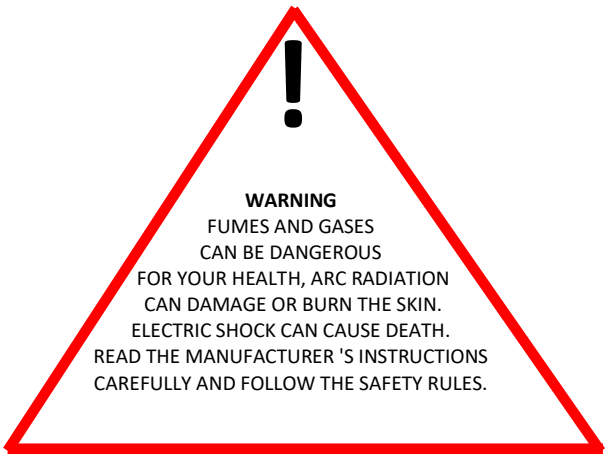
SAFRA

INFORMATION AND DATA

ON HEALTH AND SAFETY FOR

COPPER ALLOY

WELDING WIRES AND RODS



1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND THE COMPANY/BUSINESS

1.1 Product identification: copper alloy MIG and TIG arc welding wires and rods: Cu6100, Cu6180,Cu1898A,Cu5180A,Cu6560,Cu6338,Cu6327,Cu6328,CuZ-CuNi2Si (named according to ISO 24373:2018).

1.2 Relevant identified uses of the substance or mixture and uses advised against:
Product type: Continuous product of metal wire or rods
Recommended uses: electric arc welding (MIG or TIG) or metallization.

1.3 Details of the supplier of the safety data sheet:
SAFRA SPA
I-25039 TRAVAGLIATO (BS), ITALY
Telephone: 030 - 6863241 Fax : 030 -6863246
Person responsible safety data sheet: info@safraspa.it.

1.4 Emergency telephone number: in Italy = 118 (available 24/7); in Europe = 112

2. IDENTIFICATION OF HAZARDS

2.1 Classification of the substance or mixture:
The product is not classified as dangerous according to the provisions of Directives 67/548/EEC and 1999/45/EC and/or Regulation (EC) 1272/2008 (CLP) (and subsequent amendments).

2.2 Label elements:
Pictograms - not applicable
Warnings - not applicable
Risk phrases H - not applicable
Precautionary statements P - The following statements apply to the product as supplied:
Keep out of reach of children (P102).
Read label before use (P103).
The product does not require hazard labelling in accordance with point 1.3.4, Annex 1 of Regulation (EC) 1272/2008 (EC) and subsequent amendments.

2.3 Other hazards When this product is used in a welding process the main hazards are welding fumes, heat, radiation and electric shock. Avoid these risks by using special PPE and fume extractor. Overexposure to welding fumes may cause dizziness, nausea, dryness, and irritation of the nose, throat, and eyes. In addition, it may affect lung function by compromising its functioning. Overexposure to manganese fumes may cause damage to the nervous system and respiratory tract. People with pacemakers should not undertake welding tasks before consulting their physician and obtaining information from the producer of the device.
Radiation: UV rays of the electric arc can damage skin and eyes.
Heat: splashed molten metal may cause burns and starts fires.
Electricity: electric shock can kill.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances: not relevant.

3.2 Mixtures:

SAFRA	EN ISO 24373:2018	Chemical analysis %										
		Cu	Al	Fe	Mn	Ni	P	Pb	Si	Sn	Zn	Altri (*)
CAS		7440-50-8	7429-90-5	7439-89-6	7439-96-5	7440-02-0	7723-14-0	7439-92-1	7440-21-3	7440-31-5	7440-66-6	---
SF CuAl8	Cu 6100	Bal.	6,0 – 8,5	*	0,5	*	_	0,02	0,2	*	0,2	0,4(c)
SF CuAl9Fe	Cu 6180	Bal.	8,5 – 11,0	1,5	_	_	_	0,02	0,1	_	0,02	0,5
SF CuSn	Cu 1898A	Bal.	0,01	0,03	0,1 – 0,4	0,1	0,015	0,01	0,1 – 0,4	0,5 – 1,0	_	0,2
SF CuSn6	Cu 5180A	Bal.	0,01	0,1	_	_	0,01 – 0,4	0,02	_	4,0 – 7,0	0,1	0,2
SF CuSi3	Cu 6560	Bal.	0,02	0,5	0,5 – 1,5	_	0,05	0,02	2,8 – 4,0	0,2	0,4	0,5
SF CuMn13Al7	Cu 6338	Bal.	7,0 - 8,5	2,0 – 4,0	11,0 – 14,0	1,5 – 3,0	_	0,02	0,1	_	0,15	0,5
SF CuAl8Ni2	Cu 6327	Bal.	7,0 – 9,5	0,5 – 2,5	0,5 – 2,5	0,5 – 3,0	_	0,02	0,2	_	0,2	0,4

SF CuAl8Ni6	Cu 6328	Bal.	8,5 – 9,5	3,0 – 5,0	0,6 – 3,5	4,0 – 5,5	–	0,02	0,1	–	0,1	0,5
SF CuNi2Si	Cu Z-CuNi2Si	Bal.	–	0,20	0,10	1,6 – 2,5	–	0,02	0,4 – 0,8	–	–	0,3

CAS: not applicable
EINECS: not applicable
The product does not contain substances classified as hazardous to health or the environment pursuant to the provisions of Directives 67/548/EEC and/or Regulation (EC) 1272/2008 (CLP) and subsequent amendments, since, apart from the intended use of the product, the individual elements are not separable using mechanical procedures.

4. FIRST AID MEASURES

If necessary, call 118 or another public emergency number available in the area.
The following measures relate to problems that may arise during the welding process, not to the preparation as such, if the minimum safety and health requirements are not met.

4.1 Description of first aid measures:

Inhalation: Signs and symptoms of inhalation are: dizziness, uncomfortable feeling, nausea, dehydration or throat irritation. In these cases, remove from exposure and breathe deep fresh air. In the event of significant inhalation of welding fumes, get medical advice.
Skin contact: In the event of skin burns due to arc radiation or contact with splashed molten material, wash immediately with water. In case of severe and persistent burns, get medical advice.
Ingestion: It is considered very unlikely due to the shape of the product. The product is an irritant to the gastrointestinal system. If necessary, get medical advice.
General warnings –If any discomfort develops, get medical advice. Show this safety data sheet to the medical personnel.

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

The following measures refer to problems that may occur during welding procedures, whenever the minimum health and safety requirements are not followed, and do not refer to the product as supplied.
- Copper alloy is welded in an inert and protective atmosphere, for example argon or helium, using the MIG or TIG method. Welding generates fumes and intense ultraviolet radiation, which forms oxides, ozone and nitrogen. Ultraviolet radiation from welding may also cause skin and eye burns.
- Exposure to low levels of ozone may cause eye, nose and throat irritation. Inhalation may cause tightness, headache, shortness of breath, cough, sneezing, nausea, and narrowing of the oral cavities. Symptoms disappear as soon as you move away from exposure.
- Exposure to high levels of ozone may cause acute shortness of breath, lung changes, bleeding and pulmonary oedema (fluid in the lungs). Symptoms of pulmonary oedema may be delayed by one or more hours. Exposure of animal and human tissue to high concentrations of ozone has shown a chromosomal change, in reproductive effects, in blood and death due to pulmonary congestion.
- Nitrogen oxides may cause irritation of the eye, skin (if damp), and respiratory tract infection. Exposure to high levels of nitrogen oxides may cause delayed pulmonary oedema (fluid in the lungs) which can be fatal. Nitrate can lead to the formation of methaemoglobin, which reduces the ability of the blood to deliver oxygen to the tissues. Chronic exposure may cause pulmonary fibrosis.

- Overexposure to copper dust/particulate matter and its fumes may reduce lung function and may be associated with neurological effects.
- Chronic exposure to inert silicon dust can increase air intake resistance and contribute to chronic bronchitis. Intratracheal delivery of silicon to rabbits in the laboratory resulted in major lung injury.
- Exposure to zinc oxide fumes as a consequence of burns, welding and work on liquid metal may result in fever, chills, shortness of breath and feeling unwell (metal fume fever), as well as irritation of the upper respiratory tract. Temporary symptoms may include fever, chills, nausea, vomiting, and muscle aches. Exposure to dust or particulate matter presents a low risk to health.
- Hexavalent chromium (Chromium VI) may cause asthma, kidney damage, primary irritant dermatitis, sensitising dermatitis, skin ulcer and pulmonary oedema (fluid in the lungs). Chronic inhalation or overexposure has been

associated with lung, nasal and gastrointestinal cancer. Hexavalent chromium is listed as carcinogenic to humans by the IARC (Group 1) = the agent is carcinogenic to humans. Chromium and some of its derivatives are listed as carcinogens by the NTP. Hexavalent chromium compounds can be generated during welding operations wherever the metal contains chromium. A significant amount of chromium in the fumes may be hexavalent chromium; the latter has very low exposure limits, not more than 0.005 mg/m3 (5µg/m3).
- Potential damage resulting from overexposure of copper fumes may occur during welding, oxyacetylene welding, cutting, etc. Overexposure to copper powders/mist may cause irritation to eye, skin and inflammation of the upper respiratory tract. Chronic overexposure may result in blood disorders (anaemia), as well as discoloration of hair and skin. Overexposure to copper fumes can cause irritation of the upper respiratory tract, nausea, fever, chills, shortness of breath and feeling unwell (metal fume fever).
- Nickel powders and fumes can sensitize the skin, cause allergic contact dermatitis and conjunctivitis. Chronic inhalation of high levels of nickel may cause respiratory and lung irritation, pulmonary fibrosis, perforation of the nasal septum, sinusitis, respiratory sensitization and asthma. Nickel compounds are listed by the NTP and listed as carcinogenic to humans by the IARC (Group 1) = the agent is carcinogenic to humans. Metallic nickel is a possibly carcinogenic to humans as defined by the IARC (Group 2B) = the agent is possibly carcinogenic to humans.
- Beryllium may cause irritating dermatitis, allergic contact dermatitis and skin granuloma. Inhalation of excessive levels of beryllium may result in acute pneumonia (inflammation of lung tissues). Beryllium may cause sensitization of the lungs in susceptible individuals. Chronic inhalation of fumes and dust by these sensitized individuals can result in a serious, progressive disease called CBD (Chronic Beryllium Disease). This disease is often misdiagnosed as sarcoidosis, but it is an allergic condition in which lung tissues become inflamed. This inflammation is sometimes accompanied by fibrosis, and reduces oxygen uptake into blood cells. CBD can, over time, be fatal. Inhalation of beryllium caused lung tumors in animals. Beryllium is reported by the NTP, and is recognized as carcinogenic to humans by the IARC (Group 1) = the agent is carcinogenic to humans.
- Inorganic lead dust and fumes are listed as possibly carcinogenic to humans by the IARC, Group 2B = the agent is possibly carcinogenic to humans. Overexposure to lead fumes and dust may cause weakening of the extremities (peripheral neuropathy), stomach disorders, kidney, liver and central nervous system, blood and blood-producing tissues, as well as reproductive organs problems. Overexposure to lead has been associated with effects on human reproduction (e.g., reduced fertility and foetal harm in pregnant women exposed to the agent). Lead is a toxic accumulating metal by inhalation or ingestion.

4.3 Indication of any immediate medical attention and special treatment needed: not available.

5. FIRE-FIGHTING MEASURES

5.1 Extinguishing media.
Suitable extinguishing media: powder or foam.
Unsuitable extinguishing media: we advise against the use of water and halogen extinguishing media.

5.2 Special hazards arising from the substance or mixture: the product can be dangerous under the following conditions:
- Dust or particulate matter dispersed in the air can be explosive.
- Drops, particulate matter and dust exposed to water can generate flammable/explosive hydrogen. This gas may present an explosion hazard in enclosed or poorly ventilated environments.

- Powders and particulate matter exposed to certain metal oxides. A small source of ignition may initiate an exothermic reaction
- Molten copper exposed to water/moisture, or other metal oxides. Moisture trapped in molten copper can be explosive. If exposed to other metal oxides, molten copper may initiate an exothermic reaction.
Hazardous combustion products: the packaging is made of cardboard, therefore subject to ignition and combustion. It is recommended to follow the normal fire precautions.

5.3 Advice for firefighters:
Special protective equipment: self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Specific methods: none.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures: Not applicable because the product is solid and not dangerous. However, welders must wear normal protective clothing made of certified materials

suitable for electric arc welding such as welding gloves, helmet or face shield with UV filter lens, garment cover, jacket and pants made of flame-retardant material, leather apron and safety boots.

6.2 Environmental precautions: not applicable because the product is solid and not dangerous. Any disposal of the product must follow the directives of your country regarding the disposal and recycling of metallic solid waste.

6.3 Methods and material for containment and cleaning up: not applicable because the product is solid and not dangerous.

6.4 Reference to other sections: refer to sections 8 and 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling: high density solid product; handle with caution.

7.2 Conditions for safe storage, including any incompatibilities: Store the product in its original packaging in dry places protected from atmospheric agents and acidic and basic substances. Avoid thermal shock. Storage in unsuitable environments can give rise to surface oxidation phenomena and chemical reactions which may be harmful to the quality of the material itself.

7.3 Specific end uses: arc welding (MIG and TIG) and metallisation.

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters:

8.1.1 TLV-TWA exposure limit values: refer to the exposure limits of each individual component present in the welding fumes, dust or other compounds and compare it to the table below.

			Limit values (mg/m³) according to	
	CAS No.	**Format**	**ACGIH TLV-TWA**	**OSHA PEL**
Aluminium	7429-90-5	Total dust, fume Breathable	1	15 5
Beryllium and beryllium compounds	7440-41-7	All Be compounds	0,00005	0,002, 0,005 ceiling 0,025 for 30 min.
Chromium	7440-47-3	Metal Cr II Compounds CR III Compounds CR VI Water-soluble compounds CR VI Water-insoluble compounds	0,5 --- 0,5 as Cr 0,05 as Cr 0,01 as Cr	1 0,5 as Cr 0,5 as Cr 0,005 as Cr VI 0,005 as Cr VI
Copper	7440-50-8	Fumes Dust / fog	0,2 1	0,1 1
Iron	7439-89-6	Oxides and fumes dusts (such as Fe)	5 (breathable)	10
Lead	7439-92-1	Inorganic and elemental compounds	0,05 as Pb	0,05 as Pb
Magnesium	7439-95-4	Fumes and oxides	10 (inhalable)	15 (total particulate matter)
Manganese	7439-96-5	Fumes	0,2	5 (ceiling)
Nickel	7440-02-0	Metal Soluble inorganic compounds Insoluble inorganic compounds	1,5 as Ni 0,1 as Ni 0,2 as Ni	1 as Ni 1 as Ni 1 as Ni
Silicon	7440-21-3	Total dust Breathable	TLV Withdrawn ---	15 5
Vanadium	7440-62-2	Breathable dusts Fumes	0,05 come V_2O_5 (inhalable)	0,5 (ceiling) as V_2O_5 0,1 (ceiling) as V_2O_5
Zinc	7440-66-6	Oxides, fumes Total oxide powders Total breathable dusts	--- --- 2, 10 (STEL)	5 15 5
Zirconium	7440-67-7	Basic	5, 10 (STEL)	5 (only compounds)

8.2 Exposure controls:

8.2.1 *Appropriate engineering controls*

Protect your body and eyes from light emissions and welding fumes during use as they may be sources of danger.

8.2.2 *Individual protection measures, such as personal protective equipment*

Respiratory protection: use respiratory protection suitable for the welding activity depending on the welding activity and the environment in which you are. Provide adequate ventilation and/or a suitable fume extractor.

Hand protection: use gloves suitable for welding, which protect from heat and UV rays.
Eye protection: use protective goggles or masks equipped with filters capable of filtering the IR and UV emissions that develop during welding.
Skin protection: wear protective clothing for body, hands and head; use safety shoes that can protect against radiation, sparks and electric shock. Avoid wearing greasy or dirty clothes with combustible substances that may catch fire.

8.2.3 *Environmental exposure controls*
Provide adequate ventilation and/or a suitable gas and fume extractor.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Physical state: solid copper alloy wires and rods with a diameter between 0.8mm and 5.0mm.
Colour: polished bronze.
Odour: none.
Melting point: from 910° to 1090° c.
Freezing point: not applicable.
Flammability: not applicable.
Lower and upper explosion limit: not applicable.
Flash point: not applicable.
Auto-ignition temperature: not applicable.
Decomposition temperature: not applicable.
PH: not available
Kinematic viscosity: none.
Solubility: none.
Partition coefficient n-octanol/water (log value): not applicable.
Density and/or relative density: 7.4-8.9 g/cm³
Relative vapour density: none.
Particle characteristics: not available.

9.2 Other information: not available.

10. STABILITY AND REACTIVITY

10.1 Reactivity: the product is not reactive if used, stored and transported under normal conditions. Avoid contact with strong acids or bases that may generate hazardous gases.

10.2 Chemical stability: copper wires and rods are stable in normal environment.

10.3 Possibility of hazardous reactions: with strong acids or bases that may react and release hazardous gases.

10.4 Conditions to avoid: do not touch the wire or rod with bare hands during welding, as it is possible to risk both electric shock and burns. Use protective gloves.

10.5 Incompatible materials: acids or bases that may react and release hazardous gases.

10.6 Hazardous decomposition products: when the product is used during the welding process, hazardous decomposition products resulting from volatilization, reaction and oxidation, include those listed in section 3 for each alloy used and the type of base material used. For exposure limits, please refer to the table in section 8.

11. TOXICOLOGICAL INFORMATION

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

a) *Acute toxicity*: the product itself does not have any toxicity and does not present any danger of VOC release. During welding, fumes and gases develop, the composition of which depends on various factors: base material used, welding process and procedures, etc. Other conditions that may influence the composition are: substances present on the surface of the base material, number of welders and volume of the work area, quality and quantity of ventilation.

b) *Skin corrosion/irritation*: it is possible to incur the risk of burns during welding if you do not use personal safety devices.

c) *Serious eye damage/irritation*: welding fumes and the light generated by the electric arc may cause eye irritation and dryness if the environment is not adequately ventilated and if there is no fume extraction system.

d) *Respiratory or skin sensitisation*: welding fumes may cause damage to the respiratory tract and to the lungs if the environment is not adequately ventilated and if there is no fume extraction system.

e) *Germ cell mutagenicity*: not available

f) *Carcinogenicity*: the risk of cancer cannot be excluded if exposure to fumes is prolonged.

Carcinogens ACGIH:

Aluminium (CAS 7429-90-5): A4 not classifiable as a human carcinogen
Lead (CAS 7439-92-1): A3 animal carcinogen confirmed, of unknown relevance to humans.

IARC Monographs. Overall evaluation of carcinogenicity:
Lead (CAS 7439-92-1): 2B Possibly carcinogenic to humans.
US NTP Report on carcinogens: anticipated to be a carcinogen:
Lead (CAS 7439-92-1): anticipated to be a carcinogen.

g) *Reproductive toxicity*: not available
h) *STOT-single exposure*: not available
i) *STOT-repeated exposure*: not available
j) *Aspiration hazard*: welding fumes may cause damage to the respiratory tract and to the lungs if the environment is not adequately ventilated and if there is no fume extraction system. Small overexposures to welding fumes may lead to uncomfortable situations such as metal fume fever, dizziness, nausea, dehydration or irritation of the nose and throat, and can aggravate pre-existing breathing problems such as asthma and emphysema. Aluminium welding and arc spray metallization can generate Ozone whose overexposure can be irritating on mucous membranes and lung membranes.

CLASSIFICATION OF CARCINOGENS

Ingredient	OSHA	NTP	IARC	Target organ
Chromium	N	Y	3	Lungs
Hexavalent chromium	N	Y	1	Lungs
Lead	N	N	2B	Lungs, stomach
Nickel	N	Y	1	Lungs, stomach

Key:
N = Not identified as carcinogenic to humans.
Y = Identified as carcinogenic to humans.
IARC-code for evidence of human carcinogenicity: 1 = Positive; 2A = Probably; 2B = Possibly; 3 = Not classifiable; 4 = Probably negative.

11.1.7 Delayed and immediate effects as well as chronic effects from short and long-term exposure
Inhalation: Small overexposures to welding fumes may lead to uncomfortable situations such as metal fume fever, dizziness, nausea, dehydration or irritation of the nose, throat or eyes and can aggravate pre-existing breathing problems such as asthma and emphysema. Copper welding and arc spray metallization can generate ozone; overexposure to ozone can be irritating on the mucous membranes, and can cause irritation, congestion and oedema. Welding fumes were defined as possibly carcinogenic to humans from the IARC (group 2B): suspected carcinogenic agent.
Ingestion: no specific information is available about the toxicological effects caused by the ingestion of the product.
Carcinogenicity: the risk of cancer cannot be excluded if exposure to fumes is prolonged.

Skin/eye exposure: possible effects resulting from exposure to ultraviolet rays of the electric arc are conjunctivitis and burns to the skin.

11.2 Information on other hazards: not available

12. ECOLOGICAL INFORMATION

12.1 Toxicity: use in accordance with good working practices, avoiding the dispersion of the product into the environment. The product has no inhibitory effects on the activity of microorganisms.
12.2 Persistence and degradability: the product does not contain substances for which information has been provided on their ability to degrade under certain environmental circumstances as a result of biodegradation or other processes such as oxidation or hydrolysis.
12.3 Bioaccumulative potential: not established.
12.4 Mobility in soil: the product does not contain substances for which information has been provided on their distribution in environmental compartments or relevant data on their absorption/desorption.
12.5 Results of PBT and vPvB assessment: not established.
12.6 Endocrine disrupting properties: not established.
12.7 Other adverse effects: not established

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods: dispose of product residues and waste in accordance with the law.

EWC waste disposal code:
120113: welding wastes
120103: non-ferrous metal filings and turnings
For non-EU countries, check the waste disposal regulations of the reference country.

14. TRANSPORT INFORMATION

The product is not classified as dangerous for transport by road, rail, sea and air.

14.1 UN number or ID number: not applicable.
14.2 UN proper shipping name: not applicable.
14.3 Transport hazard class: not applicable.
14.4 Packing group: not applicable.
14.5 Environmental hazards: none.
14.6 Special precautions for user: none.
14.7 Maritime transport in bulk according to IMO instruments: not applicable.

15. REGULATORY INFORMATION

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

1. Directive 1999/45/EC and subsequent amendments.
2. Regulation (EC) 1907/2006 of the European Parliament (REACH).
3. Regulation (EC) 1272/2008 of the European Parliament (CLP).
4. Regulation (EC) 790/2009 of the European Parliament (1st Atp. CLP).
5. Regulation (EC) 453/2010 of the European Parliament (Safety Data Sheets).
6. Commission Regulation (EU) 2015/830 of 28 May 2015.
7. Directive 2008/98/EC of the European Parliament and of the Council.
8. Directive 94/62/EC of the European Parliament and of the Council.

For Non-EU countries, check the health, safety and environment regulations and legislation specific to the reference country.

15.2 Chemical safety assessment: not applicable.

16. OTHER INFORMATION

Before using this product in any new process or experiment, an in-depth study must be conducted on the safety and compatibility of the product with the materials. The supplier is not responsible for any damage caused by the use of the product in incorrect applications and/or under conditions other than those provided for. This safety data sheet has been compiled in accordance with the European Directives in force and is applicable in all countries that have implemented these Directives in national legislation. The data contained are those currently reported in the specialized technical literature; what is reported in the text is of informative nature and does not replace rules and provisions issued by public institutional bodies. The information is provided for the protection of health and safety in the workplace; no liability is accepted for any damage resulting from the use of this information other than those mentioned. This data sheet cancels and replaces any previous revision.

GENERAL BIBLIOGRAPHY

ACGIH: American Conference of Government Industrial Hygienists.
TLV: Threshold Limit Value.
TWA: Time-Weightened Average.
CAS: Chemical Abstract Service.
EINECS: European Inventory of Existing Commercial Chemical Substances.
PBT: Persistent, Bioaccumulating and Toxic.
vPvB: very Persistent and very Bioaccumulating.

Note for users:
The information contained in this data sheet is based on the current level of knowledge available on the date of its latest version. The user has the duty to ensure that this information is appropriate and complete with respect to the specific intended use.
This document should not be interpreted as a guarantee of any specific property of the product.

Since the use of the product does not fall under the direct control of SAFRA SPA, the user has the duty to observe, under his own responsibility, the laws and regulations in force regarding hygiene and safety. SAFRA assumes no responsibility for the accuracy and completeness of the data contained in this safety data sheet.
It is the sole responsibility of the user to know what material to use for their work. Any material may present unknown hazards and must therefore be used with caution. Although some of the hazards have been indicated within this safety data sheet, this does not guarantee that there are no others.

ANNEX 1

EXPOSURE SCENARIOS

Welding/brazing fumes can have effects on health and the environment. Fumes are a mixture of various gases and fine particles which, if inhaled or ingested, may pose a health risk. The degree of risk depends on the composition of the smoke, its concentration and the duration of exposure. The composition of the fumes depends on the processed material, the process and the filler metal used, the coatings on the base material such as paint, galvanising, plating, oil or contaminants from degreasing or cleaning activities. A systematic approach to exposure assessment is needed, taking into account the particular operational circumstances for the operator and the assistant personnel exposed to these fumes.

Considering the emission of fumes during welding, brazing and cutting of metals, it is recommended to 1) arrange risk management measures by applying information and general guidelines proposed by the exposure scenario and 2) use the information within the SDS of SAFRA, in accordance with Directive 1907/2006 and subsequent amendments (REACH).

The operator must ensure that the risk from welding fumes to his health and safety is eliminated or reduced to a minimum. The following principles shall apply:

a) Select the right combination of process/material of the lowest class, as far as possible;
b) Fix the welding process with the lowest emission parameters;
c) Apply the relevant collective protection measures in accordance with the class number. In general, the use of PPE is taken into account after all other measures have been applied.
d) Use personal protective equipment in accordance with the duty cycle.
In addition, the exposure to welding fumes of welders and operators will be checked for compliance with national regulations and regulations.

Risk Management for individual processes / combination of basic materials

Class[1]	Welding process (according to ISO4063)	Basic material	Comments	Ventilation Extraction Filtration[2]	PPE[3] DC<15%	PPE[3] DC>15%
Unconfined spaces [10]						
I	GTAW (141)	All	Except Aluminium	low GV[4]	n.r.	n.r.
	SAW (12)					
	Autogenous (3)					
	PAW (15)					
	ESW/EGW (72-73)					
	Resistance (2)					
	Spot welding (78)					
	Solid state (521)					
	Gas brazing (9)					
II	GTAW (141)	Aluminium	Except Cd alloys	low GV[4]	n.a.	FFP2[5]
III	GMAW (131 – 135)	All	Except Cu/Be/V alloys	low GV[4] low LEV[6]	Improved helmet	FFP2[5]
IV	All Class I processes	Painted / treated / oiled	Paint without Pb	low GV[4]		
	All Class III processes	Painted / treated / oiled	Paint without Pb	low GV[4] low LEV[6]	FFP2[5]	FFP3, TH2/P2 or LDH2[11]
V	MMAW (111)	Stainless steel, Ni-, Be- and V- alloys.	n.a.	low LEV[6]	TH3/P3, LDH3[9]	TH3/P3, LDH3[9]
	FCAW (136/137)	Stainless steel, Mn- and Ni-alloys.				
	GMAW (131)	Cu-alloys				

	Powder Plasma Arc (152)	**Stainless steel, Mn-, Ni- and Cu- alloys.**				
Enclosed or confined spaces [10]						
I	**Laser (52)**	**All**	**Closed system**	**medium GV[7]**	**n.a.**	**n.a.**
	Electron emission (51)					
VIII	**All**	**All**	**Confined system**	**high LEV[8] – Outdoor Air Flow**	**LDH3[9]**	**LDH3[9]**

Key:

[1] Class: approximate classification for risk mitigation by selecting the process/combinations of materials with the lowest value.
[2] Recommended values complying with national maximum permissible limits. The extracted fumes, for any material with the exception of iron and non-alloy aluminium, will be filtered before being released into the atmosphere.
[3] Personal protective equipment (PPE) required to avoid exceeding national exposure limit values (DC: duty cycle, expressed in 8 hours).
[4] Low General Ventilation (GV). With the addition of Local Exhaust Ventilation (LEV) and outside exhaust air, the capacity of the GV or LEV can be reduced by 1/5 of the original demand.
[5] Filtering mask (FFP2)
[6] When an alloy filler metal is used, measurements as per class V are required.
[7] Medium General Ventilation (GV) (double when compared to Low).
[8] High Local Exhaust Ventilation (LEV), extraction at source (includes a table, cap, arm or torch extraction).
[9] Helmet with powered filters (TH3/P3), or helmet with air recirculation (LDH3).
[10] A confined space, despite its name, is not necessarily small. Examples of confined spaces include ships, silos, drums, basements, tanks, etc.
[11] Filtering mask (FFP3), helmet with active filters (TH2/P2) or helmet with air recirculation (LDH2).

In the table indicated above on "Risk management for individual processes/combination of materials", reference is made to the following regulations for personal and collective protection measures:

ISO 4063	Welding and allied processes — Nomenclature of processes and reference numbers
EN ISO 15012-1:2006	Health and safety in welding and allied processes - Requirements, testing and marking equipment for air filtration - Part 1: Testing of the separation efficiency for welding fume.
EN ISO 15012-2:2008	Health and safety in welding and allied processes - Requirements, testing and marking equipment for air filtration - Part 2: Determination of the minimum air volume flow rate of captor hoods and nozzles.
EN 149:2009	Respiratory protective devices – Filtering half masks to protect against particles - Requirements, testing, marking (FFP1 - FFP2 – FFP3).
EN 1835:2001	Respiratory protective devices – Light duty construction compressed air line breathing apparatus incorporating a helmet or a hood - Requirements, testing, marking (LDH1 - LDH2 - LDH3).
EN 12941:2009	Respiratory protective devices - Powered filtering devices Incorporating a helmet or a hood - Requirements, Testing, Marking (TH1 - TH2 - TH3).
EN 143:2007	Respiratory protective devices – Particle filters - Requirements, Testing, Marking (P1, P2, P3).
Directive 1998/24/EC	Article 6.2 on the protection of the health and safety of workers from the risks related to chemical agents at work.
BGR 190	Use of respiratory protection (regulations for safety and health at work).
TRGS 528	Welding works (Technical Rules for Hazardous Substances).