



SAFETY DATA SHEET

4643 Aluminum Welding and Metallizing Wire

Issued: 2016-09-09

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

1.1. Product identifier

Trade name 4643 Aluminum Welding and Metallizing Wire

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

Product type This product is a continuous solid metal wire.

Use Arc Welding

1.3. Details of the supplier of the safety data sheet

SDS created by Jeffrey Freiburger

Supplier AlcoTec Wire Corporation

Street address 2750 Aero Park Drive
MI 49686-9263 Traverse City
USA

Telephone 1-800-228-0750

Web site <http://www.alcotec.com>

Email alcotec@alcotec.com

1.4. Emergency telephone number

Emergency phone number (717)637-8911 or (800)424-9300

Available outside office hours No



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SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Description

In the form these substances are present in this product they do not contribute to a hazard classification of the product. The product is not classified

2.2. Label elements

The product do not require labeling

2.3. Other hazards

When this product is used in a welding process, the most important hazards are welding fumes, heat, radiation and electric shock. Avoid exposure to brazing and welding fumes, radiation, spatter, electric shock, heated materials and dust. Overexposure to cutting, scarfing and welding fumes may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes. Overexposure to cutting, scarfing and welding fumes may affect pulmonary function. Persons with a pacemaker should not go near welding or cutting operations until they have consulted their doctor and obtained information from the manufacturer of the device.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

Chemical name	CAS No. EC No. REACH No.	Concentration	Classification	H-phrase
Aluminum	7429-90-5 231-072-3 -	>99%	-	-
Silicon	7440-21-3 231-130-8 -	4,5 - 6%	-	-
Iron	7439-89-6 231-096-4 01-2119462838 - 24	<0,8%	-	-
Copper	7440-50-8 231-159-6 01-2119480154 - 42	<0,3%	-	-
Titanium	7440-32-6 231-142-3 -	<0,2%	-	-

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Zinc	7440-66-6 - -	<0,1%	-	-
magnesium powder (pyrophoric)	7439-95-4 231-104-6 -	<0,05%	-	-
Manganese	7439-96-5 231-105-1 01-2119449803 - 34	<0,05%	-	-

Substance additional information weight.

Ingredients not listed shall not exceed 0.05% by weight individually, Total combination of ingredients not listed shall not exceed 0.15% by weight. Beryllium shall not exceed 0.0003% by

SECTION 4: First aid measures

4.1. Description of first aid measures

No first aid measures should be required for this product as shipped. ELECTRIC SHOCK can kill. Disconnect and turn off the power. Use a nonconductive material to pull victim away from contact with live parts or wires. If not breathing, begin artificial respiration, preferably mouth-to-mouth. If no detectable pulse, begin Cardio Pulmonary Resuscitation (CPR).

Inhalation

If breathing has stopped, perform artificial respiration and obtain medical assistance immediately! If breathing is difficult, provide fresh air and call physician.

Skin contact

For skin burns from arc radiation, promptly flush with cold water. Get medical attention for burns or irritations that persist. To remove dust or particles wash with mild soap and water.

Eye contact

For radiation burns due to arc flash, see physician. To remove dusts or fumes flush with water for at least fifteen minutes. If irritation persists, obtain medical assistance.

Ingestion

According to experience not expected.

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

No first aid measures should be required for this product as shipped.

Inhalation

Overexposure to welding fumes may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes. Chronic overexposure to welding fumes may affect pulmonary function.

Skin contact

ARC RAYS and SPARKS can injure eyes and burn skin.

Eye contact

ARC RAYS and SPARKS can injure eyes and burn skin.

According to experience not expected.

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Ingestion

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

Not applicable

SECTION 5: Firefighting measures

5.1. Extinguishing media

Not applicable

5.2. Special hazards arising from the substance or mixture

No specific recommendations for welding consumables. Welding arcs and sparks can ignite combustible and flammable materials. Use the extinguishing media recommended for the burning materials and fire situation.

5.3. Advice for firefighters

**Special protective equipment
for fire-fighters**

Wear self-contained breathing apparatus as fumes or vapors may be harmful.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions: refer to section 8.

6.2. Environmental precautions

Refer to Section 13.

6.3. Methods and material for containment and cleaning up

Solid objects may be picked up and placed into a container. Liquids or pastes should be scooped up and placed into a container. Wear proper protective equipment while handling these materials. Do not discard as refuse.

6.4. Reference to other sections

Refer to Section 8 and Section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

**Preventive handling
precautions**

Handle with care to avoid stings and cuts. Wear gloves when handling welding consumables. Avoid exposure to dust. Do not ingest. Some individuals can develop an allergic reaction to certain materials. Retain all warning and identity labels.

7.2. Conditions for safe storage, including any incompatibilities

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Keep separate from chemical substances like acids and strong bases, which could cause chemical reactions.

7.3. Specific end use(s)

Arc Welding

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure limits

Use industrial hygiene monitoring equipment to ensure that exposure does not exceed applicable national exposure limits. The following limits can be used as guidance. Unless noted, all values are for 8 hour time weighted averages (TWA). For information about welding fume analysis refer to Section 10.

National occupational exposure limits

CAS No.	EC No.	Exposure Limit Values ppm / mg/m3	Short term exposure limit ppm / mg/m3	Ceiling Limit Value ppm / mg/m3	Country
Please see Appendix for 8.1 National Occupational Exposure Limits at the end of this document.					

8.2. Exposure controls

Not applicable

Other

Avoid exposure to brazing and welding fumes, radiation, spatter, electric shock, heated materials and dust. Train welders to avoid contact with live electrical parts and insulate conductive parts.

Ventilation

Use respirator or air supplied respirator when welding or brazing in a confined space, or where local exhaust or ventilation is not sufficient to keep exposure values within safe limits. Use special care when welding painted or coated steels since hazardous substances from the coating may be emitted. Ensure sufficient ventilation, local exhaust, or both, to keep welding fumes and gases from breathing zone and general area.

Personal protective equipment

Wear hand, head, eyes, ear and body protection like welders gloves, helmet or face shield with filter lens, safety boots, apron, arm and shoulder protection. Keep protective clothing clean and dry.

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SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	Silver grey
Appearance, colour	Not applicable
Appearance, physical state	Not applicable
Auto-ignition temperature	Not applicable
Decomposition temperature	Not applicable
Evaporation rate	Not applicable
Explosive properties	Not applicable
Flammability (solid, gas)	Not applicable
Flash point	Not applicable
Initial boiling point and boiling range	Not applicable
Melting point / freezing point	970 - 1515 °F
Odour	None
	Not applicable
Odour treshold	Not applicable
	Not applicable
Oxidising properties	Not applicable
Partition coefficient: n-octanol / water	Not applicable
	0.1 lb/in ³
pH value	Not applicable
Relative density	None
	Not applicable
Solubility	Not applicable
Solubility in water	Not applicable

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Upper / lower flammability or explosive limits Not applicable
Not applicable

Vapour density

Vapour pressure

Viscosity

9.2. Other information

Not applicable

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity The product is non-reactive under normal conditions of use, storage, and transport.

10.2. Chemical stability

Chemical stability Stable at normal conditions

10.3. Possibility of hazardous reactions

Not applicable

10.4. Conditions to avoid

Conditions to avoid Incompatible with strong acids and oxidizing agents. This product is only intended for normal welding purposes.

10.5. Incompatible materials

Incompatible materials Incompatible with strong acids and oxidizing agents.

10.6. Hazardous decomposition products

Hazardous decomposition products When this product is used in a welding process, hazardous decomposition products would include those from the volatilization, reaction or oxidation of the materials listed in Section 3 and those from the base metal and coating.

Other

Refer to applicable national exposure limits for fume compounds, including those exposure limits for fume compounds found in Section 8.

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SECTION 11: Toxicological information

11.1. Information on toxicological effects

Information on toxicological effects

Inhalation of welding fumes and gases can be dangerous to your health. Classification of welding fumes is difficult because of varying base materials, coatings, air contamination and processes. The International Agency for Research on Cancer has classified welding fumes as possibly carcinogenic to humans (Group 2B).

acute toxicity

Overexposure to welding fumes may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes.

skin corrosion/irritation

Not applicable

serious eye damage/irritation

Not applicable

respiratory or skin sensitisation

Not applicable

germ cell mutagenicity

Not applicable

carcinogenicity

Not applicable

reproductive toxicity

Not applicable

STOT-single exposure

Not applicable

STOT-repeated exposure

Not applicable

aspiration hazard

Not applicable

Other

Long term effect

Chronic toxicity: Overexposure to welding fumes may affect pulmonary function.

SECTION 12: Ecological information

12.1. Toxicity

Toxicity

Welding consumables and materials could degrade/weather into components originating from the consumables or from the materials used in the welding process. Avoid exposure to conditions that could lead to accumulation in soils or groundwater.

12.2. Persistence and degradability

Not applicable

12.3. Bioaccumulative potential

Not applicable

12.4. Mobility in soil

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Not applicable

12.5. Results of PBT and vPvB assessment

Not applicable

12.6. Other adverse effects

Not applicable

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Disposal considerations

Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal and local regulations. Use recycling procedures if available. Residues from welding consumables and processes could degrade and accumulate in soils and groundwater.

SECTION 14: Transport information

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

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

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SECTION 15:Regulatory information

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

Not applicable

15.2. Chemical safety assessment

Not applicable

Other

Canada: WHMIS classification: Class D; Division 2, Subdivision A - Canadian Environmental Protection Act (CEPA): All constituents of these products are on the Domestic Substance List (DSL). USA EPA Toxic Substance Control Act: All constituents of these products are on the TSCA inventory list or are excluded from listing. This product contains or produces a chemical known to the state of California to cause cancer and birth defects (or other reproductive harm). (California Health & Safety Code § 25249.5 et seq.) Spills or releases resulting in the loss of any ingredient at or above its RQ require immediate notification to the National Response Center and to your Local Emergency Planning Committee. SDS Developed in accordance with EU Regulation (EC) No. 1907/2006 (REACH).

SECTION 16:Other information'

This Safety Data Sheet has been revised due to modifications to Sections 1-16.

Changes to previous revision

American National Standard Z49.1 "Safety in Welding and Cutting", ANSI/AWS F1.5 "Methods for Sampling and Analyzing Gases from Welding and Allied Processes", Refer to ESAB "Welding and Cutting - Risks and Measures", F52-529 "Precautions and Safe Practices for Electric Welding and Cutting" and F2035 "Precautions and Safe Practices for Gas Welding, Cutting and Heating" available from ESAB, and to: www.esab.com

References to key literature and data sources

Other

Manufacturer's notes

ESAB requests the users of this product to study this Safety Data Sheet (SDS) and become aware of product hazards and safety information. To promote safe use of this product a user should: -notify its employees, agents and contractors of the information on this SDS and any product hazards/safety information. -furnish this same information to each of its customers for this product. -request such customers to notify employees and customers for the same product hazards and safety information. The information herein is given in good faith and based on technical data that ESAB believes to be reliable. Since the conditions of use is outside our control, we assume no liability in connection with any use of this information and no warranty, expressed or implied is given. Contact ESAB for more information.

Appendix for 8.1 National Occupational Exposure Limits

Nickel (7440-02-0)		
Austria Austria	TEL TRK (mg/m ³) OEL chemical category (AT)	0,5 mg/m ³ (dust, inhalable fraction) Group A1 Carcinogen dust/aerosol, Respiratory sensitizer dust, Skin sensitizer
Belgium Bulgaria Bulgaria	Limit value (mg/m ³) OEL TWA (mg/m ³) Bulgaria - BEI	1 mg/m ³ 0,05 mg/m ³ 45 µg/l (Medium: urine - Time: after several shifts - Parameter: Nickel)
Croatia Croatia	GVI (granična vrijednost izloženosti) (mg/m ³) OEL chemical category (HR)	0,5 mg/m ³ Carcinogen category 3
France France	VME (mg/m ³) OEL chemical category (FR)	1 mg/m ³ 1 mg/m ³ (metal gratings) Carcinogen category 2
Greece	OEL TWA (mg/m ³)	1 mg/m ³
USA ACGIH	ACGIH TWA (mg/m ³)	1,5 mg/m ³ (inhalable fraction)
Latvia	OEL TWA (mg/m ³)	0,05 mg/m ³
Spain Spain	VLA-ED (mg/m ³) OEL chemical category (ES)	1 mg/m ³ (manufacturing, commercialization and use restrictions according to REACH) C1A, Sensitizer
Switzerland Switzerland Switzerland	VME (mg/m ³) OEL chemical category (CH) Switzerland - BEI	0,5 mg/m ³ (inhalable dust) Category C3 carcinogen, Sensitizer 45 µg/l (Medium: urine - Time: end of shift, and after several shifts (for long- term exposures) - Parameter: Nickel (N))
United Kingdom United Kingdom United Kingdom	WEL TWA (mg/m ³) WEL STEL (mg/m ³) WEL chemical category	0,5 mg/m ³ 1,5 mg/m ³ (calculated) Potential for cutaneous absorption
Czech Republic Czech Republic Czech Republic	Expoziční limity (PEL) (mg/m ³) OEL chemical category (CZ) Czech Republic - BEI	0,5 mg/m ³ Sensitizer 0,077 µmol/mmol Creatinine (Medium: urine - Time: discretionary - Parameter: Nickel) 0,04 mg/g Kreatinin (Medium: urine - Time: discretionary - Parameter: Nickel)
Denmark	Grænseværdie (langvarig) (mg/m ³)	0,05 mg/m ³ (dust and powder)
Estonia Estonia	OEL TWA (mg/m ³) OEL chemical category (ET)	0,5 mg/m ³ Sensitizer
Finland Finland	HTP-arvo (8h) (mg/m ³) Finland - BEI	0,01 mg/m ³ 0,1 µmol/l (Medium: urine - Time: end of shift at end of workweek - Parameter: Nickel)
Hungary Hungary	MK-érték OEL chemical category (HU)	0,1 mg/m ³ Carcinogenic substance, Sensitizer
Ireland Ireland	OEL (8 hours ref) (mg/m ³) OEL (15 min ref) (mg/m ³)	0,5 mg/m ³ 1,5 mg/m ³ (calculated)
Lithuania	IPRV (mg/m ³)	0,5 mg/m ³

Appendix for 8.1 National Occupational Exposure Limits

Chromium (7440-47-3)		
EU	IOELV TWA (mg/m ³)	2 mg/m ³
Austria	MAK (mg/m ³)	2 mg/m ³
Belgium	Limit value (mg/m ³)	0,5 mg/m ³
Bulgaria	OEL TWA (mg/m ³)	2,0 mg/m ³
Croatia	GVI (granična vrijednost izloženosti) (mg/m ³)	2 mg/m ³
Cyprus	OEL TWA (mg/m ³)	2 mg/m ³
France France	VME (mg/m ³) France - BEI	2 mg/m ³ (indicative limit) 0,01 mg/g Kreatinin (Medium: urine - Time: augmented during shift - Parameter: Total Chromium (Background noise on non-exposed subjects (soluble aerosol)) 0,03 mg/g Kreatinin (Medium: urine - Time: end of shift at end of workweek - Parameter: Total Chromium (Background noise on non-exposed subjects (soluble aerosol))
Germany	TRGS 900 Occupational exposure limit value (mg/m ³)	2 mg/m ³ (inhalable fraction)
Gibraltar	OEL TWA (mg/m ³)	2 mg/m ³
Greece	OEL TWA (mg/m ³)	1 mg/m ³
USA ACGIH	ACGIH TWA (mg/m ³)	0,5 mg/m ³
Italy	OEL TWA (mg/m ³)	0,5 mg/m ³
Latvia Latvia	OEL TWA (mg/m ³) Latvia - BEI	2 mg/m ³ 10 µg/g creatinine (Medium: urine - Time: change of shift - Parameter: Chromium (reference value for total Chromium concentration for occupationally unexposed population in blood <0.5µg/L, and in urine 0.5 g/L)
Spain	VLA-ED (mg/m ³)	2 mg/m ³ (indicative limit value)
Switzerland	VME (mg/m ³)	0,5 mg/m ³ (inhalable dust)
Switzerland	OEL chemical category (CH)	Sensitizer
Netherlands	Grenswaarde TGG 8H (mg/m ³)	0,5 mg/m ³
United Kingdom United Kingdom	WEL TWA (mg/m ³) WEL STEL (mg/m ³)	WEL TWA (mg/m ³) 0,5 mg/m ³
Czech Republic	Expoziční limity (PEL) (mg/m ³)	1,5 mg/m ³ (calculated)
Denmark	Grænseværdie (langvarig) (mg/m ³)	0,5 mg/m ³ (dust)
Estonia	OEL TWA (mg/m ³)	0,5 mg/m ³ (powder)
Finland	HTP-arvo (8h) (mg/m ³)	2 mg/m ³

Appendix for 8.1 National Occupational Exposure Limits

Chromium (7440-47-3)		
Hungary	AK-érték	0,005 mg/m ³
Hungary	OEL chemical category (HU)	2 mg/m ³
Ireland	OEL (8 hours ref) (mg/m ³)	Sensitizer
Ireland	OEL (15 min ref) (mg/m ³)	2 mg/m ³
Lithuania	IPRV (mg/m ³)	6 mg/m ³ (calculated)
Luxembourg	OEL TWA (mg/m ³)	2 mg/m ³
Malta	OEL TWA (mg/m ³)	2 mg/m ³
Norway	Grønseverdier (AN) (mg/m ³)	2 mg/m ³
Norway	Grønseverdier (Korttidsverdi) (mg/m ³)	0,5 mg/m ³
Poland	NDS (mg/m ³)	0,5 mg/m ³
Romania	OEL TWA (mg/m ³)	0,5 mg/m ³
Romania	OEL chemical category (RO)	0,05 mg/m ³ (from metallurgy) 2 mg/m ³ (metallic)
Romania	Romania - BEI	Carcinogen from metallurgy
Slovenia	OEL TWA (mg/m ³)	10 µg/g creatinine (Medium: urine - Time: during working hours - Parameter: Chrome) 30 µg/g creatinine (Medium: urine - Time: end of work week - Parameter: Chrome)
Sweden	nivågränsvärde (NVG) (mg/m ³)	2 mg/m ³
Portugal	OEL TWA (mg/m ³)	0,5 mg/m ³ (total dust)
Portugal	OEL chemical category (PT)	2 mg/m ³ (indicative limit value)

Copper (7440-50-8)		
Austria	MAK (mg/m ³)	1 mg/m ³ (inhalable fraction) 0,1 mg/m ³ (respirable fraction, smoke)
Austria	MAK Short time value (mg/m ³)	4 mg/m ³ (inhalable fraction) 0,4 mg/m ³ (respirable fraction, smoke)
Belgium	Limit value (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust and mist)
Bulgaria	OEL TWA (mg/m ³)	0,1 mg/m ³ (metal vapor)
Croatia	GVI (granična vrijednost izloženosti) (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust)
Croatia	KGVI (kratkotrajna granična vrijednost izloženosti) (mg/m ³)	2 mg/m ³ (dust and fume)
France	VLE (mg/m ³)	2 mg/m ³ (dust)
France	VME (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust)

Appendix for 8.1 National Occupational Exposure Limits

Copper (7440-50-8)		
Greece	OEL TWA (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust)
Greece	OEL STEL (mg/m ³)	2 mg/m ³ (dust)
USA ACGIH	ACGIH TWA (mg/m ³)	0,2 mg/m ³ (fume)
Latvia	OEL TWA (mg/m ³)	0,5 mg/m ³
Spain	VLA-ED (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust and mist)
Switzerland	VLE (mg/m ³)	0,2 mg/m ³ (inhalable dust)
Switzerland	VME (mg/m ³)	0,1 mg/m ³ (inhalable dust)
Netherlands	Grenswaarde TGG 8H (mg/m ³)	0,1 mg/m ³ (inhalable fraction)
United Kingdom	WEL TWA (mg/m ³)	1 mg/m ³ (dust and mists) 0,2 mg/m ³ (fume)
United Kingdom	WEL STEL (mg/m ³)	0,6 mg/m ³ (calculated-fume) 2 mg/m ³ (dust and mist)
Czech Republic	Expoziční limity (PEL) (mg/m ³)	1 mg/m ³ (dust) 0,1 mg/m ³ (fume)
Denmark	Grænseværdie (langvarig) (mg/m ³)	1,0 mg/m ³ (dust and powder) 0,1 mg/m ³ (fume)
Estonia	OEL TWA (mg/m ³)	1 mg/m ³ (total dust) 0,2 mg/m ³ (respirable dust)
Finland	HTP-arvo (8h) (mg/m ³)	1 mg/m ³ 0,1 mg/m ³ (respirable dust and fume)
Hungary	AK-érték	1 mg/m ³ 0,1 mg/m ³ (fume)
Hungary	CK-érték	4 mg/m ³ 0,4 mg/m ³ (fume)
Ireland	OEL (8 hours ref) (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust and mist)
Ireland	OEL (15 min ref) (mg/m ³)	0,6 mg/m ³ (calculated-fume) 2 mg/m ³ (dust and mist)
Lithuania	IPRV (mg/m ³)	1 mg/m ³ (inhalable fraction) 0,2 mg/m ³ (respirable fraction)
Norway	Grenseverdier (AN) (mg/m ³)	0,1 mg/m ³ (fume) 1 mg/m ³ (dust)
Norway	Grenseverdier (Korttidsverdi) (mg/m ³)	0,1 mg/m ³ (fume) 1 mg/m ³ (dust)
Poland	NDS (mg/m ³)	0,2 mg/m ³
Romania	OEL TWA (mg/m ³)	0,50 mg/m ³ (powder)
Romania	OEL STEL (mg/m ³)	0,20 mg/m ³ (fume) 1,50 mg/m ³ (dust)

Appendix for 8.1 National Occupational Exposure Limits

Copper (7440-50-8)		
Slovakia	NPHV (priemerná) (mg/m ³)	1 mg/m ³ (dust) 0,1 mg/m ³ (fume)
Slovakia	NPHV (Hraničná) (mg/m ³)	2 mg/m ³ (dust) 0,2 mg/m ³ (fume)
Slovenia	OEL TWA (mg/m ³)	1 mg/m ³ (inhalable fraction) 0,1 mg/m ³ (respirable fraction, fume)
Slovenia	OEL STEL (mg/m ³)	4 mg/m ³ (inhalable fraction) 0,4 mg/m ³ (respirable fraction, fume)
Sweden	nivågränsvärde (NVG) (mg/m ³)	1 mg/m ³ (total dust) 0,2 mg/m ³ (respirable dust)
Portugal	OEL TWA (mg/m ³)	0,2 mg/m ³ (fume) 1 mg/m ³ (dust and mist)

Chromium (7440-47-3)		
EU	IOELV TWA (mg/m ³)	2 mg/m ³
Austria	MAK (mg/m ³)	2 mg/m ³
Belgium	Limit value (mg/m ³)	0,5 mg/m ³
Bulgaria	OEL TWA (mg/m ³)	2,0 mg/m ³
Croatia	GVI (granična vrijednost izloženosti) (mg/m ³)	2 mg/m ³
Cyprus	OEL TWA (mg/m ³)	2 mg/m ³
France	VME (mg/m ³)	2 mg/m ³ (indicative limit)
France	France - BEI	0,01 mg/g Kreatinin (Medium: urine - Time: augmented during shift - Parameter: Total Chromium (Background noise on non-exposed subjects (soluble aerosol)) 0,03 mg/g Kreatinin (Medium: urine - Time: end of shift at end of workweek - Parameter: Total Chromium (Background noise on non-exposed subjects (soluble aerosol))
Germany	TRGS 900 Occupational exposure limit value (mg/m ³)	2 mg/m ³ (inhalable fraction)
Gibraltar	OEL TWA (mg/m ³)	2 mg/m ³
Greece	OEL TWA (mg/m ³)	1 mg/m ³
USA ACGIH	ACGIH TWA (mg/m ³)	0,5 mg/m ³
Italy	OEL TWA (mg/m ³)	0,5 mg/m ³

Chromium (7440-47-3)		
Latvia Latvia	OEL TWA (mg/m ³) Latvia - BEI	2 mg/m ³ 10 µg/g creatinine (Medium: urine - Time: change of shift - Parameter: Chromium (reference value for total Chromium concentration for occupationally unexposed population in blood <0.5µg/L, and in urine 0.5 g/L)
Spain	VLA-ED (mg/m ³)	2 mg/m ³ (indicative limit value)
Switzerland Switzerland	VME (mg/m ³) OEL chemical category (CH)	0,5 mg/m ³ (inhalable dust) Sensitizer
Netherlands	Grenswaarde TGG 8H (mg/m ³)	0,5 mg/m ³
United Kingdom United Kingdom	WEL TWA (mg/m ³) WEL STEL (mg/m ³)	0,5 mg/m ³ 1,5 mg/m ³ (calculated)
Czech Republic	Expoziční limity (PEL) (mg/m ³)	0,5 mg/m ³ (dust)
Denmark	Grænseværdie (langvarig) (mg/m ³)	0,5 mg/m ³ (powder)
Estonia	OEL TWA (mg/m ³)	2 mg/m ³
Finland	HTP-arvo (8h) (mg/m ³)	0,005 mg/m ³
Hungary Hungary	AK-érték OEL chemical category (HU)	2 mg/m ³ Sensitizer
Ireland Ireland	OEL (8 hours ref) (mg/m ³) OEL (15 min ref) (mg/m ³)	2 mg/m ³ 6 mg/m ³ (calculated)
Lithuania	IPRV (mg/m ³)	2 mg/m ³
Luxembourg	OEL TWA (mg/m ³)	2 mg/m ³
Malta	OEL TWA (mg/m ³)	2 mg/m ³
Norway Norway	Grenseverdier (AN) (mg/m ³) Grenseverdier (Korttidsverdi) (mg/m ³)	0,5 mg/m ³ 0,5 mg/m ³
Poland	NDS (mg/m ³)	0,5 mg/m ³
Romania Romania Romania	OEL TWA (mg/m ³) OEL chemical category (RO) Romania - BEI	0,05 mg/m ³ (from metallurgy) 2 mg/m ³ (metallic) Carcinogen from metallurgy 10 µg/g creatinine (Medium: urine - Time: during working hours - Parameter: Chrome) 30 µg/g creatinine (Medium: urine - Time: end of work week - Parameter: Chrome)

Chromium (7440-47-3)		
Slovenia	OEL TWA (mg/m ³)	2 mg/m ³
Sweden	nivågränsvärde (NVG) (mg/m ³)	0,5 mg/m ³ (total dust)
Portugal	OEL TWA (mg/m ³)	2 mg/m ³ (indicative limit value)
Portugal	OEL chemical category (PT)	A4 - Not Classifiable as a Human Carcinogen

Carbon monoxide (630-08-0)		
Austria	MAK (mg/m ³)	33 mg/m ³
Austria	MAK (ppm)	30 ppm
Austria	MAK Short time value (mg/m ³)	66 mg/m ³
Austria	MAK Short time value (ppm)	60 ppm
Belgium	Limit value (mg/m ³)	29 mg/m ³
Belgium	Limit value (ppm)	25 ppm
Bulgaria	OEL TWA (mg/m ³)	40 mg/m ³
Bulgaria	OEL STEL (mg/m ³)	200 mg/m ³
Bulgaria	Bulgaria - BEI	5 % (Medium: blood - Time: at the end of exposure or end of shift - Parameter: Carboxyhemoglobin)
Croatia	GVI (granična vrijednost izloženosti) (mg/m ³)	35 mg/m ³
Croatia	GVI (granična vrijednost izloženosti) (ppm)	30 ppm
Croatia	KGVI (kratkotrajna granična vrijednost izloženosti) (mg/m ³)	232 mg/m ³
Croatia	KGVI (kratkotrajna granična vrijednost izloženosti) (ppm)	200 ppm
Croatia	OEL chemical category (HR)	Reproductive Toxin category 1

Carbon monoxide (630-08-0)		
Croatia	Croatia - BEI	12,5 ml/l (Medium: blood - Time: at the end of the shift - Parameter: Carbon monoxide (Smoking significantly increases the occurrence)) (Medium: blood - Time: at the end of the shift - Parameter: Carboxyhemoglobin (Smoking significantly increases the occurrence)) 18 ppm (Medium: final exhaled air - Time: at the end of the shift - Parameter: Carbon monoxide (Smoking significantly increases the occurrence))
France	VME (mg/m ³)	55 mg/m ³
France	VME (ppm)	50 ppm
France	OEL chemical category (FR)	Reproductive Toxin category 1A
France	France - BEI	(Medium: blood - Parameter: Carbon monoxide) 3,5 % of hemoglobin (Medium: blood - Time: end of shift - Parameter: Carboxyhemoglobin (Background noise on nonexposed subjects, Non-specific (observed after the exposure to other substances)))
Germany	TRGS 900 Occupational exposure limit value (mg/m ³)	35 mg/m ³ (The risk of damage to the embryo or fetus cannot be excluded even when AGW and BGW values are observed)
Germany	TRGS 900 Occupational exposure limit value (ppm)	30 ppm (The risk of damage to the embryo or fetus cannot be excluded even when AGW and BGW values are observed)
Germany	TRGS 903 (BGW)	5 % (Medium: whole blood - Time: end of shift - Parameter: CO-Hb (derivation of biological threshold limit due to acute toxic effects))
Greece	OEL TWA (mg/m ³)	55 mg/m ³
Greece	OEL TWA (ppm)	50 ppm
Greece	OEL STEL (mg/m ³)	330 mg/m ³
Greece	OEL STEL (ppm)	300 ppm

Appendix for 8.1 National Occupational Exposure Limits

Carbon monoxide (630-08-0)		
USA ACGIH	ACGIH TWA (ppm)	25 ppm
Latvia	OEL TWA (mg/m ³)	20 mg/m ³
Spain	VLA-ED (mg/m ³)	29 mg/m ³
Spain	VLA-ED (ppm)	25 ppm
Spain	OEL chemical category (ES)	TR1A
Spain	Spain - BEI	(Medium: blood - Time: end of shift - Parameter: Carboxyhemoglobin) 20 ppm (Medium: alveolar air - Time: end of shift - Parameter: CO)
Switzerland	VLE (mg/m ³)	70 mg/m ³
Switzerland	VLE (ppm)	60 ppm
Switzerland	VME (mg/m ³)	35 mg/m ³
Switzerland	VME (ppm)	30 ppm
Switzerland	Switzerland - BEI	5 % (Medium: whole blood - Time: end of shift - Parameter: Carbon monoxide in hemoglobin (N, T, X))
Netherlands	Grenswaarde TGG 8H (mg/m ³)	29 mg/m ³
United Kingdom	WEL TWA (mg/m ³)	35 mg/m ³
United Kingdom	WEL TWA (ppm)	30 ppm
United Kingdom	WEL STEL (mg/m ³)	232 mg/m ³
United Kingdom	WEL STEL (ppm)	200 ppm
Czech Republic	Expoziční limity (PEL) (mg/m ³)	30 mg/m ³
Czech Republic	Czech Republic - BEI	5 % of hemoglobin (Medium: blood - Time: end of shift - Parameter: Carbonylhemoglobin)
Denmark	Grænseværdie (langvarig) (mg/m ³)	29 mg/m ³
Denmark	Grænseværdie (langvarig) (ppm)	25 ppm
Estonia	OEL TWA (mg/m ³)	40 mg/m ³ 25 mg/m ³ (in exhaust)
Estonia	OEL TWA (ppm)	35 ppm 20 ppm (in exhaust)
Estonia	OEL STEL (mg/m ³)	120 mg/m ³
Estonia	OEL STEL (ppm)	100 ppm

Carbon monoxide (630-08-0)		
Estonia	OEL chemical category (ET)	Reproductive toxin
Finland	HTP-arvo (8h) (mg/m ³)	35 mg/m ³
Finland	HTP-arvo (8h) (ppm)	30 ppm
Finland	HTP-arvo (15 min)	87 mg/m ³
Finland	HTP-arvo (15 min) (ppm)	75 ppm
Hungary	AK-érték	33 mg/m ³
Hungary	CK-érték	66 mg/m ³
Hungary	OEL chemical category (HU)	Repr1A
Ireland	OEL (8 hours ref) (mg/m ³)	23 mg/m ³
Ireland	OEL (8 hours ref) (ppm)	20 ppm
Ireland	OEL (15 min ref) (mg/m ³)	115 mg/m ³
Ireland	OEL (15 min ref) (ppm)	100 ppm
Lithuania	IPRV (mg/m ³)	40 mg/m ³ 25 mg/m ³ (if the sources are from engines exhaust gases)
Lithuania	IPRV (ppm)	35 ppm 20 ppm (if the sources are from engines exhaust gases)
Lithuania	TPRV (mg/m ³)	120 mg/m ³ (including if the sources are from engines exhaust gases)
Lithuania	TPRV (ppm)	100 ppm (including if the sources are from engines exhaust gases)
Lithuania	OEL chemical category (LT)	Reproductive toxin
Norway	Grenseverdier (AN) (mg/m ³)	29 mg/m ³
Norway	Grenseverdier (AN) (ppm)	25 ppm
Norway	Grenseverdier (Korttidsverdi) (mg/m ³)	29 mg/m ³ (listed in the List of Administrative Norms. Written instructions shall be prepared for work in CO atmosphere if the STEL limit is exceeded)
Norway	Grenseverdier (Korttidsverdi) (ppm)	25 ppm (listed in the List of Administrative Norms. Written instructions shall be prepared for work in CO atmosphere if the STEL limit is exceeded)
Poland	NDS (mg/m ³)	23 mg/m ³
Poland	NDSch (mg/m ³)	117 mg/m ³

Carbon monoxide (630-08-0)		
Romania	OEL TWA (mg/m ³)	20 mg/m ³
Romania	OEL TWA (ppm)	17,5 ppm
Romania	OEL STEL (mg/m ³)	30 mg/m ³
Romania	OEL STEL (ppm)	26 ppm
Slovakia	NPHV (priemerná) (mg/m ³)	35 mg/m ³
Slovakia	NPHV (priemerná) (ppm)	30 ppm
Slovakia	NPHV (Hraničná) (mg/m ³)	70 mg/m ³
Slovakia	Slovakia - BEI	5 % of hemoglobin (Medium: blood - Time: end of exposure or work shift - Parameter: Carboxyhemoglobin)
Slovenia	OEL TWA (mg/m ³)	35 mg/m ³
Slovenia	OEL TWA (ppm)	30 ppm
Slovenia	OEL STEL (mg/m ³)	70 mg/m ³
Slovenia	OEL STEL (ppm)	60 ppm
Slovenia	OEL chemical category (SL)	Category 1A
Sweden	nivågränsvärde (NVG) (mg/m ³)	25 mg/m ³ (total of CO) 40 mg/m ³
Sweden	nivågränsvärde (NVG) (ppm)	35 ppm 20 ppm (total of CO)
Sweden	kortidsvärde (KTV) (mg/m ³)	120 mg/m ³
Sweden	kortidsvärde (KTV) (ppm)	100 ppm
Portugal	OEL TWA (ppm)	25 ppm

Ozone (10028-15-6)		
Austria	MAK (mg/m ³)	0,2 mg/m ³
Austria	MAK (ppm)	0,1 ppm
Austria	MAK Short time value (mg/m ³)	0,4 mg/m ³
Austria	MAK Short time value (ppm)	0,2 ppm
Austria	OEL chemical category (AT)	Group B Carcinogen
Bulgaria	OEL TWA (mg/m ³)	0,2 mg/m ³
Bulgaria	OEL STEL (mg/m ³)	0,6 mg/m ³
Croatia	KGVI (kratkotrajna granična vrijednost izloženosti) (mg/m ³)	0,4 mg/m ³

Ozone (10028-15-6)		
Croatia	KGVI (kratkotrajna granična vrijednost izloženosti) (ppm)	0,2 ppm
France	VLE (mg/m ³)	0,4 mg/m ³
France	VLE (ppm)	0,2 ppm
France	VME (mg/m ³)	0,2 mg/m ³
France	VME (ppm)	0,1 ppm
Greece	OEL TWA (mg/m ³)	0,2 mg/m ³
Greece	OEL TWA (ppm)	0,1 ppm
Greece	OEL STEL (mg/m ³)	0,6 mg/m ³
Greece	OEL STEL (ppm)	0,3 ppm
USA ACGIH	ACGIH TWA (ppm)	0,05 ppm (heavy work) 0,08 ppm (moderate work) 0,10 ppm (light work) 0,20 ppm (heavy, moderate or light workloads, <=2 hours)
Latvia	OEL TWA (mg/m ³)	0,1 mg/m ³
Spain	VLA-ED (mg/m ³)	0,1 mg/m ³ (heavy work) 0,16 mg/m ³ (moderate work) 0,2 mg/m ³ (light work) 0,4 mg/m ³ (heavy, moderate or light work <=2 hours)
Spain	VLA-ED (ppm)	0,05 ppm (heavy work) 0,08 ppm (moderate work) 0,1 ppm (light work) 0,2 ppm (heavy, moderate or light work <=2 hours)
Switzerland	VLE (mg/m ³)	0,2 mg/m ³
Switzerland	VLE (ppm)	0,1 ppm
Switzerland	VME (mg/m ³)	0,2 mg/m ³
Switzerland	VME (ppm)	0,1 ppm
Switzerland	OEL chemical category (CH)	Category C3 carcinogen
Netherlands	Grenswaarde TGG 8H (mg/m ³)	0,12 mg/m ³ (1 hour)
United Kingdom	WEL STEL (mg/m ³)	0,4 mg/m ³
United Kingdom	WEL STEL (ppm)	0,2 ppm
Czech Republic	Expoziční limity (PEL) (mg/m ³)	0,1 mg/m ³
Denmark	Grænseværdie (ceiling) (mg/m ³)	0,2 mg/m ³

Appendix for 8.1 National Occupational Exposure Limits

Ozone (10028-15-6)		
Denmark	Grænseværdie (ceiling) (ppm)	0,1 ppm
Estonia	OEL TWA (mg/m ³)	0,2 mg/m ³
Estonia	OEL TWA (ppm)	0,1 ppm
Estonia	OEL Ceiling (mg/m ³)	0,6 mg/m ³
Estonia	OEL Ceiling (ppm)	0,3 ppm
Finland	HTP-arvo (8h) (mg/m ³)	0,1 mg/m ³
Finland	HTP-arvo (8h) (ppm)	0,05 ppm
Finland	HTP-arvo (15 min)	0,4 mg/m ³
Finland	HTP-arvo (15 min) (ppm)	0,2 ppm
Hungary	AK-érték	0,2 mg/m ³
Hungary	CK-érték	0,2 mg/m ³
Ireland	OEL (8 hours ref) (ppm)	0,05 ppm (heavy work) 0,08 ppm (moderate work) 0,10 ppm (light work) 0,20 ppm (heavy, moderate or light workloads <= 2 hours)
Ireland	OEL (15 min ref) (ppm)	0,15 ppm (calculated) 0,24 ppm (calculated) 0,30 ppm (calculated) 0,60 ppm (calculated)
Lithuania	IPRV (mg/m ³)	0,2 mg/m ³
Lithuania	IPRV (ppm)	0,1 ppm
Lithuania	NRV (mg/m ³)	0,6 mg/m ³
Lithuania	NRV (ppm)	0,3 ppm
Norway	Grenseverdier (AN) (mg/m ³)	0,2 mg/m ³
Norway	Grenseverdier (AN) (ppm)	0,1 ppm
Norway	Grenseverdier (Korttidsverdi) (mg/m ³)	0,2 mg/m ³
Norway	Grenseverdier (Korttidsverdi) (ppm)	0,1 ppm
Poland	NDS (mg/m ³)	0,15 mg/m ³
Romania	OEL TWA (mg/m ³)	0,10 mg/m ³
Romania	OEL TWA (ppm)	0,05 ppm
Romania	OEL STEL (mg/m ³)	0,20 mg/m ³
Romania	OEL STEL (ppm)	0,1 ppm
Slovakia	NPHV (priemerná) (mg/m ³)	0,2 mg/m ³

Ozone (10028-15-6)		
Slovakia	NPHV (priemerná) (ppm)	0,1 ppm
Slovakia	NPHV (Hraničná) (mg/m ³)	0,4 mg/m ³
Slovenia	OEL TWA (mg/m ³)	0,2 mg/m ³
Slovenia	OEL TWA (ppm)	0,1 ppm
Slovenia	OEL STEL (mg/m ³)	0,2 mg/m ³
Slovenia	OEL STEL (ppm)	0,1 ppm
Sweden	nivågränsvärde (NVG) (mg/m ³)	0,2 mg/m ³
Sweden	nivågränsvärde (NVG) (ppm)	0,1 ppm
Sweden	takgränsvärde (TGV) (mg/m ³)	0,6 mg/m ³
Sweden	takgränsvärde (TGV) (ppm)	0,3 ppm
Portugal	OEL TWA (ppm)	0,05 ppm (heavy work) 0,08 ppm (moderate work) 0,10 ppm (light work) 0,20 ppm (heavy, moderate or light work, less than or equal to 2 hours)
Portugal	OEL chemical category (PT)	A4 - Not Classifiable as a Human Carcinogen

Welding fumes (RR-00009-9)		
Austria	MAK (mg/m ³)	5 mg/m ³ (respirable fraction)
Belgium	Limit value (mg/m ³)	5 mg/m ³ (except if otherwise specified)
France	VME (mg/m ³)	5 mg/m ³ (total particulates)
Czech Republic	Expoziční limity (PEL) (mg/m ³)	5,0 mg/m ³ (particles)
Ireland	OEL (8 hours ref) (mg/m ³)	5 mg/m ³
Ireland	OEL (15 min ref) (mg/m ³)	15 mg/m ³ (calculated)
Norway	Grenseverdier (AN) (mg/m ³)	5 mg/m ³ (not otherwise specified)
Norway	Grenseverdier (Korttidsverdi) (mg/m ³)	10 mg/m ³ (Fumes/Metal fumes containing various substances where each Norm of each substance is observed in addition to the Norm of the Welding fumes)