CHEMICAL SAFETY REPORT

Update 3: Submitted September 2021

(Replaces 2nd Update May 2016, 1st Update July 2013 and original version submitted 2010)

Substance Name: molybdenum
EC Number: 231-107-2
CAS Number: 7439-98-7
Registrant's Identity: Joint CSR submitted by the Lead Registrant (Plansee SE) on behalf of all members of the joint submission MOCONJS-MO. Document prepared by the IMOA REACH Molybdenum Consortium (MoCon)

See also the ***2014 OECD Highly Soluble Molybdenum Salts Mutual Acceptance of Data (MAD) dataset (containing primarily sodium molybdate data used for read-across in many instances in this CSR),*** which is attached in IUCLID Section 13. The afore-mentioned MAD status data is:

1) likewise contained in the relevant individual sections within this CSR.
2) also downloadable from the OECD website at:

https://hpvchemicals.oecd.org/UI/SIDS_Details.aspx?id=5c88d62f-4401-4cad-b521-521a4bd710f3

Several supporting documents/reports are to be considered together with the CSR. They are referenced in the CSR, and are attached in the technical registration dossier in IUCLID section 13.2:

- MoCon read-across concept/justification for human health hazards
- MoCon read-across concept/justification for environmental hazards
- Speciation of molybdenum compounds in water: UV spectra (in support of the above)
- DNEL derivation report
- Background document – Environmental Effects Assessments *(updated July 2021)*
- Background document – Environmental Fate properties *(updated May 2021)*
- Background document – Regional / ambient monitoring data (water, soil, sediment)
- OECD SIDS Initial Assessment Profile (SIAP), containing the dataset with MAD status
- List of assessors (list of professionals that contributed to the registration dossier).

2. MANUFACTURE AND USES

Table 6. Quantities (in tonnes/year)

Year	Tonnages (tonnes per year)
-	For confidentiality reasons the data on manufactured or imported **quantities per registrant are not provided in this joint CSR**, but are instead provided by each individual registrant of this substance in their technical registration dossier (section 3.2 in IUCLID).

2.1. Manufacture

Table 7. Manufacture

	Manufacture
M-1	**Manufacture of molybdenum powder from molybdenum trioxide** Further description of manufacturing process: **Production of Mo metal powder:** Molybdenum metal is produced by reduction of high- purity molybdenum compounds (molybdenum trioxide, ammonium heptamolybdate, ammonium dimolybdate) with hydrogen. The reduction process is usually performed in two stages: In the first step of the process molybdenum trioxide (MoO3) is reduced in an exothermic process (>400°C) to molybdenum dioxide (MoO2). The second reduction stage, in which the metal powder is produced, takes place at >1000°C. The process can be carried out either in a pusher furnace, a walking beam furnace or a rotary kiln where the hydrogen is led in a counter current flow. Reference to process description: BAT-reference document for the non-ferrous metal industries (Oct. 2014) Contributing activity/technique for the environment : **- ERC1: Manufacture of the substance** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 5: Mixing or blending in batch processes** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC 27a: Production of metal powders (hot processes)** **- PROC28: Manual maintenance (cleaning and repair) of machinery** Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
M-2	**Manufacture of molybdenum solids from molybdenum powder** Further description of manufacturing process: Contributing activity/technique for the environment : **- ERC1: Manufacture of the substance** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation**

	- PROC 26: Handling of solid inorganic substances at ambient temperature **- PROC28: Manual maintenance (cleaning and repair) of machinery** Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
M-3	**Manufacture of molybdenum within steel & alloy matrices** Further description of manufacturing process: **Production of Mo metal during Ferromolybdenum production:** Molybdenum metal is produced during the manufacture of ferromolybdenum. Ferromolybdenum is an alloy (special preparation) of molybdenum and iron. It is produced by a metallo-thermic reduction of molybdenum oxides in a smelting operation. Molybdenum sulfide (MoS2), roasted, CAS-number 86089-09-0 (also called Roasted Molybdenite Concentrate, RMC) is converted into metallic molybdenum and alloyed with iron to manufacture ferromolybdenum by the following silicothermic reduction reaction: 2 MoO3 + 3 Si -> 2 Mo + 3 SiO2 Fe + Mo -> FeMo The smelting operation is a batch process. The reaction takes place in pits, where the refractory-lined steel cylinders are placed into the pits and form crucibles that contain the silicothermic reaction. The reaction takes place when the starting materials are ignited. The smelting process produces an alloy block (ferromolybdenum) and a slag block which are then separated from each other. This well-known smelting process is also described in the European BREF Non-Ferrous Metals Industries (version December 2001, §9.1.6.2.3 p 517). The process flow sheet that illustrates the ferro-molybdenum production steps by silicothermic reduction reaction is described in Figure 2, which is available in the CSR. **Production of Mo metal during Mo-containing steel production:** Molybdenum metal is produced during the production of Mo-containing steels. Mo-containing steels are alloys (special preparations) of iron, molybdenum and other metals. Molybdenum is produced in the steel bath by a reduction of molybdenum oxides and calcium molybdate (smelting operation). Contributing activity/technique for the environment : **- ERC1: Manufacture of the substance** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery**

	Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
M-4	**Manufacture of molybdenum metal from catalysts** Further description of manufacturing process: Contributing activity/technique for the environment : **- ERC1: Manufacture of the substance** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 8b: Transfer of substance or mixture (charging and discharging) at dedicated facilities [EU REACH]** **- PROC 9: Transfer of substance or mixture into small containers (dedicated filling line, including weighing)** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manufacture of machinery** Tonnage of substance for that use: tonnes/year Related assessment: use not assessed Remarks: Reported by European Catalyst Manufacturing Association (ECMA).

2.2. Identified uses

Table 8. Formulation

	Formulation
F-1	**Formulation of molybdenum metal in the production of molybdenum alloy powders** Further description of the use: Contributing activity/technique for the environment : **- ERC3: Formulation into solid matrix** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC 27a: Production of metal powders (hot processes)** **- PROC28: Manufacture of machinery** **Product Category formulated:** PC 7: Base metals and alloys **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year

	Substance supplied to that use: as such Related assessment: use not assessed
F-2	**Formulation of molybdenum metal for powder metallurgy production of molybdenum metal/alloy mixtures** Further description of the use: Contributing activity/technique for the environment : **- ERC3: Formulation into solid matrix** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC 27a: Production of metal powders (hot processes)** **- PROC28: Manufacture and repair) of machinery** **Product Category formulated:** PC 7: Base metals and alloys **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Related assessment: use not assessed
F-3	**Formulation of molybdenum metal for the production of molybdenum-containing steel and alloy mixtures and articles** Further description of the use: Contributing activity/technique for the environment : **- ERC3: Formulation into solid matrix** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manufacture and repair) of machinery** **Product Category formulated:** PC 7: Base metals and alloys **Technical function of the substance:** alloying element; antiscaling agent; corrosion inhibitor; durability agent; hardener; weldability, heat resistance

	Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Related assessment: use not assessed
F-4	**Formulation of molybdenum metal into brake pad materials** Further description of the use: Contributing activity/technique for the environment : **- ERC3: Formulation into solid matrix** Contributing activity/technique for the workers : **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category formulated:** PC 0: Other: Brake pads **Technical function of the substance:** Friction, heat reduction Tonnage of substance for that use: tonnes/year Substance supplied to that use: in a mixture Related assessment: use not assessed
F-5	**Formulation of molybdenum metal into welding consumables** Further description of the use: Contributing activity/technique for the environment : **- ERC3: Formulation into solid matrix** Contributing activity/technique for the workers : **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category formulated:** PC 7: Base metals and alloys **Technical function of the substance:** corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Substance supplied to that use: in a mixture Related assessment: use not assessed
F-6	**Formulation of molybdenum metal at manufacturing site** Further description of the use: Contributing activity/technique for the environment : **- ERC3: Formulation into solid matrix** Contributing activity/technique for the workers : **- PROC 5: Mixing or blending in batch processes** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Technical function of the substance:** no technical function Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such Related assessment: use not assessed

Table 9. Uses at industrial sites

	Uses at industrial sites
IW-2	**Industrial use of molybdenum metal in the powder metallurgy in the production of metal/alloys mixtures and articles**

	Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 5: Mixing or blending in batch processes** **- PROC 13: Treatment of articles by dipping and pouring** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC 27a: Production of metal powders (hot processes)** **- PROC28: Manufacture of machinery** **Product Category used:** PC 7: Base metals and alloys **Sector of end use:** SU 14: Manufacture of basic metals, including alloys; SU 15: Manufacture of fabricated metal products, except machinery and equipment; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles in industrial settings; Service life of molybdenum-containing articles in professional settings; Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed
IW-1	**Production and use of molybdenum alloy powders** Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC 27a: Production of metal powders (hot processes)** **- PROC28: Manufacture of machinery** **Product Category used:** PC 7: Base metals and alloys **Sector of end use:** SU 14: Manufacture of basic metals, including alloys **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent;

	hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles in industrial settings; Service life of molybdenum-containing articles in professional settings; Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed
IW-4	**Industrial use of molybdenum in the production of molybdenum-containing steel and alloy mixtures and articles** Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC 27a: Production of metal powders (hot processes)** **- PROC28: Manufacture (cleaning and repair) of machinery** **Product Category used:** PC 7: Base metals and alloys **Sector of end use:** SU 13: Manufacture of other non-metallic mineral products, e.g. plasters, cement; SU 14: Manufacture of basic metals, including alloys; SU 15: Manufacture of fabricated metal products, except machinery and equipment; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment; SU 19: Building and construction work; SU 24: Scientific research and development **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance. Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles in industrial settings; Service life of molybdenum-containing articles in professional settings; Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed
IW-6	**Industrial use of molybdenum metal in welding consumables** Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 25: Other hot work operations with metals**

	- PROC 26: Handling of solid inorganic substances at ambient temperature **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category used:** PC 38: Welding and soldering products, flux products **Sector of end use:** SU 15: Manufacture of fabricated metal products, except machinery and equipment **Technical function of the substance:** Enhances weldability Tonnage of substance for that use: tonnes/year Substance supplied to that use: in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles in industrial settings; Service life of molybdenum-containing articles in professional settings; Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed
IW-3	**Industrial use of molybdenum metal in coating applications including thermal spray coating** Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 7: Industrial spraying** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category used:** PC 7: Base metals and alloys; PC 9a: Coatings and paints, thinners, paint removes; PC 14: Metal surface treatment products; PC 15: Non-metal-surface treatment products **Sector of end use:** SU 14: Manufacture of basic metals, including alloys; SU 16: Manufacture of computer, electronic and optical products, electrical equipment; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment **Technical function of the substance:** corrosion inhibitor; durability agent; hardener; weldability, heat resistance. Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-coated objects in industrial settings; Service life of molybdenum-coated objects in professional settings; Service life of molybdenum-coated objects used by consumers Related assessment: use not assessed
IW-7	**Industrial use of molybdenum metal as catalyst** Further description of the use: Contributing activity/technique for the environment : **- ERC4: Use of non-reactive processing aid at industrial site (no inclusion into or onto article)** **- ERC6b: Use of reactive processing aid at industrial site (no inclusion into or onto article)** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 26: Handling of solid inorganic substances at ambient temperature**

	- PROC28: Manual maintenance (cleaning and repair) of machinery **Product Category used:** PC 20: Products such as ph-regulators, flocculants, precipitants, neutralisation agents; PC 21: Laboratory chemicals; PC 0: Other: UCN P15500, catalyst **Sector of end use:** SU 8: Manufacture of bulk, large scale chemicals (including petroleum products); SU 9: Manufacture of fine chemicals **Technical function of the substance:** catalyst; processing aid Tonnage of substance for that use: tonnes/year Substance supplied to that use: in a mixture Subsequent service life relevant for that use: no Related assessment: use not assessed
IW-5	**Industrial use of molybdenum metal in brake pad materials** Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 5: Mixing or blending in batch processes** **- PROC 14: Tabletting, compression, extrusion, pelletisation, granulation** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category used:** PC 0: Other: Brake pads **Technical function of the substance:** friction agent; heat transferring agent; heat reduction Tonnage of substance for that use: tonnes/year Substance supplied to that use: in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of brake pads containing molybdenum metal in industrial settings; Service life of brake pads containing molybdenum metal in professional settings Related assessment: use not assessed
IW-9	**Intermediate use of molybdenum metal in the manufacture of carbide powder** Further description of the use: Contributing activity/technique for the environment : **- ERC6a: Use of intermediate** Contributing activity/technique for the workers : **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category used:** PC 7: Base metals and alloys **Sector of end use:** SU 14: Manufacture of basic metals, including alloys **Technical function of the substance:** intermediate (precursor) Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such Subsequent service life relevant for that use: no Related assessment: use not assessed
IW-8	**Industrial use of molybdenum metal in the production of molybdenum alloys** Further description of the use: Contributing activity/technique for the environment : **- ERC5: Use at industrial site leading to inclusion into/onto article** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 5: Mixing or blending in batch processes** **- PROC 6: Calendering operations** **- PROC 21: Low energy manipulation of substances bound in materials and/or articles**

	- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category used:** PC 7: Base metals and alloys **Sector of end use:** SU 8: Manufacture of bulk, large scale chemicals (including petroleum products); SU 14: Manufacture of basic metals, including alloys; SU 16: Manufacture of computer, electronic and optical products, electrical equipment; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment; SU 20: Health services **Technical function of the substance:** durability agent; hardener; high strength, temperature resistance, weldability to alloys Tonnage of substance for that use: tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles in industrial settings; Service life of molybdenum-containing articles in professional settings; Service life of molybdenum-containing implants used by consumers; Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed
IW-10	**Intermediate use of molybdenum metal as catalyst precursor** Further description of the use: Contributing activity/technique for the environment : **- ERC6a: Use of intermediate** Contributing activity/technique for the workers : **- PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions** **- PROC 2: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 3: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment conditions** **- PROC 4: Chemical production where opportunity for exposure arises** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **- PROC28: Manual maintenance (cleaning and repair) of machinery** **Product Category used:** PC 20: Products such as ph-regulators, flocculants, precipitants, neutralisation agents; PC 21: Laboratory chemicals; PC 0: Other: UCN P15500, catalyst **Sector of end use:** SU 8: Manufacture of bulk, large scale chemicals (including petroleum products); SU 9: Manufacture of fine chemicals **Technical function of the substance:** intermediate (precursor) Tonnage of substance for that use: tonnes/year Substance supplied to that use: in a mixture Subsequent service life relevant for that use: no Related assessment: use not assessed

Table 10. Uses by professional workers

	Uses by professional workers
PW-2	**Professional use of molybdenum metal in laboratory analysis** Further description of the use: Contributing activity/technique for the environment : **- ERC8a: Widespread use of non-reactive processing aid (no inclusion into or onto article, indoor)** Contributing activity/technique for the workers : **- PROC 15: Use as laboratory reagent** **Product Category used:** PC 21: Laboratory chemicals **Sector of end use:** SU 9: Manufacture of fine chemicals; SU 24: Scientific research and

	development **Technical function of the substance:** laboratory chemicals Tonnage of substance for that use: tonnes/year Subsequent service life relevant for that use: no Related assessment: use not assessed
PW-1	**Professional use of molybdenum metal in welding consumables** Further description of the use: Contributing activity/technique for the environment : **- ERC8c: Widespread use leading to inclusion into/onto article (indoor)** **- ERC8f: Widespread use leading to inclusion into/onto article (outdoor)** Contributing activity/technique for the workers : **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **Product Category used:** PC 38: Welding and soldering products, flux products **Sector of end use:** SU 15: Manufacture of fabricated metal products, except machinery and equipment **Technical function of the substance:** Enhances weldability Tonnage of substance for that use: tonnes/year Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles in professional settings; Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed
PW-3	**Professional use of molybdenum metal-containing spraying consumables** Further description of the use: Contributing activity/technique for the environment : **- ERC8c: Widespread use leading to inclusion into/onto article (indoor)** **- ERC8f: Widespread use leading to inclusion into/onto article (outdoor)** Contributing activity/technique for the workers : **- PROC 11: Non industrial spraying** **- PROC 25: Other hot work operations with metals** **- PROC 26: Handling of solid inorganic substances at ambient temperature** **Product Category used:** PC 7: Base metals and alloys; PC 9a: Coatings and paints, thinners, paint removes; PC 14: Metal surface treatment products **Sector of end use:** SU 15: Manufacture of fabricated metal products, except machinery and equipment; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment **Technical function of the substance:** Enhances weldability Tonnage of substance for that use: tonnes/year Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-coated objects in professional settings; Service life of molybdenum-coated objects used by consumers Related assessment: use not assessed

Table 11. Consumer uses

	Consumer uses
C-1	**Consumer use of welding consumables** Further description of the use: Contributing activity/technique for the environment: **- ERC8c: Widespread use leading to inclusion into/onto article (indoor)** **- ERC8f: Widespread use leading to inclusion into/onto article (outdoor)** Contributing activity/technique for consumers: **- PC 38: Welding and soldering products, flux products** **Technical function of the substance:** Enhances weldability Tonnage of substance for that use: tonnes/year

	Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of molybdenum-containing articles used by consumers Related assessment: use not assessed

Table 12. Article service life

	Article service life
SL-1	**Service life of molybdenum-containing articles in industrial settings** Further description of the use: Article used by: workers Substance intended to be released from article: **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 3: Electrical batteries and accumulators; AC 7: Metal articles Contributing activity/technique for the environment: **- ERC12a: Processing of articles at industrial sites with low release** **- ERC12b: Processing of articles at industrial sites with high release** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-2	**Service life of molybdenum metal-containing articles in professional settings** Further description of the use: Article used by: workers Substance intended to be released from article: **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 3: Electrical batteries and accumulators; AC 7: Metal articles Contributing activity/technique for the environment: **- ERC10a: Widespread use of articles with low release (outdoor)** **- ERC11a: Widespread use of articles with low release (indoor)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting** **- PROC 23: Open processing and transfer operations with minerals/metals at elevated temperature** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Related assessment: use not assessed

SL-3	**Service life of molybdenum-containing articles used by consumers** Further description of the use: Article used by: consumers Substance intended to be released from article: **Article category related to subsequent service life (AC):** Contributing activity/technique for the environment: **- ERC10a: Widespread use of articles with low release (outdoor)** **- ERC11a: Widespread use of articles with low release (indoor)** Contributing activity/technique for consumers: **- AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 3: Electrical batteries and accumulators; AC 7: Metal articles** Contributing activity/technique for the workers: **Technical function of the substance:** alloying element; corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-4	**Service life of molybdenum-coated objects in industrial settings** Further description of the use: Article used by: workers Substance intended to be released from article: **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles Contributing activity/technique for the environment: **- ERC12a: Processing of articles at industrial sites with low release** **- ERC12b: Processing of articles at industrial sites with high release** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **Technical function of the substance:** corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-5	**Service life of molybdenum-coated objects in professional settings** Further description of the use: Article used by: workers Substance intended to be released from article: **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles Contributing activity/technique for the environment: **- ERC10a: Widespread use of articles with low release (outdoor)** **- ERC11a: Widespread use of articles with low release (indoor)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **- PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles** **- PROC 25: Other hot work operations with metals** **Technical function of the substance:** corrosion inhibitor; durability agent; hardener; weldability, heat resistance Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-6	**Service life of molybdenum-coated objects used by consumers** Further description of the use:

	Article used by: consumers Substance intended to be released from article: **Article category related to subsequent service life (AC):** Contributing activity/technique for the environment: **- ERC10a: Widespread use of articles with low release (outdoor)** **- ERC11a: Widespread use of articles with low release (indoor)** Contributing activity/technique for consumers: **- AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles** Contributing activity/technique for the workers: **Technical function of the substance:** corrosion inhibitor; durability agent; hardener; weldability, heat resistance. Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-7	**Service life of brake pads containing molybdenum metal in industrial settings** Further description of the use: Article used by: workers Substance intended to be released from article: **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles Contributing activity/technique for the environment: **- ERC12a: Processing of articles at industrial sites with low release** **- ERC12b: Processing of articles at industrial sites with high release** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **Technical function of the substance:** friction agent; heat transferring agent Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-8	**Service life of brake pads containing molybdenum metal in professional settings** Further description of the use: Article used by: workers Substance intended to be released from article: **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles Contributing activity/technique for the environment: **- ERC10a: Widespread use of articles with low release (outdoor)** **- ERC10b: Widespread use of articles with high or intended release (outdoor)** **- ERC11a: Widespread use of articles with low release (indoor)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- PROC 21: Low energy manipulation of substances bound in materials and/or articles** **Technical function of the substance:** friction agent; heat transferring agent Tonnage of substance for that use: tonnes/year Related assessment: use not assessed
SL-9	**Service life of molybdenum-containing implants used by consumers** Further description of the use: Article used by: consumers Substance intended to be released from article: **Article category related to subsequent service life (AC):** Contributing activity/technique for the environment: **- ERC11a: Widespread use of articles with low release (indoor)** Contributing activity/technique for consumers: **- AC 7: Metal articles** Contributing activity/technique for the workers: **Technical function of the substance:** corrosion inhibitor; hardener; increases alloy strength

	Tonnage of substance for that use: tonnes/year Remarks: E.g. prosthetic hip replacement joints. Related assessment: use not assessed