

SAFETY AND HEALTH STANDARDS

OCCUPATIONAL EXPOSURE LIMITS

Effective Date: 11/08/13	Standard: 10.7	Document Number: KUCSH0007	Rev: 04
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10.7.1 INTRODUCTION

10.7.1.1 In order to protect personnel at KUC from occupational illness, where feasible workplace hazardous exposures shall be controlled to below Occupational Exposure Limits (OELs) and / or biological test limit values.

10.7.2 DEFINITIONS

10.7.2.1 **AL** – *Action Level* is defined as established levels, typically 50% of the OEL unless mandated otherwise by a regulatory body, which acts as an early warning mechanism for avoiding incidents of over-exposure.

C – *Ceiling Limit* is defined as the concentration of a substance that should not be exceeded even instantaneously during any part of the workday.

OEL - *Occupational Exposure Limits* are levels of agents in workplace air, which it is believed are low enough to protect nearly all workers from adverse health effects over a series of eight-hour shifts for a working lifetime.

BTL - *Biological Test Limit Values* provide a method of determining total exposure to a chemical by measurement of a chemical, a metabolite or a biochemical change in the body. OEL and biological test limit values should be used as guidelines only.

TWA – *Time Weighted Average* is defined as the average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect (adjustments made for extended shifts).

STEL – *Short Term Exposure Limit* is defined as a short term TWA exposure (usually 15 minutes) as long as the TWA is not exceeded. Exposure should not occur more than four (4) times per day and there should be at least 60 minutes between successive exposures in this range.

Sk – A chemical with a *Skin notation* may be absorbed through the skin in significant quantities and cause adverse health effects.

10.7.3 REQUIREMENTS

10.7.3.1 KUC has adopted an OEL for each substance for which significant worker exposure is possible. The list of substances (Exhibit 10.7.1) was derived

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from KUC Material Safety Data Sheets (MSDS), chemical inventories, and process intermediates. The associated OELs were taken from Rio Tinto / OSHA / MSHA / ACGIH Permissible Exposure Limits (PELs) and Threshold Limit Values (TLVs). The KUC OEL and Biological Test Limit Values will take precedence and must be reviewed annually for relevance and efficacy.

- 10.7.3.2 Where workers have a working day longer than eight hours or unusual shift rotations are in effect, the TWA-OEL may need to be reduced by a suitable factor to ensure adequate worker protection. The Quebec Model must be used to determine the appropriate reduction, unless otherwise mandated by a regulatory standard.
- 10.7.3.3 For some substances, the existence of an adverse carcinogenic health effect is known or suspected, but there is no internationally accepted assessment of the appropriate OEL or no agreed practical method to quantify workplace levels. In these cases, exposures to agents meeting these criteria must be as low as reasonably practical (ALARP).
- 10.7.3.4 Where exposure to a chemical that has no defined KUC OEL may occur, the use of the most conservative established Rio Tinto/ Regulatory exposure limit must be adopted.
- 10.7.3.5 In the absence of a STEL a workers exposure should never exceed 3 times the TWA-OEL for no more than 30 minutes during a work day. In the absence of a C a workers exposure should never exceed 5 times the TWA-OEL.
- 10.7.4 **RESPONSIBILITIES**
- 10.7.4.1 HSE personnel are responsible for reviewing the KUC Occupational Exposure Limits annually and making recommendations to the KUC Standards Committee to adjust or amend according to regulatory, Rio Tinto, or new scientific information.

REFERENCE

Rio Tinto Occupational Health Standard B10 Occupational Exposure Limits
 Rio Tinto Occupational Health Standard B10 Guidance Note Occupational Exposure Limits
 Rio Tinto Work Cycle WCMS1301 Environmental and Health Exposure Monitoring
 OSHA 29 CFR Part 1910.1000

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Exhibit 10.7.1

KUC OCCUPATIONAL EXPOSURE LIMITS

Rio Tinto has established additional size selective inhalable fraction limits for Arsenic, Cadmium, Chromium, Copper, Lead, and Silver (WCMS1301). Due to processes across property that generate a wide range of particle sizes, Kennecott may adopt the OSHA exposure limits to comply with regulatory requirements.

Agents (in air)	KUC OEL
Ammonia	25 ppm (TWA) 35 ppm (STEL)
Arsenic	10 µg/m ³ (TWA)
Arsine	0.05 ppm
Asbestos	0.1 f/mL (for all types) 1.0 f/mL (C-30 min.)
Cadmium	5 µg/m ³ (TWA)
Carbon monoxide (CO)	30 ppm (TWA)
Chlorine	0.5 ppm (TWA) 1 ppm (STEL)
Chromium	500 µg/m ³ (TWA)
Hexavalent Chromium (Cr VI)	5 µg/m ³ (TWA)
Coal Dust	2400 µg/m ³ (<5% SiO ₂) (TWA) 100 µg/m ³ (>5% SiO ₂) (TWA) 3000 µg/m ³ (TWA) Respirable
Coal Tar Pitch Volatiles	0.2 mg/m ³ (TWA) Sk
Copper	1000 µg/m ³ (TWA) Dust/Mist 100 µg/m ³ (TWA) Fume
Diesel Particulate Matter (DPM)	160 TC µg/m ³ (TWA)
Fluorides	500 µg/m ³ (TWA)
Hydrogen cyanide (HCN)	5 ppm (TWA) Sk 10 ppm (STEL)
Hydrogen sulfide (H ₂ S)	5 ppm (TWA) 10 ppm (STEL)
Inhalable dust (total)- Particulate Not Otherwise Specified	10 mg/m ³ (TWA)
Ionizing radiation (gamma / x-rays) includes radon contributions	5 rem/yr
Lead	50 µg/m ³ (TWA) 30 µg/m ³ (AL)
Manganese	500 µg/m ³ (TWA) Inhalable
Mercury	25 µg/m ³ Inhalable Sk
Molybdenum	15 mg/m ³
Nitrogen dioxide	1 ppm (STEL) 5 ppm (C)

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Oil mist	500 $\mu\text{g}/\text{m}^3$ (TWA) 10000 $\mu\text{g}/\text{m}^3$ (STEL)
Respirable crystalline silica (quartz)	100 $\mu\text{g}/\text{m}^3$ (TWA)
Respirable dust – other	5000 $\mu\text{g}/\text{m}^3$
Selenium	100 $\mu\text{g}/\text{m}^3$ Inhalable
Silver	10 $\mu\text{g}/\text{m}^3$
Sodium hydroxide mist (NaOH)	2000 $\mu\text{g}/\text{m}^3$ (C)
Sulfuric acid mist	200 $\mu\text{g}/\text{m}^3$ Thoracic
Sulfur dioxide (SO ₂)	2 ppm (TWA) 5 ppm (STEL)
Styrene	100 ppm (TWA) 200 ppm (STEL)
Vanadium Pentoxide	50 $\mu\text{g}/\text{m}^3$ (TWA) Inhalable
Wood dust -	1 mg/m^3 (hardwood) 5 mg/m^3 (softwood)
Zinc	5000 $\mu\text{g}/\text{m}^3$ (TWA) dust/mist 1000 $\mu\text{g}/\text{m}^3$ (TWA) fume
Non-asbestos fibrous silicates (NAFS) – Respirable	1.0 f/mL (TWA)
NAFS – Non-Respirable	5 mg/m^3 (TWA)
Noise	85 dBA (Leq) 105 dBA (Dual Hearing Protection Req) 115dBA (C) 140 dBC (Peak)

Sk- Skin absorption - may be a significant additional source of exposure for some agents.

Inhalable- Those materials that are hazardous when deposited anywhere in the respiratory tract.

Thoracic- Those materials that are hazardous when deposited anywhere in the lung airways and gas-exchange region.

Respirable- Those materials that are hazardous when deposited in the gas exchange region.

Dust- Solid particles generated by mechanical action (e.g. crushing, grinding, impact). Particle size 0.1 μm - 30.0 μm .

Fume- Solid particles formed by condensation of vapor (e.g. welding fume). Particle size 0.001 μm - 1.0 μm

Mist- Suspended liquid droplets generated by condensation or atomization (e.g fogs) Particle size 0.01 μm - 10.0 μm .

Fibers- Solid particles with a length to width ratio of 3:1

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Exhibit 10.7.2

KUC BIOLOGICAL TEST LIMIT Values

Agents	KUC Biological Test Limits
Arsenic in urine (creatinine corrected)	50 µg/g CR (end work week)
Cadmium in blood	5 µg/L (any time)
Cadmium in urine (creatinine corrected)	5 µg/g CR (any time)
Carbon monoxide in end-exhaled air	30 ppm (post-shift)
Carboxyhaemoglobin in blood	5% (post-shift)
Chromium (VI) in urine (creatinine corrected)	30 µg/g CR (end work week)
Fluoride in urine (creatinine corrected)	3 mg/g CR (pre-shift) 10 mg/g CR (post-shift)
Lead in blood – male	40 µg/dL (any time)
Lead in blood – female of reproductive capacity	20 µg/dL (any time)

REVISION HISTORY:

MOC #	Description of Change	Prepared By	Date
7961	General review and revision of standard. Update KUC Occupational Exposure Limits. Updated format and Document number added.	KUC Safety and Health Standards Committee	02/2008
10743	Updated KUC OELs to reflect OEL changes made by Rio Tinto.	KUC Industrial Hygiene Department	10/2009
12305	Updated to comply with new Rio Tinto requirements. KUC IH personnel completed a review and provided recommended updates including removing the Rio Tinto OEL's list from the standard; the current Rio Tinto "Work Cycle" will now be referenced as the Rio Tinto requirement.	KUC Industrial Hygiene Department KUC Safety and Health Standards Committee	06 / 2010
24678	Review/addition of OELs and added further clarification by adding more definitions.	KUC Industrial Hygiene Department KUC Safety and Health Standards Committee	10/2013