries and give access to the successful bidder and other staff for the construction of the facilities. All of this information will be shown in the plans and diagrams delivered to the tender members. In this case offers will be examined.

The successful bidder must have a perfect knowledge in regard to the land configuration, the importance and progress of the works signed in the contract, the nature and the ground conditions, the site chosen for works, the access routes and the region climatology (in special when the works can be affected by these conditions). The Employer must hand over all the lands indicated and limited by the plans delivered to the tender members, who defined the assembly area.

If the successful bidder wishes to have land other than land indicated and specify in the previously appointed plans, the successful bidder must obtain the appropriate authorizations and asked for the Employer accordance in relationship to the acquisition and achievement the authorization.

The successful bidder is responsible for damages caused in public and access roads when the latter belongs to the Employer or other private individual. It must also comply with constraints and apply for licenses for special transportation. Accordingly, the successful bidder must accept liability for damage to the personal and immovable property of third parties as a consequence of the fulfilment of the contract. It is also responsible for legal complaints caused by the named damages.

1.8.3 Auxiliary installations

If the construction works area is sited where the Employer distributes electricity, then, the Employer must provide to the successful bidder enough power for the facilities. The consumed energy will be charge according to the price. The electricity distribution network in the work area will be built by isolated wires and must not interfere with the ongoing works. The establishment must be previously authorized by the Employer when located in the work area and must comply with the current legal framework. The water and compressed air supplies required for the construction works must be borne by the successful bidder and facilities must comply with standards and regulations.

The Employer may provide materials and auxiliary means under the conditions set down. The successful bidder shall be responsible of:

- Materials and required means for construction, preservation, dismantling, demolition or withdrawal with a specified period, so as works installations (offices, canteens, stores, etc.).
- Means for the monitoring and maintenance of any material stored during the work or assembly period.
- Any working tool or necessary means for the assembly execution such as scaffoldings, ladders, differential switches, etc. and other materials related to the electricity, like electrodes.
- All needed tests, accomplished in laboratory or in field, for raw materials and components during the assembly operations.
- Expenses required for the normal inspection operations accomplished by official bodies.

The successful bidder cannot justify the avoidance of the contract liabilities in spite of the difficulties found due to the simultaneous execution of other works in other installations of the same Employer, and although the contractors and suppliers intervene simultaneously in the accomplishment of all of these works.

The successful bidder has no right to claim for compensation during the works execution and for the normal fulfilment of the contract if the quality, amount or importance of materials is increased in relation to the initial prevision. A comparable note will be formalized for every new equipment inclusion and added to the contract for the initial equipment and tools contribution. The note will be annex to the contract.

However, these new material included in the contract will be charged according to prices established by common agreement when the successful bidder is forced to make supplementary material available for unforeseen circumstances or for claims of majeure force recognized by the Employer. All of this must be in agreement with this solicitation document.

1.8.4 Relationship between property, successful bidder and contractor

The successful bidder must provide the information for the execution of the contract required by the Employer due to the possible damages of the works entrusted to the own successful bidder over the contractors and suppliers.

The request for information should not present an interference during the contract execution, neither an active participation of the Employer in the successful bidder responsibilities. The demands only will be of informative nature. In any case, the successful bidder is responsible of the fulfilment of his own labor according to the liabilities of the contract.

The successful bidder or its representative, as required, must be present in the work site domiciled by the Employer in order to avoid speculations about possible delays or suspension of the orders of the Employer.

The Employer must coordinate the activities of the successful bidder, needed for the supply, with other contractors or with other entities unrelated to the contract.

The successful bidder must submit copies of the notifications and mails to the Employer when a contract is signed between other contractors appointed by the same Employer in relation to the good supply execution. The decisions made during this named contracts are valid only when the Employer gives a written approval.

If differences arise as a consequence of the previous contracts, the successful bidder must ask for a meeting with representatives of the Employer, who will solve the problems in agreement with the contracts signed. The indicated meetings must be requested with at least ten days in advance.

The employer will convene a meeting with the successful bidder and other contractors when required. The meeting is established according to the Employer and successful bidder judgments. The problems associated with the ongoing works coordination, the excessive occupation of the work site, the common means availability and the means use are debate and solve in the indicated

meetings in agreement with the approved program of works. When the general facilities are used by several contractors and suppliers, the expenses are divided depending on the supplementary used.

The Employer will be keep informed of the resolutions taken among contractors and suppliers, so solutions may be taken when differences arise. The decision is mandatory for of the parties interested.

The Employer should not found a non-expected situation during the works due to the lack of information that should be provided by the successful bidder, the suppliers or the contractors. In case of simultaneously operation or work executions of several contractors or suppliers in the same work site, everyone and each of them has responsibility for all damages caused for their acts.

1.8.5 Subcontracting of works

Unless otherwise explained explicitly in the contract or due to the nature of the works, certain construction works can be executed by third parties and not directly for the successful bidder. The following requirements must be complied:

- The construction works parts to be accomplished and the economic conditions must be notified in written to the Engineer of the subcontract, so the final resolution and acceptance can be done in advance.
- The work units hired by the successful bidder to third parties must not exceed the 50% of the total budget of the main construction work.

The subcontracting must be subordinated to the Employer's previous approval.

In any case, the Employer is not bounded to the subcontracts the successful bidder decides to established with third parties and the successful bidder obligations with de Employer are not absolved.

1.8.6 Assembly staff

The successful bidder is responsible for the specialized and non-specialized staff, the auxiliary personnel for the assembly direction and execution and the expenses for the workers hired such as travels, accommodations, meals, postings...

The recruitment of personnel must comply with the existing laws, whatever the successful bidder nationality is. The required authorizations, papers and conditions for a foreign workers hired at Spain must be procured by the successful bidder.

The staff must follow the labor laws, whatever their nationality, in regard to schedule, social insurances and other rules of general character to be implemented for a construction work.

The successful bidder must appoint a qualified technician to be present in the work site while the assembly works are taking place. This technician must accredit the correct execution of the works in front of the Employer.

The successful bidder is responsible of the tax fraud or misappropriation committed by the staff during the supply and use of materials.

The number of employees for each occupation must be proportionate to the amount of work to be executed in the prescribed time.

The successful bidder must submit a list with the staff composition and classified by professional category when the Employer requires so.

The successful bidder must preserve de discipline and order in the work site.

The Employer has the right to demand the withdrawal of any worker when there are reasons indicating a possible damage of the normal development of the works.

1.8.7 Insurances and medical assistance

The successful bidder cannot start the construction works without being insured by accident and professional sickness insurances. All of them must justify to the Employer the correct fulfilment of the current legislation in that matter.

The successful bidder has the obligation to assure the provision of adequate medical assistance due to the possible staff diseases. For that purpose, the successful bidder can insure by itself or by means of an insurance company the named assistance.

The successful bidder is responsible for the safety conditions in the work environment being forced to adopt and apply all the current provisions. Some of them are related to the measures indicated by the Labor Inspection and other competent public agencies and the safety standards according to the characteristics of the construction works.

All contractors working in the same construction area must group in a Central Safety Board in order to organize and examine the security and hygiene. The Central Safety Board is composed by the representatives of the companies and its main objective is the coordination of the safety measures approved by the committees and the safety organizations of the companies.

1.9 Construction work payment conditions

1.9.1 Definition of prices

The expenditure of goods and services will be denominated in euros and include the costs of manufacturing, supply of construction materials, assembly of equipment (both tested and in proper functioning), spare parts supply, additional services and the maintenance during the guarantee period.

The expenses from assembly, dismantling and removal of the facilities will be included on the price for supplies.

The unitary and global prices must contain the costs entailed by the execution of the works during the indicated period, including all the works imposed to the successful bidder by the contract documents and this solicitation document.

The price of materials and equipment conforming the supplies must cover with:

- Manufacturing cost, which includes the packaging, of materials and equipment coming from abroad.
- The transportation cost from the manufacturing facilities to the construction area.
- The insurance cost for transportation.
- The unitary cost for the required spare parts supply.

The price of materials and equipment includes the expenses related to the manufacturing studies, drawings, electric schemes, patent rights and other activities having influence on the final price. The Employer is free of any demand of third parties in relation to the previously named rights.

The load, unload, transfer, installation in the storage area of the materials and the expenses related to the custom import duties are included in the transportation price.

The assembly costs will contain the instruction and training expenses of the personnel of the Employer, which will be in charge of the facilities operation. The insurance prices for assembly and tests in equipment and facilities once installed according to the terms indicated in this solicitation document are also included in the assembly costs.

1.9.2 Accessory services and administrative work

The successful bidder is compelled to performed works of minor importance and supplementary benefits submitted to administrative arrangements.

The works accomplished during the construction works indicated in administrative arrangements (notations) will finish the payments in accordance to the following points:

- The employment of labor and materials: The total expenses will be calculated by taking into account the total of hours worked by the staff and the category of the personnel hired in the works. In this case, there will be an average price per hour in agreement with a previously established tariff, which includes the salaries, the social contributions, the accommodation costs, the proportion of tools and other instruments. The price paid for the materials and supplies used in the works includes transportation to the storage area. This price will be fixed in the contract document and there will be indicated a maximum of 20% of for the raise of the final price in order to cover with expenses and profits.
- The employment of auxiliary equipment includes all direct labor force, fuel and energy required for the manipulation of machinery and other equipment needed in the execution of the works and the services development previously paid to the successful bidder.

The successful bidder will receive a compensation for the use of the equipment. The payment must also include the expenses for repairs, maintenance and replacements, in agreement with the tariffs.

Several tariffs can be used depending on the equipment type. All of them will be expressed per thousand of the value of the machinery and per hour or day of used. In case new machinery is used for the works indicated in administrative arrangements, the calculations indicated below can also estimate the tariff for the equipment. However, in the latter case, the successful bidder must receive a minimum compensation in concept of assets freeze, which is also expressed per thousand of the value of the machinery. The successful bidder may also charge for the equipment transportation, round trip, and for the assembly and dismantling operations, when is considered to be appropriate.

The successful bidder will receive a minimum compensation for the assets freeze when the machinery is used for the works accomplishment after the final date of employment agreed in the contract. The fees will have the same percentage in accordance with the previous paragraphs. The Awarding Agreement and the particular solicitation document will indicate complementary details.

1.9.3 Unplanned work

The job units needed for the project completion which were not defined will be paid in agreement with contractual prices and other prices of projects of similar nature. The new prices will have the same economic conditions of the prices indicated in the contract.

In the absence of mutual agreement recognition and while pending the resolution of discrepancies, the successful bidder will receive the payments according to the valuations fixed by the Employer.

In case of convincing nonconformity for the price setting between Employer and the successful bidder, the latter will be relegated of the construction works of the area previously assigned. It also will not have any right to compensation. The Employer will take the extraordinary decision to pay for the works indicated in administration arrangements when new prices cannot be fixed.

The successful bidder indicates agreement with the prices fixed by the Employer when the materials are used and the works starts without the previous approval of fixed prices.

1.9.4 Price review

The fixed prices will be submitted to examination according to equation 1 when the economic conditions vary during the contract execution.

$$P = P_0 K \quad (1)$$

Where,

P_0 = Original price submitted to examination (€).

P = New price value after the examination.

K = Coefficient calculated in agreement with equation 2.

$$K = 0.15 + a \frac{H_i}{H_0} + b_i \frac{M_i}{M_{oi}} \quad (2)$$

Where,

a = Coefficient

b = Coefficient

H_0 = Labor force index in the date of the offer presentation.

H_i = Labor force index in the date of the examination.

M_i = Material index in the date of the offer presentation.

M_{oi} = Material index in the date of the examination.

Coefficients a and b have the following characteristic: $a + b_i = 0.85$

The indexes shown in equation 2 are official price indexes monthly recorded by the “Comité Superior de precios de Contratos del Estado” which are published in the “Boletín Oficial del Estado” according to the Royal Decree 1098/2001 of October 12. Several K coefficients can be used in the same contract and can be applied for a certain group of prices.

The prices must be submitted to revision when variations are produced in the index values. The Employer will indicate the particular equation and complementary standards to be taken into account during the revision.

If the construction works are extended because they have not finished in the schedule time due to circumstances beyond the control of the successful bidder, the K coefficients cannot be higher to those specified for the proper construction period (before of the deadline). All of these indexes will be applied by the time they will be checked.

All the prices referred to contributions made in Spain will not be considered to be revisable. Moreover, if these prices have elements depending on the economic system, their examination will be limited to fractions depending on economic variations checks at Spain.

The contract may allow the revision of prices with a foreign economic system. The price amount submitted to this examination, with the respective equations in agreement with the contract, will be limited to the obtained value:

- The initial price will be converted into Euros (when fixed in foreign currency) or any other currency change according to the reference date for prices.
- The equation for the contractual price examination will be applied over the initial price, expressed in euros. The current indexes of the foreign countries will be replaced by the indexes of same nature indicated in the contract document.
- The total amount of currencies will be also converted into euros during the examination of prices.

1.9.5 Payment terms

The contract will contain a clause prescribing how the Employer will make the payments for equipment and materials.

The assembly expenses will be completely pay in the date of final acceptance of the facilities, unless otherwise specified in the contract, which also mentions the fraction (expressed in percentage) of the total supplies and services provided by the successful bidder. The latter will not be paid until the warrantee period has ended.

The cost headings of equipment and materials delivered to the assembly area, so as the assembly and the operation of the facilities staff training, will be considered to effectuate the payments indicated in the contract.

1.9.6 Penalties

Penalties can be applied for the successful bidder and the contract can be cancel when:

- The intermediate and end dates of the approved general program of the works are not respected.
- The technique documentation delivery is not delay.
- The equipment is not able to ensure the proper functioning.
- The results obtained from tests does not correspond to adequate values.

The successful bidder is responsible for the expenses caused by the construction works delays, which can also cause the contract cancelation.

The penalties and the contract cancellation will be applied when the successful bidder cannot put remedy to the faults, defects, deviations, etc. and after having introduced the modifications in the equipment. All the remedies must not generate other direct or indirect faults which can negatively affect the Employer. The amount to be paid due to penalties must be quantify and determined in relation to the direct damage cause to the Employer.

The Employer will notify the successful bidder with a certified letter, including an advice of delivery, the application of penalties.

1.9.7 Compensations for the successful bidder

The successful bidder will have the right to ask for compensation in case of events of majeure force or damages and losses caused by the Employer and also must take the more advisable measures in order to avoid any possible damage in materials and facilities as consequence of the schedule of works.

When the successful bidder consider the causes of majeure force have occurred, a written communication must be delivered to the Employer in a maximum deadline of ten days. After this time, the complaints will not be considered. Some causes of majeure force are shown in this general solicitation document for the contracting process in public works.

The Employer is free to indicate the compensations granted to the successful bidder and is also free to decide the inclusion of the compensation requests in the first paragraph of this solicitation document section.

1.9.8 Work cease or postponement. Contract termination

The contract is immediately cancelled when the Employer commands the completely suspension of the works. The contract can also be cancelled by the successful bidder when the Employer postpones the starting of the works for more than one year. The contract cancellation is requested by a written notification and does not imply effects over possible compensations.

The successful bidder may not accept the contract cancellation after a period higher than four months from the date of the notification of the order for service. In this case, the termination of the postponement works can be prescribed. However, if the Employer commands the postponement of works in a period lower than one year, the successful bidder could not cancel the contract but could ask for compensation for damages. The successful bidder can require the provisional reception of the works done if the works have already started when the Employer decides to cancel the contract. Once the construction works have been delivered and the warranty period has come to an end, the works are finally receipt.

The contract is also cancelled if the successful bidder pass away or suffers a disability, unless the successors sign the actual contract without introducing modifications. It is also cancelled due to suspension of payments or bankruptcy. In such case, the Employer only needs to notify the termination of the contract within two months.

The preservation and security measures of urgent character will be the responsibility of the successful bidder, as the Employer commands and without taking into account the damage caused due to the decision of the courts.

In case of breach of the obligations indicated in the contract or non-compliance with the commands of the Employer, the successful bidder will have ten days (except in urgent cases) since the communication of the admonition to fulfil the requirements and demands. After that time passes, the Employer can establish a general or partial intervention. The works already executed will be examined and the materials which are not being used in the construction works will be checked and gave back to the successful bidder.

In this instance, the Employer can require the launch of a new tender in order to receive offerings, can cancel the contract or can propose the abolition of the intervention. The successful bidder can become aware of the progress of the works during the intervention regime, but it cannot obstruct or intervene the Employer orders.

The successful bidder is released from the intervention regime if it justifies its capacity to take care of the works and comply with the contract.

The surplus of expenses resulting from a new contract or the intervention will be taken into account for the total amount to be deliver to the successful bidder, although the profits to be

perceived are not enough. However, if the intervention or a new contract results in expenses reduction, the successful bidder will not benefit and the Employer will be the receiver.

The performed works will be checked when the contract is cancelled. The Employer, the successful bidder and its assignees will also list an inventory of the materials, the equipment and the facilities.

The contract cancellation can be produced by reasons beyond the control of the Employer. In such case, the Employer can call for the permanence in the construction area of the general facilities and the material in order to proceed with the construction works. These materials, equipment and facilities can be used for other companies, chosen by the Employer in order to end the construction works in agreement with the cancelled contract. The Employer will not pay any rent for this service. The materials used in the construction works will be paid according to prices fixed in the cancelled contract or other prices fixed by technical examination.

Nevertheless, if the contract is cancelled in agreement to the Employer commands, the successful bidder and the Employer must be agreed together the selection of the facilities remaining in the construction works area and the compensation that the Employer must pay. Even so, the successful bidder cannot withdraw material, equipment or supporting facilities without the express authorization of the Employer. The Employer will communicate within a four months period from the contract cancellation the materials and equipment that must stay in the construction area. The communication will also include the date for the withdrawal of the materials, the equipment and the facilities which are not going to be used during the works performance.

1.9.9 Regulation

Spanish regulations will control the tender phases and the setting of the contract. The successful bidder must comply with the current Spanish regulations during the contract execution and face the consequences of the non-compliance of the standard and rules.

The successful bidder and the Employer must submit to agreement the differences, disputes and discrepancies which may arise during the execution of the contract in agreement with the Law 60/2003 of December 22 of arbitration.

The arbitration must be equitable and the arbitrators are three engineers. These arbitrators will solve certain points submitted to decision of the notarial contract deed within the period indicated.

The salaries of the arbitrators will be paid by both, successful bidder and Employer, and will be equally divided. The award render by the arbitrators, in good faith, no appeal shall be laid for annulment before de Court of Justice, for the reasons indicated in paragraph three of the article 1696 of the Code of Civil Procedure.

2. Particular solicitation document

2.1 Solicitation document nature

The purpose of these particular technical specifications is to lay down the technical and facultative conditions that must govern the installation of the plant described in this project.

The works of the present project consist in the installation of the necessary equipment and operation of a polylactic acid production plant.

With regard to the definition and finishing of the different work units, it must be considered that all the works, auxiliary means and materials that are necessary for the correct execution and completion of any work unit, according to the criteria of the Director of the works, are considered already included in the price of the same even when they are not specified in the decomposition or description of the prices.

2.2 Mechanical installations

2.2.1 General conditions

The performance of the successful bidder, required by this specification, comprises the following concepts:

- Supply of all the equipment, with the contribution of the fixing material, abarcones, tortilleria, joints and all the necessary accessories for the correct assembly and operation, even when they were not expressly specified, including all the necessary elements to carry out the movement of materials in work, cranes, scaffolding, elements of access and protection, and, in general, of all the auxiliary equipment that are needed.
- Painting and identification of all pipe sections and their corresponding supports and accessories.
- Pressure and tightness tests.
- Revision and commissioning.
- Preparation of the necessary construction and assembly details sketches, which will be submitted to the approval of the Construction Management before their execution.

- Preparation of the "as built" project for all sections, including isometric layouts, plants and details.
- Processing of the necessary permits, providing the appropriate documentation.

For the preparation of the offer, the successful bidder shall:

- Take into account all that you consider necessary for the execution of the installation, even if it is not specified in detail.
- Assess the degree of difficulty in assembling the different networks, foreseeing all types of equipment necessary for their execution.
- Identify in situ the site of the work, in order to take into account in your offer everything that you consider necessary for the development of it, and is not specified in detail.
- To abide by the established rules of health and safety at work, attending at all times to the indications that the Property deems appropriate.
- Take into consideration that the area assigned to you within the land for the storage of materials, offices and services, will be your entire responsibility, both for the materials stored there, tools and assembly equipment, as well as for personal effects and documentation in general.
- Similarly, the work booths for personnel and tools will be at their own expense and must be removed at the end of the work referred to in the offer made.

2.2.2 Materials

The specifications of the materials covered by this Folder, unless otherwise indicated in the plans, shall be as indicated below.

2.2.2.1 Accessories

The accessories, elbows, tees, reductions, etc., will be according to the corresponding DIN standard, taking into account the layout needs in each case.

Joints shall be of the following minimum thicknesses and materials:

- Up to 2 ½": Teflon.
- From 2 ½" to 4": 2 mm metal or plastic.
- 4" to 12": 3 mm metal or plastic.

- From 12" onwards: 4 mm metal or plastic.

2.2.2.2 Supports

Standardised brackets of standard construction may be used where assembly conditions permit. In other cases the supports shall be constructed on site using angular profiles, minimum 60-60-6 mm, or double T-profiles with wide flanges.

Overhead or gallery piping shall be supported at most every 8 m for diameters greater than 6" and every 4 m for other diameters, and adequate intermediate supports shall be provided if necessary.

The supports for subsection of pipes not subjected to thermal stress up to 4" of diameter, will be of round of carbon steel with threaded tips and on nut. For diameters greater than 4", a carbon steel plate will be used to which threaded rod studs with double nuts will be welded to be tied to the support.

2.2.2.3 Pressure vessels

Pressure vessels shall comply with the Pressure Equipment Regulations, both in their dimensioning and in their operating assembly.

2.2.3 Work execution conditions

There are several factors to analyse:

2.2.3.1 Unions

- Pipe connections shall be made by butt welding or cylindrical thread welding, as indicated.
- Accessories, elbows, tees, reductions, etc., will also be joined by means of butt welding.
- Connections to valves are made with neck flanges according to DIN standards.
- The assembly and disassembly joints shall also be made with neck flanges according to DIN standards.
- Heating of the pipe that serves to remedy other alignment effects is not allowed.

- The length of pipes supplied shall be at least 8 m, the average length shall not be less than 9 m.
- They shall not be admitted into the tubes:
 - Laminate cracks or creases
 - Dents.
 - Scratches, corrosions that can attack the mechanical resistance of the tube.
 - Visible internal roughness or flakes that do not attack the mechanical strength of the tube, but are likely to be during operation.
 - All elbows, tees, valves, tubes, etc. must be positioned so that they can be disassembled.
 - At all points, flange bolts, gaskets, etc. can be easily tightened or welded.
 - Where elbows or tees are placed, they shall be attached to both sides so that they cannot be expelled.
 - Trace interferences.

In order to avoid pipe crossings of the same height, no elbows should be formed upwards, unless expressly indicated by the Site Manager.

Where two or more elbows are to be placed in a section and mounted in such a way as to avoid points of air accumulation, and where these are unavoidable, an automatic bleeder shall be installed in them.

2.2.3.2 Curved pipes

All pipe smaller than 1 ½" (38 mm) diameter will be cold bent, respecting the circular section along the curved development.

Pipes with a diameter greater than 1 ½" (38 mm) will use N-3D curves (DIN 2605).

Bent tubes will have a constant radius of curvature at all points, being free of folds, deformation, thickness variations, etc.

2.2.3.3 Soldering

The tubes are to be butt welded and overlap welding is not permitted. The material required for arc welding shall be borne by the successful bidder.

For the execution of the welds if it is necessary the interior cleaning of the metallic tube will be required by step of a brush. Your calibrated extremities will be verified with the help of a calibrated stopper.

The tube will be aligned so that its axis is confused with the preceding one and the ends to be welded will be held in place during bridging with the aid of an appropriate device. Preferably, this device will be inserted in the tube and should prevent the ovalization of the tube by expansion of the latter. Any unevenness of the edges greater than 1.2 mm will not be tolerated.

The play between the tubes must be such that in the execution of the weld the fusion of the base metal affects the entire thickness of its wall. Welding accesses will be rid of all traces of bodies of mineral or organic origin.

No weld drop will be tolerated inside the tube.

The penetration of the weld will be regular, contrary to the joints, it will be of weak volume and its thickness will be such that the sum of its value and of the eventual unevenness of the edges will not be able to exceed 16 mm. The deposited metal cord shall have no holes or lateral grooves.

The welders involved in the work must present the certificates of approval and qualification granted by the competent authority. The qualification of the welders and the radiographic reception of the welds is done as indicated below:

- Lack of penetration: welded joint not interested in the whole thickness of the tube wall. A maximum length of 25 mm of non-penetrated weld shall be permitted only when it lies between two recognised defect-free seams of 150 mm unit length.
- Collage: welded joint by which the base metal of the tube has not been melted. A maximum length of 25 mm of unfixed weld shall be permitted only when it lies between two recognised flawless beads of 150 mm unit length.
- Blows: A maximum cumulative length of 25 mm per 100 mm of bead will not be admitted except if the bead is repaired by 300 mm of defect-free weld.
- Gaseous Inclusions: Its length shall be less than 3.5 mm shall not be defined.
- Slag inclusions: Same as blowings.
- Aligned slag inclusions: The slag line may not have a maximum length of 50 mm and a maximum thickness of 1.5 mm more than if the affected cord is between two recognized blowers without defect of 300 mm minimum unit length.
- Lateral channels or grooves: A continuous channel of 4/10 mm can only be tolerated if the length is greater than 25 mm.
- Craters on the surface of the cord: Its depth shall be less than 4/100 mm.
- External oversize of the cord: Between 1 and 3 mm.
- Penetration and misalignment: The thickness of these two accumulated defects shall be less than 1.6 mm.
- Cracks: Forbidden.

The above defects may be accumulated over a maximum length of 50 mm provided that this accumulation is between two welds without defect, having a minimum length of 300 mm. In no case shall the total length of the defect combinations exceed 10% of the welded seam length.

With regard to the identification of welds, the Awardee shall have in two copies a welding notebook, in which it shall be indicated:

- The weld number (the same number may not designate two different welds).
- The manufacturing number of the tubes.
- The marking of welds in relation to well-determined marks.
- The indicative of the welder who executed the weld.
- The characteristics of the electrodes used.
- The execution date.
- The date of the grammatical examination.
- The indicative of the controller.
- The date and results of the grammagraphic tests.
- The exact lengths of the straight and shortened tubular elements between two welds.

Any weld recognized as defective at the examination or leak test indicated below shall be repaired at the expense of the Awardee.

The repair will be carried out either by local repetition of the defect or by complete replacement of the defective weld.

When the local repetition affects the first pass (background pass), every precaution will be taken to ensure that the penetration meets the above specifications. The complete replacement of the final weld will be carried out by welding a bead, replacing the removed weld.

Each replaced weld, locally or in its entirety, will be recorded in the "weld notebook", following the above specifications, plus in the case of a localized intervention, the length of the repaired bead and the method of execution will also be recorded.

2.2.3.4 Tightness and pressure tests

Once a fluid network has been assembled, it should be verified by checking the tightness of the flange bolts, that all the bolts exist in the flanges and that there are joints between them. In the case of threaded joints, the joint (Teflon tape) should be checked. The valves shall be checked for correct position, open or closed as appropriate.

Once the above check has been carried out, the leakage test shall be carried out using water at room temperature and working pressure for a period of 24 hours.

Pipe pressure tests shall be carried out for 60 minutes at 1.5 times the normal working pressure, for which the successful bidder shall provide the necessary elements.

All costs incurred by these tests shall be borne by the successful bidder, as well as any corrections to be made until the required results are achieved.

2.2.3.5 Supports and structures

This section establishes the technical conditions required for the supply and assembly of the supports necessary for the pipes covered by the specification:

Design of materials and manufacture

The materials to be used will be those indicated in the plans. All the sheet materials to be used by the supplier must be guaranteed by quality certificates from the iron and steel industry.

Laminated profiles are sufficient if they bear the quality mark printed on the lamination relief.

All welding filler materials will be guaranteed by their quality certificates. This material will be controlled during the manufacturing processes and repair of elements to verify that the material used is as specified.

Welded units

The installer will be fully responsible for ensuring that the work, both workmanship and execution, meets the required specifications.

All welding shall be carried out by one of the following procedures:

1. Manual arc with coated electrode.
2. Semi-automatic with carbon dioxide (CO₂) protection or inert gas with solid electrode.
3. Automatic with submerged arc.

The installer shall submit for approval the welding procedures to be used, which shall include as a minimum:

1. Edge preparation.
2. Position
3. Process used, with indication of parameters.
4. Characteristics of the filler metal.
5. Sequence and number of passes.

6. Preheating temperatures and method.
7. Final heat treatment, if applicable.

The mechanical characteristics of the deposited metal shall be at least those indicated for the base material.

No welding, even provisional, shall be permitted for non-approved welders.

2.2.4 Paintings and insulations

2.2.4.1 Pipes and accessories

The pipes will be sandblasted, grade Sa 2 ½. Carbon steel pipes shall be treated as indicated:

1. Cleaning. The outer surface of pipes, curves, etc. will be cleaned by scraping, manual brushing with a steel brush to leave the surface in a degree of finish corresponding to St-2.
2. Once the pipe has been cleaned according to the procedure indicated above and immediately afterwards, it will be given a coat of primer with a minimum thickness of 40 micrometres of dry film.
3. Finished. Based on two coats of acrylic paint, both coats being of different tones and with a thickness of 35 micrometres of dry film each.

2.2.4.2 Supports

Supports shall be treated as indicated:

1. Cleaning with sandblasting, grade Sa 2 ½.
2. Anticorrosive primer, with a thickness of not less than 40 microns, and a high thickness (80 microns) chlorinated rubber base coat.
3. Finish based on two coats of acrylic paint, both being of different shades and with a minimum thickness of 50 microns each. The color and tones will be chosen according to the Employer.

2.2.5 Quality control, inspection and tests

2.2.5.1 Quality control. General requirements

The successful bidder shall carry out and maintain a Quality Control Plan.

The successful bidder shall control the documents, procedures and reports related to the quality of the equipment. The Property or its representative shall have access to these documents, procedures and reports when required.

The successful bidder shall identify, document and notify to the Employer all breaches or deviations from the requirements of this specification.

At the end of the works the documentation generated in the works will be delivered to the Employer.

2.2.5.2 Tests and trial in pipelines

Non-destructive testing

The successful bidder shall be responsible for all non-destructive examination and testing of pipelines supplied under this specification.

The Property shall have the authority to stop work or withhold shipment if the specification requirements, including those relating to documentation, have not been met.

All non-destructive testing will be performed by qualified personnel.

Welds to be examined

Pipe equal to or greater than 2" (51 mm) will be radiographed at its weld by 5%.

If the rejection rate is higher than 10% of the inspected welds, 100% will be supervised. In addition, the welds that are included in lines with pressure test cannot be submitted to it will also be radiographed.

In welds that are not going to be volumetrically examined and whose execution is carried out by root sanitizing, the correct sanitizing will be controlled by means of an examination of penetrating liquids.

All weld repairs will be examined for penetrating liquids or magnetic particles. Major pipe repairs will be X-rayed. In those welds that are not X-rayed, the inspection by penetrating liquids will be applied.

Examination procedures

RADIOGRAPHIC EXAMINATION

Acceptance procedures and standards shall be in accordance with the ASME code, section V. The final interpretation of the film and the acceptance or rejection of the film and welds shall be effected by the Employer.

The successful bidder shall inspect and accept the film and welds prior to submitting them to Employer supervision. The film will be radiographed ASTM E94 1 or 2. The acceptable film density across the weld metal will be 2.0 to 3.8 for easy review. The single vision double film X-ray technique shall be used.

For the x-ray of pipes, a numbered belt will be placed over the pipe to locate its defects. The belt will consist of lead numbers between 6.4 and 12.7 mm high, and will be spaced exactly 24.5 mm for pipe sizes from 2 ½" to 8".

No holes shall be made in the piping for x-rays without the written approval of the Employer.

EXAMINATION FOR PENETRATION LIQUIDS

Acceptance procedures and standards shall be in accordance with the ASME code. The use of water-removable penetrating liquids is not permitted.

Wall thickness gauges

A minimum of four wall thickness measurements shall be made, spaced 90° apart over the ends of all pipes and fittings or as required by the Employer when wall thickness is specified by the minimum wall in the Line List. Acceptance of pipe and fittings shall be based on the specified minimum wall plus measurement tolerance.

Thickness measurements and your situation will be reflected in your report and a copy will be sent to the Employer for approval.

2.2.5.3 Hydrostatic tests

After installation, all manufactured assemblies will be hydrostatically tested in accordance with the ASME code.

The successful bidder shall guarantee his work as being able to withstand such a test.

The following inspections and supporting tests are distinguished:

Inspections in the welds.

The successful bidder shall carry out the inspection of the welds in accordance with this specification, the scope of which shall be that indicated in the section.

The welds will be inspected visually at 100%. In addition, 5% shall be inspected by sampling with penetrating liquids or, alternatively, with magnetic particles.

Where the inspection by sampling finds that the corresponding weld does not meet the minimum quality requirements, an inspection of an additional 10% sample shall be carried out by X-ray.

This sample to be examined additionally will be the one selected by the Employer.

If additional inspection reveals that the weld meets the minimum quality requirements of this specification, the defects previously detected will be repaired and the welds will be considered acceptable.

If the additional sample examined reveals that the weld does not meet the minimum quality requirements of this specification the remaining welds will be fully inspected by X-ray and the weld that does not meet the acceptance standards will be removed, welded and inspected again

Radiographic inspection

INSPECTION PROCEDURE

- The radiographic examination shall be carried out in accordance with Article 2 of Subsection A, Section V of the ASME Code and using the radiographic technique specified in SE-94.
- The density of the film shall be in accordance with ASME section V, subarticle T-234.

ACCEPTANCE CRITERIA

The following defects shall be unacceptable:

- Any crack, lack of fusion or lack of penetration, whatever its length.
- Any porosity above that accepted in Appendix IV Section VIII of the
- ASME Code.

- Any group of in-line indications whose sum of lengths is greater than T in a $12T$ length and the distance between two contiguous indications is less than $6L$, with T being the thickness of the weld and L being the longest length of the group.
- Any linear indication whose length is greater than (T being the thickness of the weld):
 - 6 mm for $T \leq 19$ mm
 - $1/3 T$ for $16 \leq T \leq 57$ mm
 - 19 mm for $T > 57$ mm

Inspection with penetrating liquids

INSPECTION PROCEDURE

It shall be done in accordance with Article 7 of Section V of the ASME Code following the recommendations of the manufacturer of the penetrating liquids used in the inspection.

ACCEPTANCE CRITERIA

The following defects shall be unacceptable:

- Round indications with a size greater than 5 mm.
- Any crack, whatever its length.
- Four or more round in-line indications, less than 1.5 mm from edge to edge spaced apart.
- Any linear indication the length of which is greater than 1.5 mm from edge to edge.

Inspection with magnetic particles

INSPECTION PROCEDURE

It shall be done in accordance with section V of the ASME code using the most suitable method according to the geometry of the part.

ACCEPTANCE CRITERIA

They will be the same as in the case of inspection with penetrating liquids.

Visual inspection

ACCEPTANCE CRITERIA

Butt weld seams which are over-thicker than indicated shall be considered defective and shall be repaired by grinding:

- Sheet thickness up to 25 mm.
- Maximum excess thickness 2.4 mm

Welding seams with depth bites greater than 0.8 mm should also be repaired.

2.2.5.4 Repair of welds

In case of doubt about the goodness of a weld, the Property will be able to carry out higher level inspections on its own. If such inspections show that the welds are unacceptable, the cost of the welds and their repair shall be borne by the Awardee.

All welding repairs shall be carried out in accordance with approved procedures and supervised according to specified methods.

2.2.5.5 Dimensional control

The Awardee will carry out dimensional checks of the main measurements, dimensions of the welding beads, parallels, drills, verticals, fullness, dates, etc., verifying that they are within the tolerances.

The Awardee shall report the results of these checks. In particular cases, presentations should be provided for.

2.3 Concrete work

2.3.1 General

All materials, supplies, execution, etc., must conform to the current UNE standards of application, except for the most rigorous concepts mentioned in this Specifications.

2.3.2 Materials

2.3.2.1 Cement

The cement to be used in the execution of the works will be type II/35.

The successful bidder shall inform the Site Management of the manufacturer that will supply the cement and its trade name, attaching the manufacturer's warranty that its product meets the required conditions.

Neither the supplier nor the type of cement shall be changed during the execution of the work without the authorization of the Site Manager.

2.3.2.2 Water

The standard shall be applied within the corresponding current UNE standards.

2.3.2.3 Aggregates

The size of the aggregates will be 30 mm. Special care will be taken to maintain the same characteristics in the aggregates supplied, monitoring the variations of the quarry front and changes in humidity, in order to avoid dispersions in the resistance of the concrete.

The successful bidder shall provide the supplier with access to the place of manufacture and origin of the aggregates in order to carry out the appropriate verifications.

2.3.2.4 Dosage

During the execution of the work, the initial dosage will be maintained, unless the characteristics of any concrete component vary, in which case tests will be carried out to determine the new composition.

2.3.2.5 Additives

The use of any additive in the concrete is not foreseen. In the event that the need for the use of a certain type of additive is contemplated, this will need the approval of the Construction Management, for which the Awardee will propose the Supplier and the type of product, attaching the technical specification of the same.

In addition, preliminary tests will be carried out in order to assess the extent to which the strength of the concrete is modified.

2.3.2.6 Armor

AEH-500 S weldable rebar will be used to reinforce the concrete.

The dimensioning and arrangement of the reinforcements will be carried out as established in the plans of the Project.

The successful bidder shall deliver to the Site Manager the manufacturer's warranty certificate, which shall also indicate that it is suitable for welding and the conditions and procedures in which it must be carried out.

In the case of the use of connecting rod elements such as threaded sleeves, CAD weld, etc., these must be approved by an official body in the field. In any case, the tensile strength of the tensile strength at break shall meet the following requirements:

- Breakage outside the joint: higher than the breaking load of the smallest of the bars to be joined.
- Breakage at the joint: greater than 1.2 times the breaking load of the smallest of the bars to be joined.

2.3.2.7 Concrete

The cleaning concrete will be H-100. The concrete of all the elements will have the following characteristics:

- H-200.
- Plastic consistency. If you pump plastic-soft.
- Vibrating.

2.3.2.8 Engines and additives

The successful bidder shall deliver to the Construction Management for approval the type and brand of the special mortars and adhesives, as well as their technical characteristics.

2.3.3 Supplies

The manufacture of the concrete, as well as the transport, must conform to the standard within the updated UNE standards. The successful bidder will present the technical and functional characteristics of the concrete plant, which will have to comfortably overcome the needs of the work at peak times.

In order to ensure the supply of concrete to the site, the plant will have sufficient stockpiled materials to produce concrete at maximum production for ten hours.

The plant will have for its handling specialized personnel in this work, and will maintain the same personnel in order to assure a homogeneous concrete.

The plant shall have the necessary means to determine the quantity of water in the aggregates and to be able to correct the quantity of mixing water.

The transport to the point of discharge will be carried out with rotating vats with fixed blades.

2.3.4 Commissioning work

The concrete will be placed on site in accordance with the instructions set out in the subsections below.

2.3.4.1 Water

It is totally forbidden to add water on site in the transport tanks to the processed concrete coming from the concreting plant.

2.3.4.2 Placement

Special care should be taken for continuous pouring and, if necessary, they should be laid out with suitable pipes, so that in no case will the mixture be disintegrated.

2.3.4.3 Compaction

The compaction of the concrete will be carried out by vibrating, using qualified personnel and avoiding as much as possible the contact of the vibrator with the reinforcements.

Internal needle vibrators must be used, with a frequency of not less than 6000 cycles/min.

Special care will be taken in the execution of the concrete at levels below the water table to avoid water filtrations.

2.3.4.4 Thickness of concrete

When the piece to be concreted has the three dimensions greater than 2 m, the successful bidder may choose either to interrupt the pouring so that the vertical dimension has 24-hour waiting times at each height of 2 m, or to place thermocouples (or copper tubes and thermometers) at the points furthest from the surface, stopping the pouring of the concrete when it exceeds 60 °C. The successful bidder may also choose to place thermocouples (or copper tubes and thermometers) at the points furthest from the surface, stopping the pouring of the concrete when it exceeds 60 °C.

The successful bidder must propose the thicknesses after having investigated maximum temperatures at 24 hours.

2.3.4.5 Concrete joint

Whenever a concrete joint is made below the water table, a watertight joint and an adhesive joint of the old and new concrete is available. Before applying the adhesive, the joint should be cleaned of any loose dirt or aggregate. The surface layer of the mortar should be minced and removed, leaving the aggregate uncovered.

2.3.4.6 Shoring, formwork and stripping

As a general rule, the stripping time for any structural element shall not be less than 72 hours, unless the Project Management authorizes a shorter period or requires a longer one.

The removal of the shoring for stripping shall not be permitted until the period considered necessary by the Site Management for stripping has elapsed.

2.3.5 Control

The tests that are carried out will be charged to the Awardee, through a specialized company.

On site there will be available, for the control, of tape measure, ruler, level, plumb, thermometer, Abrams cone, seven specimen moulds with plate and retacator.

2.3.5.1 Concrete

The control tests shall be carried out in the mode of statistical control on a normal scale. The definition of the parts of the work will be made in agreement with the Direction of Work, in view of the planning of the concreting.

2.3.5.2 Armor

The control is performed at the normal level.

2.3.5.3 Forms and layout

Concreting shall not be carried out without the prior approval of the Construction Management, checking the arrangement and diameter of the reinforcement, geometric shape, condition of the surfaces against which the concrete will be concreted, etc.

2.3.5.4 Informative essays

The Construction Management reserves the right to demand from the successful bidder, when it deems it necessary, informative essays.

2.3.6 Parts and assemblies' receipt

For the reception of a part, the controls carried out must have been positive and the geometric tolerances must be complied with.

The reception of a set requires the acceptance of each of the parties.

In the event that a part is not suitable for reception, the Site Manager will study and decide whether or not to demolish it, repair the part, and carry out information tests or load tests and other types of checks to determine whether the part can fulfil the functions for which it was intended. If a piece is accepted in conditions not suitable for reception, the Awardee shall submit to the Site Manager a proposal for compensation.

2.3.7 Measurement

Measurements shall be made on a plane. The successful bidder may, in special cases, propose to the Construction Management another type of measurement for approval.

2.3.8 Deliverable documentation

On receipt of the work, the Awardee will deliver a complete dossier with the guarantee and quality certificates for all the materials used, as well as the certificates for all the tests and inspection carried out.

2.4 Electrical installation

2.4.1 Object

The successful bidder performance, required by this specification, covers the concepts shown below.

2.4.1.1 Low voltage power systems

Control cabinet B.T.

Discharge, assembly, levelling, assembly and connection of the B.T. switchgear cabinet: for services and battery charges.

B.T. Cables Command

Discharge, laying, connection and testing of those belonging to: power B.T. cables, command/control cables, and instrumentation cables.

2.4.1.2 Installations of current socket and lighting

Supply and installation of lighting equipment and sockets for the equipment plant, control room, outdoor and surrounding roads.

2.4.1.3 Ground net

Supply and installation of the plant ground network.

It must be taken into account that the buried mesh of the ground net must be installed at the time of making the foundations, without waiting for the equipment installation period.

Likewise, mesh branches that pass-through pavements and reinforced concrete slabs must be electrically joined to the steel mesh of the pavement itself.

2.4.1.4 Several

Supply and installation of the trays and tubes necessary for the laying of the cables previously related.

The supply of the trays includes the corresponding special pieces, supports to fix the rack of existing pipes or structures or to install others.

Supply and installation of cable glands in all cabinets. Supply and installation of terminal bottles and their supports.

2.4.2 Applicable regulation

They are the set of specifications, plans and documents related to these Terms and Conditions.

They shall also apply:

- Low Voltage Electrotechnical Regulations (B.O.E. September 18, 2002)
- Complementary Technical Instructions.
- Applicable UNE standards, in their latest revision.
- Applicable EU rules and regulations.

2.4.2.1 Quality and execution of work

You will agree to the terms of this specification.

Low voltage panels, control centers and various panels

The successful bidder will install, assemble and supply the different panels described, being its responsibility its electrical and mechanical assembly with the specific tolerances, as well as the supply and laying of the interconnection cables.

It must also follow the manufacturer's recommendations for fixing and levelling.

When, due to transport limitations, shipments are made in different consignments, they must be coupled and connected, both electrically and mechanically.

The entire interior must be cleaned and the necessary paint retouches must be carried out.

All protections shall be properly regulated and all interlocks checked where appropriate.

The connections of the power and control cables shall be made by fixing the cable to the inside of the panel and leaving a loop or lyre on each wire, so that the connection terminals cannot be subjected to stress by the conductor.

Check the tightness of all connecting screws and the existence of all bridges indicated in the applicable diagrams.

All the power conductors must keep the same order of connection phase-identification of the conductor, so that this order of phases is the same in any point of the installation.

In addition to indicating the number of the cable corresponding to each wire, the control conductors shall bear the number of the auxiliary terminal where it will be connected and the number of the original terminal block, as well as the reference to the terminal strip.

The interconnecting conductors shall bear the reference and terminal number to which the other end of the conductor will be connected.

Before carrying out any type of test, it must be verified that the size and setting of the circuitbreakers are as indicated in the corresponding diagram, as well as that the cable cross-section and terminal sizing are correct.

Cable entries shall be made through suitable cable rings.

Terminal strips shall be mounted in accessible locations, with sufficient space for inspection, maintenance and connection of external cables.

The cable shields are installed by means of macaroni up to the connection points on the corresponding terminal strips.

CABLES

Measures shall be taken to ensure that cables are not subjected to excessive stresses during installation. In any case, the radius of curvature of the cables will always be more than ten times the diameter.

The laying will be made on tray or directly in the channels arranged for it. In any case, they shall be grouped by voltages and the groups corresponding to each voltage shall be separated in order to avoid disturbances caused by induction.

The cables should be protected between the floor or pavement level and 2.5 m above it from possible mechanical damage, by placing them inside protection tubes or in a tray with a protection cover.

The cables will be installed on trays by laying them one next to the other along the tray and fixing them to it by means of polyester rope or polyamide flanges, UNEX brand or similar. The fixation will be made individually by cable and a fixation will be arranged every two meters in the case of horizontal disposition of the tray, because if this one is arranged in a vertical plane the fixation of the cables will be made every meter.

Different trays will be used for:

- High voltage cables.
- Power cables and low voltage control.
- Official measurement cables (under tube).
- Control cables.

In general, the trays on the upper levels will be used to lay the high voltage cables.

No more than two layers of cables shall be laid on horizontally arranged trays, where the tray layout is vertical, only one layer of cables shall be installed.

Special care shall be taken in the installation of the tray and the laying of cables on it, when in the path of the tray it must pass through expansion joints of structures or it has to link two structures between which there may be movements or relative displacements.

In these cases the tray must be cut and leave a curve in all the cables laid in it, so that it allows the movements of the structures to which they are supported without being subjected to tensions or efforts.

Network of then to earth and lightning conductor

GENERAL CHARACTERISTICS

The earthing installation shall be suitable to achieve an efficient earthing of the equipment, masses and structures of the installation.

It shall be carried out in accordance with the provisions of the Rules and Regulations previously indicated in these Conditions and with the plans drawn up for this purpose.

The chemical electrodes will be installed according to the manufacturer's instructions.

Ground busbars shall be installed in such a way that they are accessible, but in such a way that they do not interfere with or hinder the laying or installation of other elements or systems.

Ground busbars shall be fixed to walls or structures using, in the case of metal structure fixation, devices that electrically isolate the busbar from the supporting structure.

Overhead taps and connections to equipment shall be made using terminal clamps of appropriate dimensions to the cables to be connected. In the case of screws, suitable elements (grover washer, lock nut, etc.) must be provided to prevent loosening.

The successful bidder will test the grounding system in order to determine the continuity of the cable and connections. It will also measure the ground resistance of each of the electrodes before they are connected to the system.

All the cable tray systems of the installation (tubes, trays, etc.) in the case that they are metallic, will be connected to earth at the beginning of their routes, being considered as such the one that is closest to the low voltage panel.

The shield and armor of the high voltage cables will be grounded at the power points. The shield and armour, when both exist together, will connect to each other at the connection points and at the splices. These connections will also be made to the equipment housings at the cable termination points, by means of corresponding cable glands or terminal bottles. In no case shall the armature be considered as a protective conductor.

Signal cable shields shall be connected to an independent ground.

Grounding of non-conductive metal parts of medium-voltage supply equipment shall be carried out by direct connection to the "Protective Grounding System" system.

All metal parts associated with electrical equipment (rails, supports, structures, etc.) that do not contain live parts shall be connected directly to the "Protective Grounding System".

The connection to equipment and structures will be made by means of screwed clamps that allow the disconnection of the conductors when one wants to verify the earthing systems.

The shields of all instrument cables will be grounded to the corresponding instrument.

EXECUTION OF THE INSTALLATION

The successful bidder, once the earthing installation has been completed, will check that the passage voltage and contact voltage at the various points of the plant are lower than the tolerated ones.

In the event that the measured stresses are higher than tolerable in any part of the plant, mesh elements will be added until lower than tolerable stresses are achieved.

Where necessary, grounding continuity bridges shall be used in all cable trays.

Metal structures which are not welded or bolted together when they are joined shall be connected by means of bridges which guarantee the electrical continuity of the assembly.

The successful bidder shall verify that all connections and bolted joints are properly tightened.

The successful bidder shall collaborate with the Civil Works Clerk to properly assemble the electrode registers, as well as for any other work related to the ground installation.

Records will be levelled, marked and provided with recordable lids.

All cable laying will be carried out in a single run, avoiding splices.

Whenever possible, power cable trays should be used.

The minimum distance between electrodes of the same earthing system shall be three (3) meters.

The electrode must be connected to the earth cable by means of a clamp or a screwed clamp so that the earth resistance of the electrode can be checked at any time, independently of the mains.

The ends of the electrodes in which the connection to the earth cable is made shall be accessible for inspection and periodic verification, for this purpose, for each electrode there shall be a register or chest with a lid allowing such tasks.

Each register or pit shall have markings indicating the grounding system to which the electrode installed there belongs.

HARDWARE

When the supports are to be fixed by means of concrete or mortar, the civil work Subcontractor shall carry out such fixation and the electrical Subcontractor shall supply such supports, giving the former sufficient details for its correct situation.

In the cases in which the fixing of the supports is by means of welding, staples, expansion bolts, etc., the installation will be carried out by the electrical subcontractor himself, who will protect the welding of the support to the metallic structure, after its cleaning, with two coats of primer with paint.

The welding procedures to be used by the Subcontractor, both for the manufacture of the supports and for their installation, will be approved by the Construction Management.

Welding of supports to pipes, vessels or equipment is strictly prohibited, given the possibility that heat treatment may be required.

The successful bidder must consult with the Site Management before carrying out any welding and obtain prior written authorization from the latter.

Metallic structures may not be drilled without the written authorization of the Site Manager.

The supports shall be dimensioned, unless otherwise indicated, in such a way that there is a sufficient distance (150 mm minimum) between the supported end and the supporting surface, in order to allow subsequent painting work, fire protection, heat insulation, etc.

All supports and fixings shall be suitable for the function for which they are intended and shall be spaced as closely as possible to avoid excessive deflection, so as to achieve a good appearance and completion of the work.

Handrails may not be used to secure any type of support.

Before beginning the manufacture of any type of support, the Subcontractor must have the approval of the Construction Direction of the sketch of the same.

Care should be taken to avoid fixing supports and, consequently, trays, tubes, etc., to places where excessive vibration or expansion phenomena may damage instrument ducts. Likewise, the attachment to equipment whose maintenance involves frequent disassembly should be avoided.

2.4.3 Inspections, tests and receipt

The successful bidder shall carry out all the tests and trials of circuits and equipment, as well as those required by the Property, providing the necessary manpower and means, in accordance with what is indicated in this document.

In general, the following tests and trials are included without limitation:

- Necessary tests to have the guarantee of the manufacturers.
- Phase-to-phase and phase-to-ground insulation testing of all cables.
- Insulation level.
- Continuity tests and measurement of the resistance of the earth network and of step and contact voltages.
- Checking of polarities and phase sequences.
- Night check of the lighting system.
- Certifications of all tests.

In particular, testing of cables shall be carried out immediately after the cables are laid and before making the connection. The wiring will be checked for correct identification, continuity

and insulation resistance between conductors and between conductors and ground. These continuity and insulation resistance tests shall be performed using appropriate equipment to comply with applicable regulations.

2.5 Equipment in the facilities

2.5.1 List of equipment

The polylactic acid production facility has the equipment shown in tables 1 and 2.

Table 1. Equipment of the polylactic acid production facility.

Code	Equipment item	Code	Equipment item
TK-101	Storage tank	E-402	Reboiler
E-101	Evaporator	P-401 A/B	Centrifugal pump
EJ-101	Ejector	V-401	Vapour-Phase Separator
E-102	Condenser	EJ-401	Ejector
P-102 A/B	Centrifugal pump	E-403	Condenser
V-101	Vapour-Phase Separator	V-402	Vapour-Phase Separator
R-201	Reactor	EJ-402	Ejector
EJ-201	Ejector	T-402	Distillation column
EJ-202	Ejector	E-404	Condenser
P-201 A/B	Gear pump	E-405	Reboiler
V-301	Vapour-Phase Separator	P-402 A/B	Centrifugal pump
P-301 A/B	Gear pump	V-403	Vapour-Phase Separator
E-301	Heat exchanger	EJ-403	Ejector
R-301	Reactor	V-404	Vapour-Phase Separator
P-302 A/B	Gear pump	EJ-404	Ejector
E-302	Condenser	E-406	Condenser
T-401	Distillation column	E-407	Heat exchanger
E-401	Condenser	P-403 A/B	Centrifugal pump

Table 2. Equipment of the polylactic acid production facility (Continuation).

Code	Equipment item	Code	Equipment item
T-403	Distillation column	R-501	Reactor
E-408	Condenser	P-501 A/B	Gear pump
E-409	Reboiler	R-502	Reactor
EJ-405	Ejector	P-502 A/B	Gear pump
EJ-406	Ejector	X-601	Extruder
V-405	Vessel drum	E-601	Heat exchanger
P-404 A/B	Centrifugal pump	V-602	Vapour-Phase Separator
P-405 A/B	Centrifugal pump	EJ-601	Ejector
E-410	Heat exchanger		

2.6 Specification sheet of the equipment

Table 3. Specification sheet for pumps P-101 A and P-101 B.

Pump P-101 A/B	
Type	Centrifugal
Efficiency (%)	45%
Power (W)	325.80

Table 4. Specification sheet for pumps P-102 A and P-102 B.

Pump P-102 A/B	
Type	Centrifugal
Efficiency (%)	45%
Power (W)	713.90

Table 5. Specification sheet for pumps P-201 A and P-201 B.

Pump P-201 A/B	
Type	Gear
Efficiency (%)	50%
Power (W)	181.26

Table 6. Specification sheet for pumps P-301 A and P-301 B.

Pump P-301 A/B	
Type	Gear
Efficiency (%)	80%
Power (W)	245.44

Table 7. Specification sheet for pumps P-302 A and P-302 B.

Pump P-302 A/B	
Type	Centrifugal
Efficiency (%)	80%
Power (W)	43.46

Table 8. Specification sheet for pumps P-502 A and P-502 B.

Pump P-502 A/B	
Type	Gear
Efficiency (%)	80%
Power (W)	136620.35

Table 9. Specification sheet for pumps P-401 A and P-401 B.

Pump P-401 A/B	
Type	Centrifugal
Efficiency (%)	45%
Power (W)	411.96

Table 10. Specification sheet for pumps P-402 A and P-402 B.

Pump P-402 A/B	
Type	Centrifugal
Efficiency (%)	70%
Power (W)	10755.59

Table 11. Specification sheet for pumps P-403 A and P-403 B.

Pump P-403 A/B	
Type	Centrifugal
Efficiency (%)	45%
Power (W)	2663.76

Table 12. Specification sheet for pumps P-404 A and P-404 B.

Pump P-404 A/B	
Type	Centrifugal
Efficiency (%)	70%
Power (W)	976.25

Table 13. Specification sheet for pumps P-405 A and P-405 B.

Pump P-405 A/B	
Type	Centrifugal
Efficiency (%)	45%
Power (W)	2958.09

Table 14. Specification sheet for pumps P-501 A and P-501 B.

Pump P-501 A/B	
Type	Gear
Efficiency (%)	80%
Power (W)	100144.28

Table 15. Specification sheet for ejector EJ-101.

Ejector EJ-101	
Type	Steam jet ejector
Motive steam (kg/h)	7383.36
Utility	High pressure steam
Suction pressure (kPa)	6.50
Compressibility ratio	7.69

Table 16. Specification sheet for ejector EJ-201.

Ejector EJ-201	
Type	Steam jet ejector
Motive steam (kg/h)	843.15
Utility	High pressure steam
Suction pressure (kPa)	35.00
Compressibility ratio	1.43

Table 17. Specification sheet for ejector EJ-202.

Ejector EJ-202	
Type	Steam jet ejector
Motive steam (kg/h)	2797.90
Utility	High pressure steam
Suction pressure (kPa)	50.00
Compressibility ratio	2.03

Table 18. Specification sheet for ejector EJ-301.

Ejector EJ-301	
Type	Steam jet ejector
Motive steam (kg/h)	3765.56
Utility	High pressure steam
Suction pressure (kPa)	2.50
Compressibility ratio	2.40

Table 19. Specification sheet for ejector EJ-401.

Ejector EJ-401	
Type	Steam jet ejector
Motive steam (kg/h)	640.54
Utility	High pressure steam
Suction pressure (kPa)	2.00
Compressibility ratio	7.50

Table 20. Specification sheet for ejector EJ-402.

Ejector EJ-402	
Type	Steam jet ejector
Motive steam (kg/h)	599.05
Utility	High pressure steam
Suction pressure (kPa)	15.00
Compressibility ratio	6.76

Table 21. Specification sheet for ejector EJ-403.

Ejector EJ-403	
Type	Steam jet ejector
Motive steam (kg/h)	36.57
Utility	High pressure steam
Suction pressure (kPa)	2.00
Compressibility ratio	7.50

Table 22. Specification sheet for ejector EJ-404.

Ejector EJ-404	
Type	Steam jet ejector
Motive steam (kg/h)	22.32
Utility	High pressure steam
Suction pressure (kPa)	15.00
Compressibility ratio	6.76

Table 23. Specification sheet for ejector EJ-405.

Ejector EJ-405	
Type	Steam jet ejector
Motive steam (kg/h)	1341.28
Utility	High pressure steam
Suction pressure (kPa)	2.00
Compressibility ratio	7.50

Table 24. Specification sheet for ejector EJ-406.

Ejector EJ-406	
Type	Steam jet ejector
Motive steam (kg/h)	4180.01
Utility	High pressure steam
Suction pressure (kPa)	15.00
Compressibility ratio	6.75

Table 25. Specification sheet for ejector EJ-601.

Ejector EJ-601	
Type	Steam jet ejector
Motive steam (kg/h)	242.31
Utility	High pressure steam
Suction pressure (kPa)	6.50
Compressibility ratio	4.62

Table 26. Specification sheet for reactor R-501.

Reactor R-501	
Temperature (°C)	180
Pressure (kPa)	30
Type	Stirrer storage tank
Volume (m ³)	2.82
Diameter (m)	1.03
Height (m)	3.08

Table 27. Specification sheet for vessel V-301.

Vessel V-301	
Temperature (°C)	160
Pressure (kPa)	35
Type	Stirrer storage tank
Volume (m ³)	3.36
Diameter (m)	1.25
Height (m)	2.50

Table 28. Specification sheet for vessel V-101.

Vessel V-101	
Type of vessel	Vertical
Pressure (kPa)	50
Temperature (°C)	85
Thickness of the shell (mm)	12.70
Length (m)	10.479
Diameter (m)	2.502
Hold-up time (min)	10.000
Mass of the shell (kg)	8356.97

Table 29. Specification sheet for vessel V-401.

Vessel V-401	
Type of vessel	Vertical
Pressure (kPa)	2
Temperature (°C)	112
Thickness of the shell (mm)	12.70
Length (m)	2.000
Diameter (m)	10.000
Hold-up time (min)	4.362
Mass of the shell (kg)	6375.74

Table 30. Specification sheet for vessel V-402.

Vessel V-402	
Type of vessel	Vertical
Pressure (kPa)	15
Temperature (°C)	112
Thickness of the shell (mm)	4.45
Length (m)	2.195
Diameter (m)	0.728
Hold-up time (min)	5.000
Mass of the shell (kg)	178.37

Table 31. Specification sheet for vessel V-403.

Vessel V-403	
Type of vessel	Vertical
Pressure (kPa)	2
Temperature (°C)	112
Thickness of the shell (mm)	3.18
Length (m)	2.340
Diameter (m)	0.407
Hold-up time (min)	0.200
Mass of the shell (kg)	75.97

Table 32. Specification sheet for vessel V-404.

Vessel V-404	
Type of vessel	Vertical
Pressure (kPa)	15
Temperature (°C)	112
Thickness of the shell (mm)	2.54
Length (m)	0.300
Diameter (m)	2.000
Hold-up time (min)	193.338
Mass of the shell (kg)	38.25

Table 33. Specification sheet for vessel V-405.

Vessel V-405	
Type of vessel	Horizontal
Pressure (kPa)	2
Temperature (°C)	132.9739385
Thickness of the shell (mm)	2.54
Length (m)	0.300
Diameter (m)	2.000
Hold-up time (min)	344.427
Mass of the shell (kg)	38.25

Table 34. Specification sheet for vessel V-601.

Vessel V-601	
Type of vessel	Vertical
Pressure (kPa)	6.5
Temperature (°C)	220
Thickness of the shell (mm)	4.45
Length (m)	3.672
Diameter (m)	0.734
Hold-up time (min)	5.000
Mass of the shell (kg)	300.84

Table 35. Specification sheet for condenser E-102.

Condenser E-102	
Type	U-tube Shell and tube
Heat exchange (kW)	343.08
Area (m ²)	17.70
LMTD (°C)	96.89053499
U (W/m ² °C)	200

Table 36. Specification sheet for heat exchanger E-103.

Heat exchanger E-103	
Type	Floating head shell and tube
Heat exchange (kW)	377.64
Area (m ²)	10.07
LMTD (°C)	37.49
U (W/m ² °C)	1000

Table 37. Specification sheet for heat exchanger E-301.

Heat exchanger E-301	
Type	Floating head shell and tube
Heat exchange (kW)	70.22
Area (m ²)	12.28
LMTD (°C)	57.18
U (W/m ² °C)	100

Table 38. Specification sheet for condenser E-302.

Condenser E-302	
Type	U-tube shell and tube
Heat exchange (kW)	1770.38
Area (m ²)	30.34
LMTD (°C)	129.684032
U (W/m ² °C)	500

Table 39. Specification sheet for heat exchanger E-401.

Condenser E-401	
Type	U-tube shell and tube
Heat exchange (kW)	289.92
Area (m ²)	11.08
LMTD (°C)	87.22
U (W/m ² °C)	300

Table 40. Specification sheet for heat reboiler E-404.

Reboiler E-404	
Type	U-tube shell and tube
Heat exchange (kW)	534.18
Area (m ²)	20.42
LMTD (°C)	87.22
U (W/m ² °C)	300

Table 41. Specification sheet for condenser E-408.

Condenser E-408	
Type	U-tube shell and tube
Heat exchange (kW)	241.89
Area (m ²)	13.12
LMTD (°C)	92.17
U (W/m ² °C)	200

Table 42. Specification sheet for heat exchanger E-407.

Heat exchanger E-407	
Type	Double pipe
Heat exchange (kW)	84.27
Area (m ²)	1.63
LMTD (°C)	86.04
U (W/m ² °C)	600

Table 43. Specification sheet for heat exchanger E-601.

Heat exchanger E-601	
Type	U-tube shell and tube
Heat exchange (kW)	10059.52
Area (m ²)	4604.80
LMTD (°C)	36.41
U (W/m ² °C)	60

Table 44. Specification sheet for heat exchanger E-410.

Heat exchanger E-410	
Type	Double pipe
Heat exchange (kW)	127.30
Area (m ²)	2.13
LMTD (°C)	59.83
U (W/m ² °C)	1000

Table 45. Specification sheet for condenser E-403.

Condenser E-403	
Type	Double pipe
Heat exchange (kW)	48.93
Area (m ²)	2.16
LMTD (°C)	113.501
U (W/m ² °C)	200

Table 46. Specification sheet for condenser E-406.

E-406	
Type	Double pipe
Heat exchange (kW)	3.89
Area (m ²)	0.35
LMTD (°C)	110.83
U (W/m ² °C)	100

Table 47. Specification sheet for reboiler E-402.

Reboiler E-402	
Type	U-tube kettle reboiler
Heat exchange (kW)	370.60
Area (m ²)	27.11
LMTD (°C)	13.67
U (W/m ² °C)	1000

Table 48. Specification sheet for reboiler E-405.

Reboiler E-405	
Type	U-tube kettle reboiler
Heat exchange (kW)	617.97
Area (m ²)	51.20
LMTD (°C)	12.07
U (W/m ² °C)	1000

Table 49. Specification sheet for reboiler E-409.

Reboiler E-409	
Type	U-tube kettle reboiler
Heat exchange (kW)	162.61
Area (m ²)	9.74
LMTD (°C)	23.85
U (W/m ² °C)	700

Table 50. Specification sheet for reactor R-201.

Reactor R-201	
Type	Falling film evaporator
Heat exchange (kW)	74.18
Area (m ²)	2.96
LMTD (°C)	71.69
U (W/m ² °C)	350

Table 51. Specification sheet for reactor R-301.

Reactor R-301	
Type	Horizontal evaporator
Heat exchange (kW)	155.11
Area (m ²)	8.00
LMTD (°C)	32.33
U (W/m ² °C)	600

Table 52. Specification sheet for evaporator E-101.

Evaporator E-101	
Type	Falling film evaporator
Heat exchange (kW)	2360.08
Area (m ²)	30.27
LMTD (°C)	97.50
U (W/m ² °C)	2000

Table 53. Specification sheet for column T-401.

Column T-401	
Type of column	Packed column
Thickness of the shell (mm)	25.40
Mass of the shell (kg)	54754.86
Diameter of the column (m)	4.26
Length of the column (m)	21.29
Pressure of operation (kPa)	2.00

Table 54. Specification sheet for column T-402.

Column T-402	
Type of column	Packed column
Thickness of the shell (mm)	19.05
Mass of the shell (kg)	30725.03
Diameter of the column (m)	3.68
Length of the column (m)	18.42
Pressure of operation (kPa)	2.00

Table 55. Specification sheet for column T-403.

Column T-403	
Type of column	Packed column
Thickness of the shell (mm)	12.70
Mass of the shell (kg)	6223.54
Diameter of the column (m)	2.03
Length of the column (m)	10.15
Pressure of operation (kPa)	2.00

Table 56. Specification sheet for reactor R-502.

Customer		Job. No.						
Address		Reference No.						
Plant Location		Proposal						
Parc Sagunt I (Valencia-Sagunto)	Date	17/06/2019	Rev					
Service Unit	Item No.	R-502						
Size	Type	AEW	Horz.					
Surf/Unit (Gross/Eff.)	Shell Unit	1	Surf/Shell (Gross/Eff.)					
644.90 m ²			644.90 m ²					
PERFORMANCE OF ONE UNIT								
Fluid Allocation	Shell Side		Tube side					
Fluid Name	Lactide/PLA mixture		Cold Water					
Fluid Quantity Total	kg/h	6013.85	6722.91					
Vapour (In/Out)								
Liquid	6013.85	6013.85	6722.91					
Steam								
Water			6722.91					
Noncondensables			6722.91					
Temperature	°C	180	180					
Specific gravity		1.245	1.245					
Viscosity, Liquid	mN-s/m ²							
Molecular weight, vapour								
Molecular weight, Noncondensable								
Specific Heat	kJ/kg °C	0.0012	0.0012					
Thermal conductivity	W/m °C	0.195	0.195					
Latent Heat	kJ/kg							
Inlet Pressure	kPa	3	101.325					
Velocity	m/s	0.0016	0.433					
Pressure Drop Allow/calc	kPa	93.96	1.730					
Fouling Resistance	m ² -°C/W	0.00033	0.00033					
Heat exchange	130240.55 W	MTD (corrected)	139.278283 °C					
Heat Transfer Rate, Service	1.45 W/m ² °C	Clean	1.45 W/m ² °C					
CONSTRUCTION OF ONE SHELL			Sketch (Bundle Nozzle Orientation)					
	Shell side	Tube side						
Design/ Test Pressure	kPa							
Design Temp. Max/Min	°C	207.78		207.78				
No. Passes per Shell		1		1				
Corrosion Allowance	mm							
Connections Size & Rating	In	mm						
	Out	mm						
	Intermediate	mm						
Tube No.	441.92 OD	76.2 mm	Length	6096 mm	Pitch	95.25 mm	Layout	90°
Tube type	Plain		Material	Stainless Steel 316				
Shell	ID	2850 OD	2875.4 mm	Shell Cover				
Channel of Bonne			Channel Cover					
Tubesheet- Stationary			Tubesheet-Flotating					
Floating Head cover			Impingement Protection					
Baffles-Cross	Type	% Cut (Dia.)	20	Spacing	1425 Inlet	1425 mm		
Baffles-Long			Seal Type					
Supports-Tube	U-Bend		Type					
Bypass Seal Arrangement			Tube-to-tubesheet Joint					
Expansion Joint			Type					
pv ² -Inlet Nozzle		Bundle Entrance		Bundle exit				
Gasket-Shell Side			Tube Side					
Floating Head								
Code Requirements							TEMA Class	
Weight/ Shell	Filled with water					Bundle	kg	
Remarks								