CHEMICAL SAFETY REPORT

Legal name of applicant:	Robert Stuart LTD
Use title:	The continued use of Hexavalent Chromium in substances for the surface treatments on engineering components for the aerospace and defence industry to ensure that the performance requirements set by the Design authority are achieved.
Substance:	Chromium Trioxide (Chromic Acid) EC number: 215-607-8 CAS number: 1333-82-0 Sodium Dichromate EC number: 231-906-6 CAS number: 7778-50-9 Potassium Dichromate EC number: 234-190-3 CAS number: 10588-01-9
Submitted by:	Robert Stuart LTD
Report Issue:	1
Date:	28th February 2024

Table of Contents

Table of Abbreviations

As Low As Reasonably Practicable	ALARP
Analysis Of Alternatives	AOA
Airworthiness Review Certificate	ARC
Chemical Processing	CP
Derived No-Effect Level	DNEL
Environmental Contributing Scenario	ECS
Environmental Management System	EMS
Environmental Release Category	ERC
Global Market Forecast	GMF
Health and Safety Executive	HSE
Local Exhaust Ventilation	LEV
Major accident Prevention Policy	MAPP
Non-Destructive Testing	NDT
Operational Conditions	OC
Personal Protective Equipment	PPE
Performance Review Institute	PRI
Process Category	PROC
Risk Management Measures	RMM
Respiratory Protective Equipment	RPE
Robert Stuart Ltd	RSL
Sustainable Aviation Fuel	SAF
Safety Data Sheet	SDS
Socio-Economical Analysis	SEA
Safety Management System	SMS
Substance of Very High Concern	SVHC
United States Munitions List	USML
Worker Contributing Scenario	WCS

EXPOSURE ASSESMENT AND RISK CHARICTERISATION

Robert Stuart Ltd (RSL) will use this Chemical Safety Report to demonstrate the risks to health from the current operation of Hexavalent Chromium substances is As Low As Reasonably Practicable (ALARP). With the current control measures in place, worker exposure is kept below the Derived No-Effect Level (DNEL).

This document is formulated to coincide with the ***AOA and SEA*** report generated by Robert Stuart Ltd to address concerns and apply for use of Hexavalent Chromium in substances for the surface treatments on engineering components for the aerospace and defence industry under REACH.

RSL will provide information on the operations that involve the 'Substance of Very High Concern' (SVHC) and will discuss all control measures that are currently in place for each operation. This will then be assisted with the provided results of external tests to establish that the tasks performed at RSL have no effect on the local environment or employees.

Introduction

The Use of Specified Hexavalent Chromium on Site

RSL is a relatively small consumer of hexavalent chromium compounds in comparison with many industrial electroplating companies as the use of these materials is limited to the treatment of small batches of small high value flight related components.

In general, most parts are under 1.5m long and weigh under 20kg per piece part and are treated by immersion in appropriate specified process chemistry. Bulk loads of smaller cadmium electroplated fasteners are almost universally sodium dichromate passivated using "barrel plating".

Hexavalent chromium compounds are used in an operation with an extensive range of treatment routines. Whilst some parts are on site for one treatment it is common for parts to have several treatments, with some parts being returned to site at RSL several times in their manufacturing life cycle for additional sequential treatments. An example of this may be a part which goes through non-destructive testing (NDT) prior to being shot peened, by an external provider, to improve in-service fatigue resistance and then returned for hard chromium electroplating to impart wear resistance. After grinding to dimension by the client the part is returned for selective cadmium electroplating and thermal stress relieving and painting to impart corrosion resistance.

As a result of this interrelated process dependence, losing the ability to carry out any one process removes the possibility of being a "one stop shop" process supplier who is capable of supplying and managing a complex integrated treatment cycle.

System of Operation at Robert Stuart Ltd

Robert Stuart Ltd (RSL) offers a combination of surface treatment options that are all performed at our single site in Harlow, Essex.

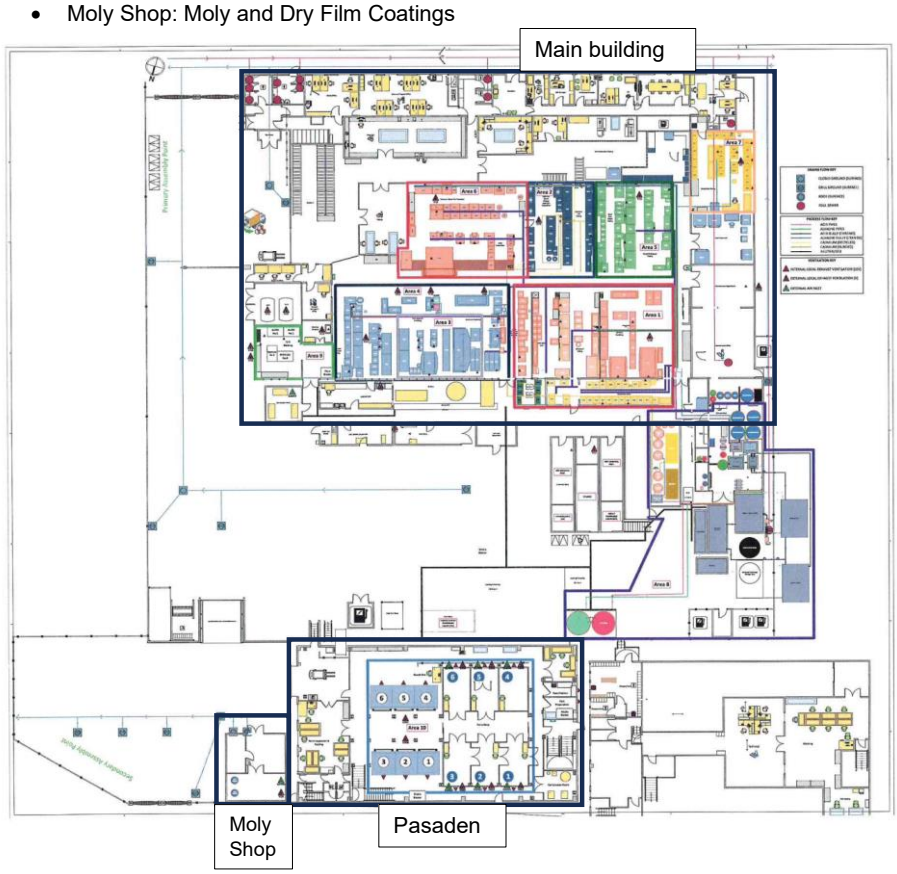
The following document will discuss the process of operation for a part at RSL and cover the system of operation for the company.

Layout At RSL

Robert Stuart Ltd has a collection of 3 buildings on the one site in Harlow,

Each building holds its own function and performs a separate operation.
Depending on the Process Requirements, parts can travel round multiple building. These 3 building are demonstrated in the site map below and control the following functions:

- Main building: Goods In, Goods out, Aqueous Surface treatment, Non-Destructive Testing, Packing, Inspection and Offices
- Pasadena: Masking, Paint Shop, Inspection, Packing and Offices
- Moly Shop: Moly and Dry Film Coatings



The Main building is the focal point of this report as this covers all the use of Hexavalent substances at RSL. Areas: 1,2,3,4,5,6,7,9 are the points where treatment of articles can occur.

As seen on the site map (PDF also Attached for ease of viewing), each treatment has its own line which includes pre cleaning tanks. All tanks are given an assigned number when on the shop floor that includes the Line number followed by the Tank number. As an example, 24/01 seen in Area 3, Hard Sulphuric Anodising.

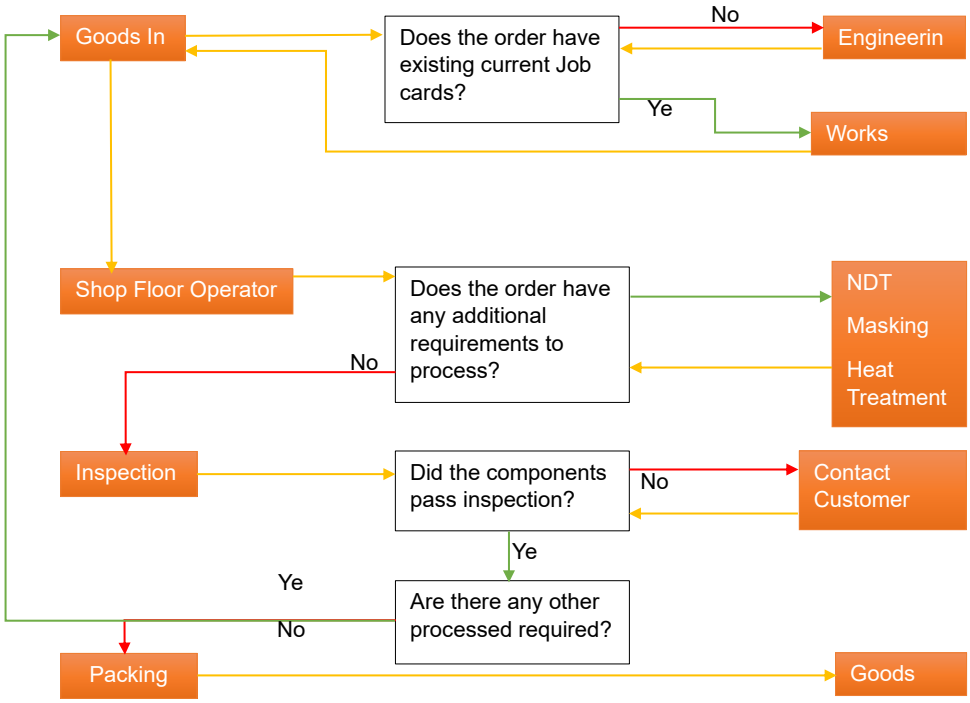
All items Referenced with WB** are assigned work benches that are assigned to each process. these are used by the same staff on a continuous basis and each line has its own operator/s who are dedicated to the individual line.

Lastly, the key included on the site map shows the breakdown of the gully system at RSL and show how the different chemicals are kept segregated to ensure responsible usage of chemicals.

Parts Processing Example

The following is a typical operation route for a part being processed at RSL.

For In-depth Breakdown of the flow diagram, see below.



Break Down of System Flow

Parts are received in Goods-In. The Goods-In team will read the order and start the contract review. If a data sheet and route is already in existence and up to date. The order forms shall be passed to be booked in. If these requirements are not met, the order shall be passed to the Engineering Department.

The Engineering Department will review the design drawing, order and the specification called up. They will ensure that the process can be performed and that RSL holds the relevant processing approvals. From here, they will generate a data sheet that will instruct the operations for the treatment in accordance with the latest issue specification and the engineering drawing. (For an Example, see Data Sheets in this report.) After this is done the order is passed back to the Goods In Department where a route card is made in conjunction with the Data Sheet.

Once a data sheet and route card are allocated to the job, the order will be booked in and a member of Goods In will take the components and the job cards to the shopfloor employee for the required process.

The Operator will then preform the process steps as stated on the Data Sheet including pre-cleaning, treatment and on occasions, masking and demasking. Unless an additional requirement is needed such as Non-destructive testing, heat treatment or masking are required, the components will stay on the operator's line until the process is complete. Once the treatment is complete the components are passed to the Inspection Department.

The Inspection Department will continue to follow the Job cards and assess the quality of the Treatment in accordance with the specification stated. Once components are inspected, the employee in inspection will perform one of 3 tasks:

- Contact customer and notify of inspection failure.
- Pass the parts to the next treatment line if another treatment is required.
- Pass to the Packing Department

The Packing Department will then pack the Components in appropriate containers and will pass the parts and paperwork to the Goods-Out Department.

Data Sheet

Each order that is processed through RSL will have a route card that reference a Data sheet made by the engineering department in accordance with the drawing and specification.

These Datasheets show the step-by-step processes that are required for the specific components.

The following example is of a Datasheet that would be used on the Hard Chrome Plating line.

Specific component information

Referenced Specification

MATERIAL TYPE	HIGH NICKEL STEEL								
MATERIAL SPECIFICATION									
PART NUMBER SERIES	N/A								
PART NUMBER	638-291								
PART NAME	TORQUE BAR								
PROCESS SPECIFICATION	AMS2460 CLASS 2								
STATE AREA/LOCATION OF PLATING	MASK AS REPAIR SCHEME								
VAT QUANTITY									
PLATING AREA OF PART	SQ.IN								
TOTAL AREA - VAT LOAD	SQ.FT								
MASKING TYPE USED	WAX/LEAD TAPE								
BATCH/ LOT TEST	YES								
PERIODIC TEST	YES								

PROCESS CARD NO:

PRIME

PROCESS INSTRUCTION: A8856 ISSUE 1

CHROMIUM PLATING

VITAL/CRITICAL PART | | NO

OTHER DETAILS

CHECK DRAWING FOR AFTER PLATE DIMENSIONS

VISUAL AFTER DE-EMBRITTLEMENT - NO DEFECTS, NO CORROSION EVIDENT, SURFACE TO BE CRACK FREE, THICKNESS, ADHESION AFTER HEAT TREATMENT

AS7108 ANALYSIS, HYDROGEN EMBRITTLEMENT, HARDNESS 800HV MINIMUM

Process as stated in the specification with additional requirements stated on the Drawing.

PROCESS	REQUIREMENT				TANK NUMBER	OPERATOR RECORD				STAMP
VAPOUR DEGREASE		USING PROGRAM NUMBER 3				PROGRAM NUMBER USED				
STRESS RELIEF	3 HOURS MINIMUM	180 - 200°C	START WITHIN 2 HOURS AFTER ETCH		OVEN NUMBER	°C	OVEN LOAD DATE/TIME	TIME TEMP REACHED	TIME END OF RUN	
HOT ALKALINE CLEAN (ACTIVAX)		60 - 70°C		2 - 10 MINUTES	36/05	°C			MINUTES	
COLD RINSE										
DRAIN AND BLOW DRY										
MASK AS REQUIRED FOR PLATING								MASKING STAMP	INSPECTION STAMP	
CHECK AND RECORD PRE-PLATE SIZE										
PUMICE CLEAN AREA TO BE PLATED, TAKING CARE NOT TO DAMAGE MASKING										
COLD RINSE - WATER BREAK TEST GI 28 - REPEAT CLEANING AND TEST IF REQUIRED				30 SECONDS MINIMUM					SECONDS	
NICKEL STRIKE	2 - 4 VOLTS AS GUIDE	RT		APPROX. 2 MIN		°C	VOLTS	AMPS	SECONDS	
TRANSFER WET TO										
LIVE CHROMIUM PLATE VAT	SET VOLTAGE TO ACHIEVE CURRENT	50 - 55°C	144 - 288 AMPS/Ft²	> 8 HOURS AS GUIDE	34/02, 34/03 34/05, 36/01	°C	VOLTS	AMPS	TIME TAKEN	
.0006 - .0008"/HOUR (15 - 20 MICRONS/HOUR) AS GUIDE									TIME OUT OF VAT	
COLD RINSE										
CHECK THICKNESS			AS PER ORDER							
COLD RINSE										
DRAIN AND BLOW DRY										
UN-MASK AND DE-WIRE/JIG. CLEAN AS REQUIRED										
DE-EMBRITTLEMENT	3 HOURS MINIMUM	180 - 200°C	START WITHIN 4 HOURS OF PLATING		OVEN NUMBER	°C	OVEN LOAD DATE/TIME	TIME TEMP REACHED	TIME END OF RUN	
PASS TO INSPECTION										
TEMPORARY PROTECT USING PX24 OIL										

Requirements given on Order or on Engineering Drawing

Operators stamp to confirm step if followed to Data sheets Requirements

Tank number for required chemical in line with specification requirements.

RAISED R.TAYLOR

Robert Stuart Ltd

DATE: 19/5/22

Introduction to the assessment for the environment

Tonnage

The average annual usage of Hexavalent Chromium substances at Robert Stuart Ltd is below 1,000kg. This is broken down into approximately the following amounts of the relevant compounds which we request to be licenced:

Chromic Acid (chromium trioxide)	annual use 500kg
Sodium Dichromate	annual use 250Kg
Potassium Dichromate	annual use 50Kg

Robert Stuart Ltd operates within the constraints and control measures detailed in the company's IPPC licence. All the hexavalent chromium compounds used in the chemical production processes at RSL are held in aqueous form on the shop floor.

In the natural environment chromium most commonly occurs in the third oxidation state as cation (Cr^{+3}) and sixth, Cr(VI), in the form of anions. Chromium (VI) is a strong oxidant easily reduced to Chromium (III) (Cr(III)), which is naturally present in the environment, is an essential nutrient, whereas chromium (VI) is formed in industrial processes and enters the environment as anthropogenic pollution.

The three hexavalent chromium compounds used on site are immediately dissociated into their cationic and anionic forms on dissolution in water. The toxic form, the chromium VI ionic species is the relevant topic of discussion.

There are several controlled and mitigated perceived problems in using these chemicals with the primary risks being chemical outfall to the environment through the trade wastewater or bulk waste chemical releases, airborne releases to the local environment and population, and an operator risk of inhalation of airborne aerosols arising from the use of the chemistry and the risk of dermal transfer to operators.

Chromic Acid (chromium trioxide)

ES#	Exposure scenario (ES) name and related environmental contributing scenarios	Tonnage per use (t/year)	Daily local tonnage (t/day)	Annual local tonnage (t/year)
ES1 (M)	Surface coatings; Metal surface treatment products	0.5		
	- (aqueous); Surface coatings; Metal surface treatment products (ERC 1)		0.025	0.5

Sodium Dichromate

ES#	Exposure scenario (ES) name and related environmental contributing scenarios	Tonnage per use (t/year)	Daily local tonnage (t/day)	Annual local tonnage (t/year)
ES1 (M)	(aqueous); Surface coatings; Metal surface treatment products	0.25		
	- (aqueous); Surface coatings; Metal surface treatment products (ERC 1)		0.013	0.25

Potassium Dichromate

ES#	Exposure scenario (ES) name and related environmental contributing scenarios	Tonnage per use (t/year)	Daily local tonnage (t/day)	Annual local tonnage (t/year)
ES1 (M)	(aqueous); Surface coatings; Metal surface treatment products	0.05		
	- (aqueous); Surface coatings; Metal surface treatment products (ERC 1)		2.5E-3	0.05

Comments on assessment approach for the environment

The system of operation and infrastructure at RSL controls the impact on the environment so much so that there is no soil or air contamination above the reportable level in the EH40. In addition to this, the control system in place mean that the water disposed into local sewage is in the form Chromium (III) compounds and below the reporting threshold.

Scope and type of assessment for man via environment

The control measures and system of operation in place at RSL result in exposure assessment for man via the environment not being possible.

Introduction to the assessment for workers

Type of risk characterisation required for workers

Chromic Acid (chromium trioxide), Sodium Dichromate and Potassium Dichromate have the same risk characterization because all operation is below the suggested DNEL levels stated in EH40/2005 issue 4. These limits for Chromium (VI) compounds are as follows.

Route	Type of effect	Risk characterisation type	Hazard conclusion (see section 5.11)
Inhalation	Systemic effects - long term	Quantitative	DNEL (Derived No Effect Level) = 0.025 mg/m³
	Systemic effects - acute	Qualitative	DNEL (Derived No Effect Level) = 0.025 mg/m³
	Local effects - long term	Quantitative	DNEL (Derived No Effect Level) = 0.025 mg/m³
	Local effects - acute	Qualitative	DNEL (Derived No Effect Level) = 0.025 mg/m³
Dermal	Systemic effects - long term	Quantitative	DNEL (Derived No Effect Level) = 0.01 mg/m³bw/day
	Systemic effects - acute	Qualitative	DNEL (Derived No Effect Level) = 0.01 mg/m³bw/day
	Local effects - long term	Quantitative	DNEL (Derived No Effect Level) = 0.01 mg/m³
	Local effects - acute	Qualitative	DNEL (Derived No Effect Level) = 0.01 mg/m³
Eye	Local effects	Qualitative	DNEL (Derived No Effect Level) = 0.01 mg/m³

Comments on assessment approach for workers

RSL has a full time Level 6 qualified and IOSH established Health & Safety and Environmental Manager. This Manager is responsible to the Chairman for the implementation and maintenance of the Safety Management System (SMS), the Environmental Management System (EMS) and the Major Accident Prevention Policy (MAPP). This includes the development of any associated documents.

The HSE Manager also acts as the Company's Competent Person on matters relating to Health and Safety, Environmental Management and Emergency Planning.

It is also the responsibility of the HSE manger to ensure safe operations on site and to measure and report on the procedures used to maintain the safety of the company staff and responsible environmental compliance across the business.

Introduction to the assessment for consumers

Exposure assessment is not applicable as there are no consumer-related uses for the substance because RSL produces articles that are set to the specification of the design authority. The articles themselves are considered inert after production and thus will not have any effect on the customers.

Summary of representative risk management measures (RMMs) and operational conditions (OCs)

Hexavalent Chromium in substances in operation at Robert Stuart Ltd

ECS and WCS	Task (ERC/spERC or PROC)	Duration of activity	Annual amount per site (tonnes/year)	Technical RMMs, including: *Containment, *Ventilation (general, LEV…) *customized technical installation, etc	Organisational RMMs, including: *Duration and Frequency of exposure *OSH management system *Supervision *Monitoring arrangements *Training, etc	PPE (characteristics)	Other conditions	Effectiveness of waste water and waste air treatment (for ERC)	Release factors: water, air and soil (for ERC)
ECS 0	The use of Hexavalent Chromium in substances for the surface treatments on engineering components for the aerospace and defence industry.	<= 8 h/day	<1 Tonne	RSL operates with several control measures in place to reduce risk. The technical installations involve: Lids to cover vats. Local Exhaust Ventilation (LEV) Separate gullies to keep Acid and Alkaline separate. Waste treatment system with its	RSL operates from Monday to Friday with an average of 39 hours a week per employee. The worker exposure limit is kept in line with EH40/2005 Iss 4. All staff receive area related training and only operate in the section they are trained in. The staff at RSL are all opted into a yearly health check	Operators have access to appropriate PPE for the Role Preformed. The PPE used at RSL is: 1. Gloves (both Reusable and single use) 2. Apron 3. Wellington Boots		RSL has testing Performed to confirm the efficiency of the waste treatment system as well as set maintenance of the treatment plant	The infrastructure at RSL means that there are no factors that impact soil. Reports by external bodies are preformed to ensure that RSL stays below all derived legal limits.

				own Failure control measures included. A below ground membrane to prevent any structural failure from causing ground contamination.	with added biological monitoring programs active for workers that operate around Hexavalent Chromium compounds. Individual PPE is supplied to and maintained by staff. A supply of PPE is kept in house so that items can be replaced in an efficient and timely manner upon request.	4. Eye Protection 5. Respiratory Protective Equipment (RPE) 6. Safety Boots All PPE suppled meets the appropriate British and international standards.			
WCS 1	Storage of Hexavalent Chromium Chemicals	<= 0.5 h when Required	<1 Tonne	All Hexavalent substances are kept in secure containers from the manufacture until the point they used. These containers remain in a allocated secure area at RSL until they are needed.	This task is less than an hour of potential exposure and does not require interaction with chemicals, only movement to a storage area.	See Above 1,6	Additional Equipment such as pump trucks, Fork trucks and sack barrows are used to aid in movement of the chemicals in a secure manner.	See Above	See Above
WCS 2	Mixing Chemical Solution	<= 0.5 h when Required	<1 Tonne	Tanks with LEV will be in operation while chemical solution is being added to the required vats.	The process takes less than an hour and will only be performed outside of operational hours.	See Above 1,2,3,4,5	Spills kits are accessible, with a core staff group trained in their use. These can be used to	See Above	See Above

				The vats stay in set locations so, if a spillage were to occur, chemicals would be captured in the waste treatment system.	This process is not a set task at an allocated time but only when required. This task is only performed by the RSL Chief Chemist who has had training for this application.		manage spills if required.		
WCS 3	Operation of plating-Loading and unloading in Cold vats (Cold Vats refers to any and all vats that run at ambient template and do not produce any mist or vapor)	<= 8h/day time around chemical <= 1 h/day	<1 Tonne	This operation uses the full set of infrastructure in the use of Gullys & the installed under floor membrane. These all assist the risk management for spillages and mist generated in operation.	The average daily shift for employee is 8 hours. Operators do not spend all this time in front of the chemical vats. But will only be around the vats when loading and unloading articles. All staff must undergo training for their process line. The shop floor has an allocated production manager who participates in production and monitors employees to ensure correct and safe operations.	See Above 1,2,3,4,	Spills kits are accessible, with a core staff group trained in their use. These can be used to manage spills if required.	See Above	See Above

WCS 4	Operation of plating-Loading and unloading in Hot vats up to 100 ℃. (hot vats refer to any chemical process that is heated and can create a mist of vapor)	<= 8h/day time around chemical <= 1 h/day	<1 Tonne	This operation uses the full set of infrastructure in the use of Gullys & the installed under floor membrane. LEVs, Lids These all assist the risk management for spillages and mist generated in operation.	The average daily shift for employee is 8 hours. Operators do not spend all this time in front of the chemical vats. But will only be around the vats when loading and unloading articles. All staff must undergo training for their process line. The shop floor has an allocated production manager who participates in production and monitors employees to ensure correct and safe operations.	See Above 1,2,3,4,	Spills kits are accessible, with a core staff group trained in their use. These can be used to manage spills if required.	See Above	See Above
WCS 5	Providing Maintenance	<= 1-3 h When Required	<1 Tonne	This operation will only be performed out of operational hours. All lids will be closed when maintenance is being performed. If the vat has an attached LEV and lid, the LEV will be in operation and	Only trained staff will perform the required maintenance. Maintenance and repair do not have an allocated duration or frequency but in response to notes made in fortnightly testing.	See Above 1,4,6		See Above	See Above

				the lid will be closed.					
WCS 6	Effluent Treatment	<= 1h/day	<1 Tonne	The effluent Treatment area has its own separate bunding as its own control measure. There is a surrounding gully with the capacity to hold all spillages if there was a critical failure of the effluent treatment plant.	The Effluent Treatment plant is constantly monitored during a working week. The maintenance team regularly perform an audial and visually inspections on this equipment to make sure that there are no points of concern. Scheduled maintenance is performed when the equipment is not in operation and only by Trained staff.	See Above 1,2,3,4,5,6		See Above	See Above

Commented [SM1]: Capacity of?

WCS-1 Arrival and Bund storage facilities to prevent soil and water pollution in the event of spillage.

	Method
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 0.5 h when required. the arrival of new chemicals on sight is not a daily occurrence. For this reason, the duration of activity is not based on a daily or weekly time frame.	
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced *The Chief Chemist is included in the advanced staff monitoring program. the program takes biological data and produces reports showing levels of Chromium detected.*	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Yes (effectiveness >= 80%)	
• Respiratory protection: No	
• Face/eye protection: No	
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: Ambient	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
• Containment: High level (99.9%) *The facility has a collection on gully that can hold greater than the current level of chemical stored on sight.*	

WCS-2 Mixing operations; (aqueous)

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 0.5 h when required *When additions to the operational chemistry are needed, they are made with whole drum additions by the works chemist.*	
Technical and organisational conditions and measures	
• Local exhaust ventilation: Yes, specifically designed LEV such as receiving hoods (assumed effectiveness >= 80-90%) *All tanks which operate above ambient temperature or can generate spray or fumes during operation are extracted using LEV lip extraction systems which are maintained, routinely monitored and reported*	
• Occupational Health and Safety Management System: Advanced	
• Room ventilation: Basic (up to 3 ACH)	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with specific employee training. (effectiveness >= 95%) *This operation is performed with the chemist wearing appropriate PPE suited for the task.*	
• Respiratory protection: Yes (APF >= 10)	

	Method
• Face/eye protection: Eye protection	
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: <= Ambient to 100 °C	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
• Containment: High level (99.9%) *Each production line has a surrounding gully. these will contain any spills and transport the chemicals to the waste treatment facility. In addition, there are localized spills kits that can be used by trained staff.*	

WCS-3 Surface coatings; Metal surface treatment products; Manufacture, Cold Vats

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8h/day • Time around chemical <= 1 h/day	
Technical and organisational conditions and measures	
• Local exhaust ventilation: No	
• Occupational Health and Safety Management System: Advanced	
• Room ventilation: Basic (up to 3 ACH)	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with specific employee training. (effectiveness >= 95%)	
• Respiratory protection: No	
• Face/eye protection: Eye protection	
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: Ambient	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
• Containment: High level (99.9%)	
• Distance of workers to the source: >= 1m	

WCS-4 Surface coatings; Metal surface treatment products; Manufacture, Hot Vats

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8h/day • Time around chemical <= 1 h/day	
Technical and organisational conditions and measures	
• Local exhaust ventilation: Yes, specifically designed LEV such as receiving hoods (assumed effectiveness >= 80-90%)	
• Occupational Health and Safety Management System: Advanced	
• Room ventilation: Basic (up to 3 ACH)	
Conditions and measures related to personal protection, hygiene, and health evaluation	
• Dermal protection: Chemical resistant dermal protection with specific employee training. (effectiveness >= 95%)	
• Respiratory protection: No	
• Face/eye protection: Eye protection	
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: Up to 100 °C	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
• Containment: High level (99.9%)	
• Distance of workers to the source: >= 1m	

WCS5 Equipment cleaning and maintenance

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: <= 100 %	
• Physical form of the used product: Liquid, including paste/slurry/suspension	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 1-3 h when required	
Technical and organisational conditions and measures	
• Local exhaust ventilation: Yes, specifically designed LEV such as receiving hoods (assumed effectiveness >= 80-90%) if the operating temperature is above ambient temperature for the associated vat	
• Occupational Health and Safety Management System: Advanced	
• Room ventilation: Basic (up to 3 ACH)	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with specific employee training. (effectiveness >= 95%)	

	Method
• Respiratory protection: No	
• Face/eye protection: Eye protection	
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: <= Ambient to 100 °C	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
• Carefulness of handling for contaminated objects: Careful handling, involves workers showing attention to potential danger, error or harm and carrying out the activity in a very exact and thorough (or cautious) manner	
• Chemical protective clothing: Standard safety clothing	

RISK CHARACTERISATION RELATED TO COMBINED EXPOSURE

Worker Exposure by Process

As there is a common mobile work force across the shop floor there are commonalities of risk, control measures and monitoring process.

The risk exposure of staff has been determined and measured by static, personal and biomonitoring.

The UK Health Security Agency has published toxicological information on chromium compounds and determined that the risk from the operational chemistry may be by inhalation of aerosols from uncontrolled spray, fumes emitted from the surface of the chemistry, and dermal contamination. See appendix 6 for the full report.

The following categories are WCS for different operations involving Hexavalent Chromium solution. Each task will breakdown the associated risk and the discuss the control measures in place to mitigate these risks.

Storage

Storage of Hexavalent Chromium materials and additions to the operational tanks is controlled by the laboratory chemist.

The main risks associated with this WCS are: spillage, absorption, inhalation and environmental damage. These risks are all mitigated through correct transportation and secure storage.

The base chemistry is generally in sealed 25kg secure transit drums. When these arrive on sight, the chief chemist would then transport them to the secure chemical store. RSL has a variety of equipment such as: a forklift, pump trucks and sack barrows to aid manual handling, as well as reduce likelihood of damage caused in transport around the facility.

When moving chemical barrels around the facility, the chemist will be in appropriate PPE, including safety boots and gloves.

Mixing of Chemicals

When additions to the operational chemistry are needed, they are made with whole drum additions by the works chemist. This WSC has the risk of inhalation and dermal absorption through generated uncontrolled splash and chemical vapor. These risks are only applied to

the chemist and will not affect shop floor employees as this task is only preformed outside of shop floor operational hours.

This operation is performed with the chemist wearing appropriate PPE suited for the task. This includes: Gloves, Safety boots, and a Respiratory Mask.

All tanks which operate above ambient temperature or can generate spray or fumes during operation are extracted using LEV lip extraction systems which are maintained, routinely monitored and reported. For full test data, see appendix 4.

The control measures in place are efficient as this member of staff is included in the monitoring plan which shows there has been no effect of operation on their health.

In case of potential spillage, Spills kits and the gully closes to the tank will collect the chemical and transport it to the waste treatment facility to prevent any environmental effect.

Operational Processes

Operators on the shop floor are highly mobile throughout their shift. Although operators can move freely between areas of the Shop floor, they typically only stay in their allocated line of production. The risks of exposure for this function fall under two categories: absorption and inhalation.

The first control measure in place by RSL to reduce the risk of exposure is by limiting the duration of possible exposure. This is achievable because when parts are being plated, they can be suspended on jigging allowing the employee to leave the area until the time the parts need to be removed. RSL also provides each line with a workstation so that pre and post work on the components can be performed away from the chemical vats.

All employees operating on the shop floor have set work uniform and appropriate PPE. Which includes Gloves (both disposable and reuseable), wellington boots, eye shields and aprons. This precautionary feature protects the employees from uncontrolled spray and splash.

Inhalation is managed by two key installations. The first being the LEV system which extracts the mist generated by the process. The second being the vat lids that are closed to capture residual chemical vapor and prevent this going into the shop floor environment.

These control measures are seen to be sufficient as supported by the staff monitoring data provided.

Similar to the operation of mixing chemistry, the use of Spills kits and gulleys can be used so that any spills can be transported it to the waste treatment facility to prevent any and all environmental effect.

The subsection bellow will expand on this WPC for all the relevant processes and provide greater depth and information.

Processes At Robert Stuart Ltd

Articles being produced at RSL can undergo one or more processes that can include a Hexavalent Chromium solution. These processes can be broken down into the following categories:

- Electrolytic (These are processes that involve running current through the articles while in the solution containing Hexavalent Chromium)
- Non-Electrolytic (These do not have Electrical current involved but can be Broken into Hot and Cold sub sections)

The following sub sections will show the detailed descriptions of what steps is included in each process and a related flow chart for each treatment Process. This will be colour coded to show what sequence of operation contains the Hexavalent Chromium being used.

NOTE – there are several process operations that are identical regardless of the process being performed. This is typically Preclean, Masking and Post treatment steps. Although similar they are not all in the same tanks and have specific tanks designated to their process (line).

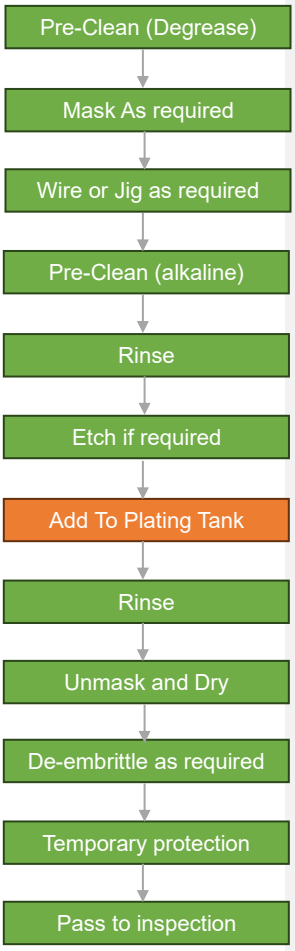
Each section will include the exposure probability of for each employee working on the respective line. This calculation is calculated based on 40 years of exposure; 8h/day; 5 days/week that are Exposure to (1)ug Cr(VI) relates to an excess risk of 4.0 x 10-3. Each probability is then based on the latest readings provided in Green Air Monitoring- Occupational Hygiene Monitoring Report (which can also be found in the appendix).

Electrolytic Processes

Hard Chrome Plating

Staff included in this process:	3 Shop floor operator
The PPE worn by employees:	Gloves, Goggles, Apron & Wellington Boots Average
Paid hours worker per week:	39 Hours
Time around SVHC tank per operator per day:	6.36 minutes
Excess Exposure Probability:	0.024
Map Area	1 Tanks

A typical Data card for Hard Chrome plating will follow the following operations stated in the flow diagram. Elements of this diagram may vairy depending on what specification the job needs to fall in line with.



For each article, all steps in this diagram are conducted by one of the three hard chrome plating operators.

Pre-Clean

The operator will select the job pack along with the Physical Articles where they will read the information provided on the Data Card and follow each step as stated. The Typical first operation include placing the components in a basket and placing them in a Vapor Degreaser then leaving the area while this task is underway and returning when the task is finished.

Mask

Once the articles are collected, the operator will take the components to their workstation and start to mask the parts as required on the order. Typical masking consists of applying wax to the articles then removing the non-masked areas using the craft knife. This operation is undertaken at the operator's workstation.

Wire or Jig

After the masking operation the operator will jig or wire the articles so that they can be correctly suspended in each tank. This task is also performed at the workstation.

Pre-Clean

All parts will then undergo a cleaning operation where the articles are suspended in the appropriate cleaning tank. Once in the tank the operator will activate the calibrated timer and leave the area.

Rinse

When the timer has alerted the operator, they will go to the tank and the parts removed from the tanks and go through rinse and water break test.

Etch

If required, the Parts are then placed in an etch tank until the time alerts the operator to remove the articles. (This is specified by the Specification.)

Plating

When etching is complete, the lid for the Hard Chrome vat is opened, the parts are promptly suspended in the tank and the lid is closed. The current is then applied to start the plating operation and the operator then leaves the area with the timer counting down the time required to apply the level of deposit requested. They return to the workstation where they can continue to mask and jig other Job packs. Once the timer alerts the operator that the correct time is passed the operator will return to the vat, turn off the current, remove the articles and close the lid.

Additional Note - This tank has an LEV attached that with the addition of the lid, collects the mist generated during operation.

Rinse

Post plating the suspended article undergo a thorough cold rinse in a cascading rinse tank. This rinse tanks water then runs RS waste treatment system where contaminants are removed.

Unmask

Post rinse, the articles are dried and taken to the operator's workstation where they are demasked and removed from the jigs.

De-embrittle

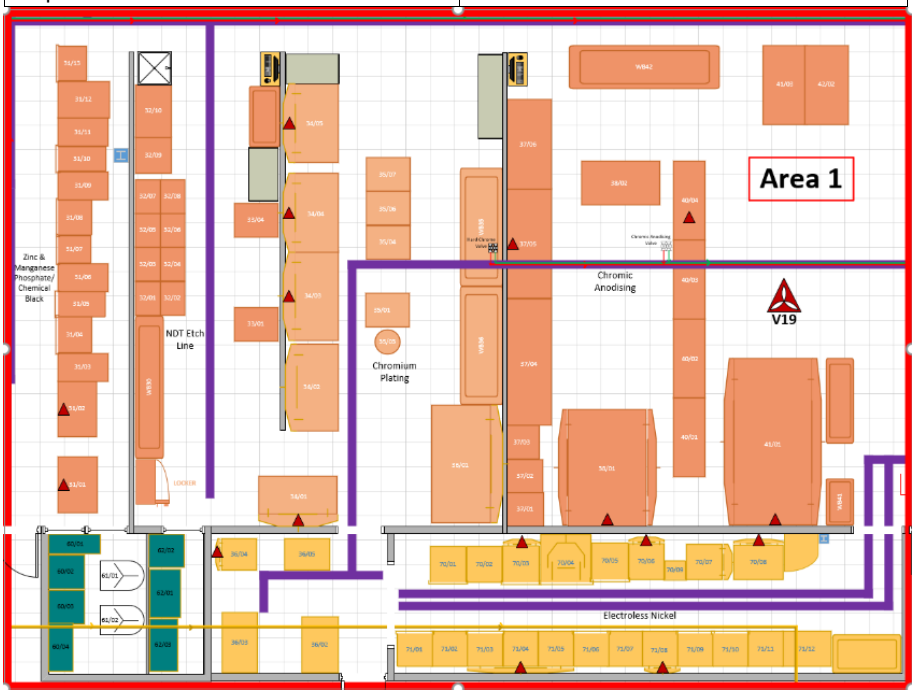
If required, the parts are past to the oven area when thy are loaded into an oven and de-embrittles as stated in the relevant specification.

Inspection

After plating or de-embrittlement if required. the articles are pasted to inspection where the relevant checks are undergone, and they are temporary protected.

Chromic Acid Anodising

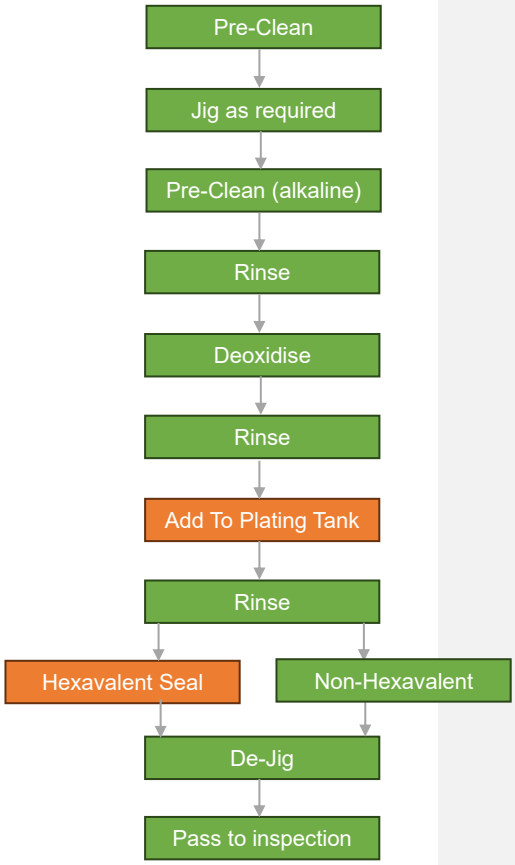
Staff included in this process:	2 Shop floor operator
The PPE worn by employees:	Gloves, Goggles, Apron & Wellington Boots Average
Paid hours worker per week:	39 Hours
Time around SVHC tank per operator per day:	5.55 minutes
Excess Exposure Probability:	0.028
Map Area	1



The Chromic Acid Anodising line is run by two shop floor operators who are solely responsible for this line. For each article needing Chromic Acid Anodising, all steps in this diagram are conducted by one of the operators.

Pre-Clean

The operator will select the job pack along with the Physical Articles where they will read the information provided on the Data Card and follow each step as stated. The Typical first operation include placing the components in a basket and placing them in a Vapor Degreaser then leaving the area while this task is underway and returning when the task is finished.



Jig

After the masking operation the operator will jig the articles so that they can be correctly suspended in each tank. This task is also performed at the workstation.

Pre-Clean

All parts will then undergo a cleaning operation where the articles are suspended in the appropriate cleaning tank. Once in the tank the operator will activate the calibrated timer and leave the area.

Rinse

When the timer has alerted the operator, they will go to the tank and the parts removed from the tanks and go through rinse and water break test.

Deoxidise

If required, the Parts are then placed in a Deoxidised tank where the operator will set a timer and leave the area until the time alerts the operator to remove the articles. (This is specified by the Specification.)

Rinse

When the timer has alerted the operator, they will go to the tank and the parts removed and go through an additional rinse prior to plating.

Plating

After the rinse, the operator checks that the articles are firmly secured on the jig, they then confirm what Preset Anodising Program is required and takes the work over to the anodising tank.

The lid for the anodising vat is opened, the parts are carefully suspended in the tank in such a way that there will be no possibility of the separate jigs touching one another or touching the

sides of the vat. The lid is then closed, the operator then turns on the air cooling/agitation system. lastly the operator selects the anodising program and then when in progress leaves the area. Similarly to other process lines, they return to the workstation where they can continue to mask and jig other Job packs. Once the timer alerts the operator that the program would have finished, the operator will return to the vat, turn off the agitation, lift the Lid, remove the articles and close the lid.

NOTE – This tank has an LEV attached that with the addition of the lid, collects the mist generated during operation.

Rinse

Post plating the suspended article undergo a thorough cold rinse in a cascading rinse tank. This rinse tanks water then runs RS waste treatment system where contaminants are removed.

Seal

Depending on what is called for by the customer or the specification, the articles can go through either a hexavalent or non-hexavalent seal.

Non-Hexavalent Seal

This is typically a Hot Water seal where the parts are submerged in a hot water tank for a time stated by the specification.

Hexavalent Seal

There are two Hexavalent Seals that can be requested. These are Sodium Dichromate and Potassium Dichromate Seals.

The operator will place the articles in the required solution for the time requested by setting a timer. They then leave the tank and return when the parts are to be removed.

Note – These tanks hold solutions that are elevated temperature and non-electrolytic however, are in this category due to the treatment process being electrolytic. These tanks operate up to 100C and have an LEV attached to gather all residual mist generated by the tanks.

De-jig

The articles are dried and taken to the operator's workstation where they are demasked and removed from the jigs.

Inspection

The articles are pasted to inspection where the relevant checks are undergone, and they are temporary protected.

Non-Electrolytic Processes

Non-electrolytic processes are classified as processed that do not have current passing through the articles then in the solution that contains Hexavalent substances.

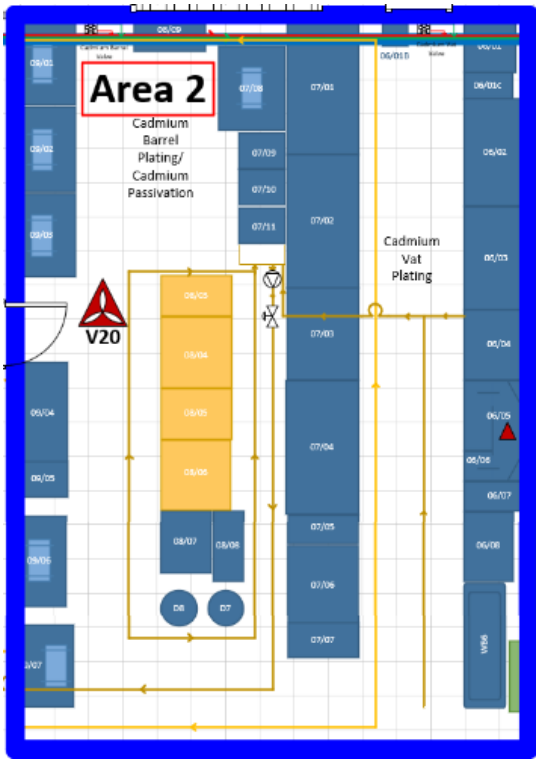
This can them be further expanded to elevated and non-elevated temperatures. In this case elevated temperatures are considered as any tank artificially heated above room temperature.

Non-Elevated Non-Electrolytic

Passivation (as a full process)

Staff included in this process:	2 Shop floor operator
The PPE worn by employees:	Gloves, Goggles, Apron & Wellington Boots Average
Paid hours worker per week:	39 Hours
Time around SVHC tank per operator per day:	8.16minutes **
Map Area	2

**NOTE – The operators that perform this task also do other plating operations using the same passivate so this time demonstrates both of these tasks per day.



Passivation can be referred to both part of a process and a process in entirety. This section refers to Passivation as a full process.

As this is not a highly demanded process, a couple operators that preform this task also work on lines relating to cadmium plating due to the same passivation being used.

Pre-Clean

The operator will select the job pack along with the Physical Articles where they will read the information provided on the Data Card and follow each step as stated. The Typical first operation include placing the components in a basket and placing them in a Vapor Degreaser then leaving the area while this task is underway and returning when the task is finished.

Jig

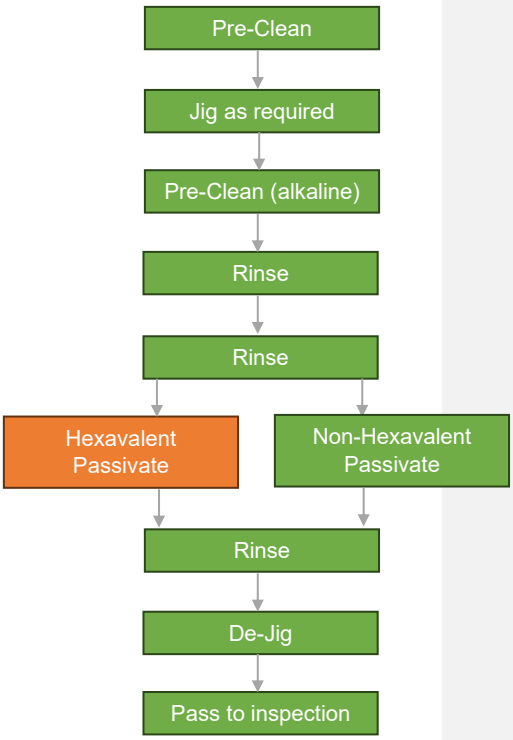
After the masking operation the operator will jig the articles so that they can be correctly suspended in each tank. This task is also performed at the workstation.

Pre-Clean

All parts will then undergo a cleaning operation where the articles are suspended in the appropriate cleaning tank. Once in the tank the operator will activate the calibrated timer and leave the area.

Rinse

When the timer has alerted the operator, the operator will go to the tank and the parts are removed from the tanks and go through cold rinse.



Rinse

After a cold rinse, the parts are emersed in a hot water rinse and then thoroughly drained. The articles then have a water break inspection. If passed the operator moves over to the passivation tanks.

Passivate

Depending on what is called for by the customer or the specification, the articles can go through either a hexavalent or non-hexavalent passivation.

Non-Hexavalent Passivate

If a non-hexavalent passivate is requested the parts as suspended in a tank with a Nitric Acid solution.

Hexavalent Passivate

For a requested Hexavalent Passivate, the articles are suspended in a tank containing Sodium Dichromate and Nitric Acid. Like all other steps, the articles are suspended in the solution for the period stated in the specification. While the article is in the vat, The operator will use a timer to leave the vat proximity and return when it need removal.

Rinse

Post Passivation, the articles undergo a rinse drag out in a cascading rinse tank to remove all excess solution.

Note – The cascading rinse is situated next to the Passivate tank so that there is minimum travel between the operations, in addition both tanks feed into the same gully to delivery to the waste treatment facility.

De-jig

The articles are dried and taken to the operator's workstation where they are demasked and removed from the jigs.

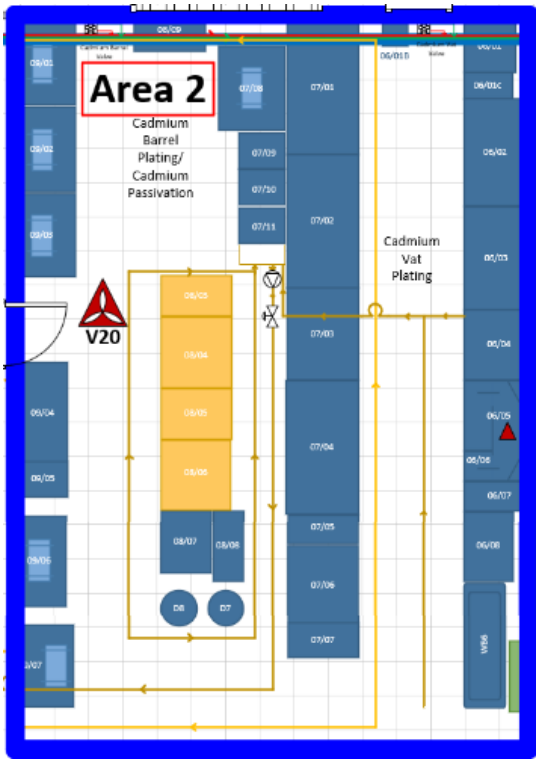
Inspection

The articles are pasted to inspection where the relevant checks are undergone, and they are temporary protected.

Passivation (Post Plating)

Staff included in this process:	5 Shop floor operator
The PPE worn by employees:	Gloves, Goggles, Apron & Wellington Boots
Paid hours worker per week:	Average 39 Hours
Time around SVHC tank per operator per day:	8.16 Minutes **

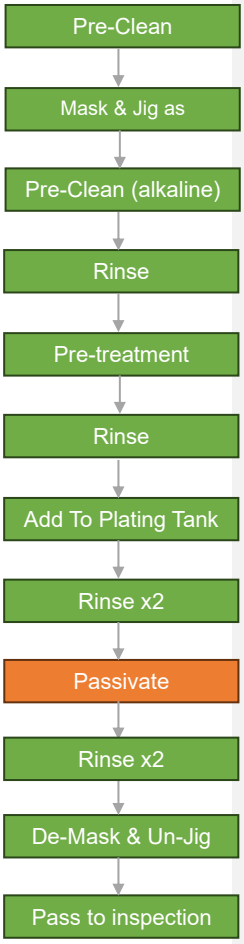
**NOTE – Some operators that perform this task also do Standalone Passivation operations (as seen in the section above) due to both operations using the same passivate, the time demonstrates both tasks per day.



In comparison to the previous section, this section relates to the post plating passivation.

Pre-Clean

The operator will select the job pack along with the Physical Articles where they will read the information provided on the Data Card and follow each step as stated. The Typical first operation include placing the components in a basket and placing them in a Vapor Degreaser then leaving the area while this task is underway and returning when the task is finished.



Mask & Jig

After the masking operation the operator will jig the articles so that they can be correctly suspended in each tank. This task is also performed at the workstation.

Pre-Clean

All parts will then undergo a cleaning operation where the articles are suspended in the appropriate cleaning tank. Once in the tank the operator will activate the calibrated timer and leave the area.

Rinse

When the timer has alerted the operator, the operator will go to the tank and the parts are removed from the tanks and go through cold rinse.

Pre-Treatment

This pretreatment can vary from specification to specification and can include but not limited to hydrochloric acid etch or cyanide rinse. These parts are suspended into the tank for the time specified in the relevant specifications.

Rinse

After pretreatment the articles are put through a cascading rinse to remove any residual chemical that remains on the component.

Plating

Depending on what is called for by the customer or the specification, the articles undergo the necessary plating for the appropriate time.

Rinse

Similarly to pretreatment, After the plating time is complete, the articles removed and are put through a cascading rinse to remove any residual chemical that remains on the component.

Passivate

After the rinse the parts are Passivated. The articles are suspended in a tank containing Sodium Dichromate and Nitric Acid. the articles are suspended in the solution for the period stated in the specification. While the article is in the vat, The operator will use a timer to leave the vat proximity and return when it need removal where possible.

Rinse

Post Passivation, the articles undergo a rinse drag out in a cascading rinse tank to remove all excess solution.

Note – The cascading rinse is situated next to the Passivate tank so that there is minimum travel between the operations, in addition both tanks feed into the same gully to delivery to the waste treatment facility.

De-jig

The articles are dried and taken to the operator's workstation where they are demasked and removed from the jigs.

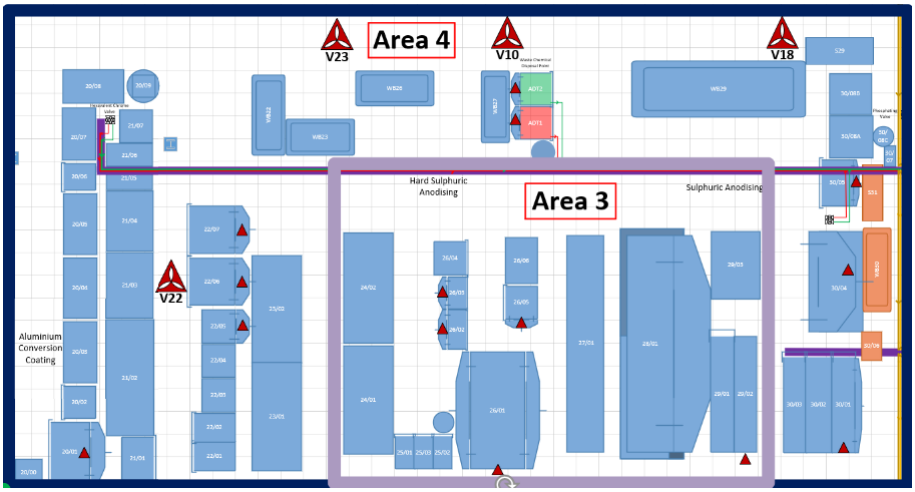
Inspection

The articles are pasted to inspection where the relevant checks are undergone, and they are temporary protected.

Elevated Temperature, Non-Electrolytic Processes

Chromate Conversion

Staff included in this process:	2 Shop floor operator
The PPE worn by employees:	Gloves, Goggles, Apron & Wellington Boots Average
Paid hours worker per week:	39 Hours
Time around SVHC tank per operator per day:	5.36 Minutes
Excess Exposure Probability:	0.0088
Map Area	4



Chromate Conversion is a full treatment process that consists of processing articles in a solution containing Hexavalent Chrome and an elevated temperature (80C maximum).

This process is primarily preformed with one operator with the occasional assistance of a second who will then run the line when the main operator is on leave.

Pre-Clean

The operator will select the job pack along with the Physical Articles where they will read the information provided on the Data Card and follow each step as stated. The Typical first operation include placing the components in a basket and placing them in a Vapor Degreaser then leaving the area while this task is underway and returning when the task is finished.

Mask & Jig

After the masking operation the operator will jig the articles so that they can be correctly suspended in each tank. This task is also performed at the workstation.

Pre-Clean

All parts will then undergo a cleaning operation where the articles are suspended in the appropriate cleaning tank. Once in the tank the operator will activate the calibrated timer and leave the area.

Deoxidise

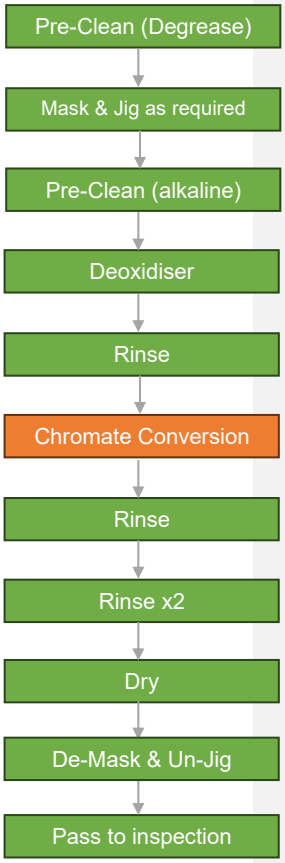
If required, the Parts are then placed in a Deoxidised tank where the operator will set a timer and leave the area until the time alerts the operator to remove the articles. (This is specified by the Specification.)

Rinse

When the timer has alerted the operator, the operator will go to the tank and the parts are removed from the tanks and go through cold rinse.

Treatment

Post Rinse, Articles are Immerse in the chromate solution for sufficient time to achieve the required colour. This is typically for 30 seconds to 2 minutes dependant on temperature, specification and alloy of the article. While suspended in the solution the article gently agitates parts to avoid air locks.



Rinse

Similarly to pretreatment, After the plating time is complete, the articles removed and are put through a cascading rinse to remove any residual chemical that remains on the component.

De-jig

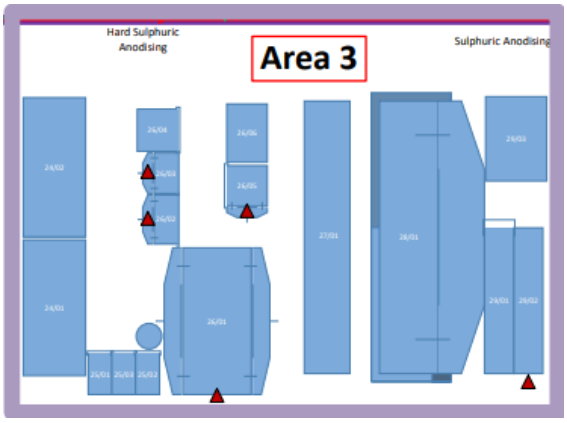
The articles are dried and taken to the operator's workstation where they are demasked and removed from the jigs.

Inspection

The articles are pasted to inspection where the relevant checks are undergone, and they are temporary protected.

Sulphuric Anodising

Staff included in this process:	2 Shop floor operator
The PPE worn by employees:	Gloves, Goggles, Apron & Wellington Boots Average
Paid hours worker per week:	39 Hours
Time around SVHC tank per operator per day:	4.56 minutes
Map Area:	3



The sulfuric line operated similar to the Chemical conversion line, in the sense that, there is one key operator and one member of support staff (who mainly assist with masking and jigging but can undergo all tasks when the main operator is on leave).

Pre-Clean

The operator will select the job pack along with the Physical Articles where they will read the information provided on the Data Card and follow each step as stated. The Typical first operation include placing the components in a basket and placing them in a Vapor Degreaser then leaving the area while this task is underway and returning when the task is finished.

Jig

After the masking operation the operator will jig the articles so that they can be correctly suspended in each tank. This task is also performed at the workstation.

Pre-Clean

All parts will then undergo a cleaning operation where the articles are suspended in the appropriate cleaning tank. Once in the tank the operator will activate the calibrated timer and leave the area.

Rinse

When the timer has alerted the operator, they will go to the tank and the parts removed from the tanks and go through rinse and water break test.

Deoxidise

If required, the Parts are then placed in a Deoxidised tank where the operator will set a timer and leave the area until the time alerts the operator to remove the articles. (This is specified by the Specification.)

Rinse

When the timer has alerted the operator, they will go to the tank and the parts removed and go through an additional rinse prior to plating.

Plating

After the rinse, the operator checks that the articles are firmly secured on the jig, they then transfer the parts into the sulphuric anodise solution (suspend jigs on bus bars) for sufficient time to achieve blue/ purple colour (this is normally specified on the Specification).

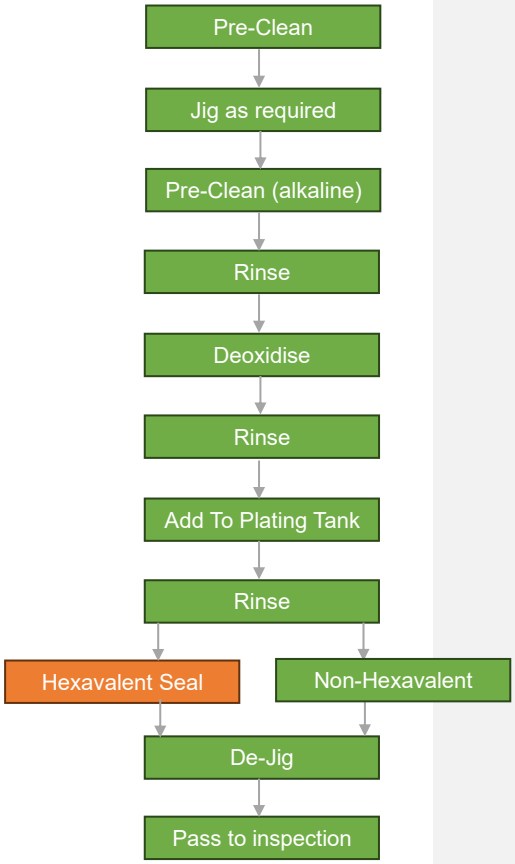
Rinse

Post plating the suspended article undergo a thorough cold rinse in a cascading rinse tank. This rinse tanks water then runs RS waste treatment system where contaminants are removed.

Seal

The Sealing operation on this process is very similar to Chromic acid anodising.

Depending on what is called for by the customer or the specification, the articles can go through either a hexavalent or non-hexavalent seal.



Non-Hexavalent Seal

This is typically a Hot Water seal where the parts are submerged in a hot water tank for a time stated by the specification.

Hexavalent Seal

There are two Hexavalent Seals that can be requested. These are Sodium Dichromate and Potassium Dichromate Seals.

The operator will place the articles in the required solution for the time requested by setting a timer. They then leave the tank and return when the parts are to be removed.

Note – These tanks operate up to 100C and have an LEV attached to gather all residual mist generated by the tanks.

De-jig

The articles are dried and taken to the operator's workstation where they are demasked and removed from the jigs.

Inspection

The articles are pasted to inspection where the relevant checks are undergone, and they are temporary protected.

Maintenance

When scheduled or required maintenance is preformed, the work will only be started outside of the shop floor operational hours. The main risk to maintenance employees is inhalation of chemical vapor and absorption through residual chemicals.

Like shop floor employees, these risks are controlled via PPE and installed infrastructure. The Maintenance employees will dress in the appropriate PPE for the task they are set to perform. Most commonly for the Maintenance team, this includes Safety boots, Gloves and Eye protection.

When preforming maintenance around a vat of chemical. All available lids will be closed to reduce chemical vapor and the appropriate LEV will be in operation. As an additional safety precaution, when working over a vat, the maintenance team will construct a separate workstation to remove all interaction with the physical tank.

Effluent Treatment

The effluent treatment plant at RSL is under constant monitoring throughout operational hours. This area is checked daily with a visual and audible monitoring to ensure safe and correct operation. As no member of staff is in contact with the system, there is little PPE needed. Only the operational safety requirements that all employees must adhere to. For Example, wearing safety boots.

In addition to daily monitoring, the treatment system follows a maintenance schedule with elements like Pumps having and overhaul inspection every 2 months and the pits being maintained 3 times a year.

As the scheduled maintenance is a more detailed inspection, there PPE requirements increase in response to this. For example, the pump maintenance will require the employee to wear gloves due to the remanence of contaminated water.

Risk Management

Chemical Containment Infrastructure at Robert Stuart Ltd

When RSL relocated from North London to the Harlow, Essex site, the structural enhancements were made to the site to future proof the facility as much as possible. This includes installing a membrane below the factory floor to stop all contamination from seeping into the outer environment. This installation acts as the final line of control and is coupled with other fixed installations that control all chemistry.

Commented [SM2]: Review - the current life span of the MEM

All the operational chemistry is contained within the well bunded production area. Aqueous releases from this area are through the maintained segregated drainage system.

Accidental spillage would be contained by the segregated drainage gullies with a capacity significantly greater than the potential released volume of chemistry.

Under normal production operation, components are removed from the production tanks, allowed to drain over tanks appropriately, and rinsed in multiple counter-flowed water rinses.

This cannot be regarded as wastewater as it is generated as a consequence of the surface treatment activities which are operated within the best possible practice guidelines and is therefore generated as a by-product of manufacturing.

These by-product rinses are segregated from specific dedicated applications into four treatment streams in segregated gully's.

1/ Cadmium containing alkaline rinse water

2/ Cadmium containing acidic chromate rinse water

3/ Acidic rinse waters

4/ Alkaline rinse waters

The two cadmium rinse streams are pumped to a twin vacuum evaporator which treats the two rinse streams separately. The alkaline cadmium and cadmium containing chromate rinses are pumped into dedicated chambers and the air pressure is significantly reduced. At ambient temperature the majority of the water boils off and is then condensed and returned to the dedicated rinses on the treatment lines.

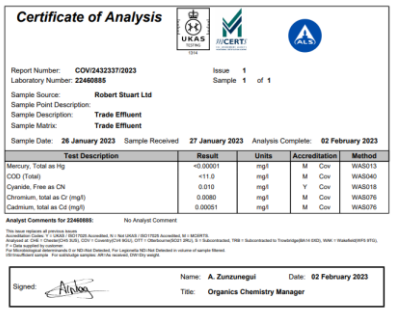
The concentrated cadmium solution is pumped back into the treatment tanks, taking rinse water and electroplating solution back to the process line in a closed loop system.

In the case of the hexavalent chromate rinse waters these are evaporated off and recondensed for return to the treatment rinses and the concentrated contaminated hexavalent chrome rinse waters are pumped to storage for collection and disposal by a licenced waste contractor off site.

Operational Environment Monitoring

RSL makes every effort to comply with legislation and to ensure that risks associated with waste produced and released into the environment is ALARP. This is checked on a scheduled basis internally and by external companies showing the output of contaminants released into the air and water stream.

These documents are known as Outfall Trade Water Analysis. The Statutory Pollution Inventory Reporting is also supplied by RSL.



Certificate of Analysis

Report Number: COV/2432337/2023 Issue 1
Laboratory Number: 22460885 Sample 1 of 1

Sample Source: Robert Stuart Ltd
Sample Point Description:
Sample Description: Trade Effluent
Sample Matrix: Trade Effluent

Sample Date: 26 January 2023 Sample Received 27 January 2023 Analysis Complete: 02 February 2023

Test Description	Result	Units	Accreditation	Method
Mercury, Total as Hg	<0.00001	mg/l	M Cov	WAS013
COD (Total)	<11.0	mg/l	M Cov	WAS040
Cyanide, Free as CN	0.010	mg/l	Y Cov	WAS018
Chromium, total as Cr (mg/l)	0.0080	mg/l	M Cov	WAS076
Cadmium, total as Cd (mg/l)	0.00051	mg/l	M Cov	WAS076

Analyst Comments for 22460885: No Analyst Comment

Signed: Name: A. Zunzunegui Date: 02 February 2023
Title: Organics Chemistry Manager

ENVIRONMENT AGENCY

Pollution Inventory reporting form

Annual releases to air, land, controlled waters, off-site transfers in wastewater, and off-site waste transfers

Each report details the minimal impact which RSL has on the environment due to the nature of the company's manufacturing activities including the use of hexavalent chromium. For the full reports, see Appendix 1 & 2.

Assessment of Risk to employees

A chromate risk assessment has been carried out and determines the general site employee exposure risk and the appropriate site implementation control measures which are in place. For the full report, please see Appendix 3.

Exposure to hexavalent chromium can be by three specific routes, dermal contamination, ingestion of hexavalent chromium, and the inhalation of mists or fumes.

The process treatment tanks fall into two categories, those operating at room temperature with no risk of fumes or spray and those which evolve fumes or spray and or which operate at elevated temperatures above 25 deg C.

RSL has several control measures in place to reduce all health risks on employees this involves supplying and maintaining record of training for all staff, supplying appropriate work wear and PPE overclothing, operating and maintaining installed ventilation systems and running a regular health monitoring system.

Training and Operation Audits

Training Audits are carried out at 6 monthly intervals, these will either be a full operator review Training record or a 6 monthly process review. The training review document will typically only change to a process review when the staff member has been doing a specified roll for many years.

After the audit, a member of the Quality department will then organise additional training where needed and log the documentation.

PPE

Dermal contamination by splashing or handling contact and possible absorption through the skin or transfer to surfaces which lead to ingestion is controlled and mitigated using appropriate, well managed PPE.

RSL provides all staff with PPE appropriate to the individual employee's role. This PPE is monitored and maintained by the employee so faults can be communicated quickly so the item of PPE to be replaced in a timely manner.

RSL also holds a stock of additional PPE onsite to be issued whenever required.

The following table shows the different types of PPE and the associated international standard that they conform to.

Personal Protective Equipment	British/International Standard
Safety Boots	ISO 20345:2022Safety Footwear Requirements Safety Cat: SRC Safety: S3
Wellington Boots	ISO 20345:2022Safety Footwear Requirements ISO 13832:2018 Chemical Footwear
Gloves (Reuseable top layer gloves and Disposable under gloves)	EN 374-1:2016+A1:2018/TYPE B Protective Gloves against Chemicals and Micro-Organisms EN374-4 – Determination of resistance to Degradation by Chemicals EN16523 – Determination to Resistance to Permeation by Chemicals
Eye Protection	EN166 Class 2
Aprons	EN14605:2005 + A1:2009 Type PB4
Respiratory Protective Equipment (RPE)*	EN140 Half Masks & Quarter Masks EN143 Particle Filter Requirements

Operator One	
	Total present measured as total leachable chemistry per week
Cadmium	4.37 ppm
Zinc	2.45 ppm
Copper	5.33 ppm
Chromium (total hexavalent)	2.36 ppm
Nickel	8.38 ppm
Operator Two	
	Total present measured as total leachable chemistry per week
Cadmium	4.43 ppm
Zinc	4.45 ppm
Copper	2.22 ppm
Chromium (total hexavalent)	3.16 ppm
Nickel	7.85 ppm
Operator Three	
	Total present measured as total leachable chemistry per week
Cadmium	6.25 ppm
Zinc	2.50 ppm
Copper	3.66 ppm
Chromium (total hexavalent)	6.17 ppm
Nickel	7.26 ppm
Operator Four	
	Total present measured as total leachable chemistry per week
Cadmium	3.60 ppm
Zinc	0.79 ppm
Copper	0.07 ppm
Chromium (total hexavalent)	0.21 ppm
Nickel	0.64 ppm

Clothing Contamination Checks

Robert Stuart Ltd Issues operators with dedicated, seasonally appropriate work wear which the operators maintain. The clothing is issued on demand so that operators can have new clothing provided to them as reasonably required. This uniform clothing is worn under appropriate PPE simply as an additional level of protection for the operative's allowing management of clothing.

To determine the level of cumulative contamination, workwear was sampled and tested for contamination as detailed below.

Four operators, working in production operations using hexavalent chromium chemistry, were chosen at random. Their workwear for a week, one pair of cargo trousers and five polo shirts were collected, and each operators clothing was soaked in 5 Lt of cold clean demineralised water for thirty minutes with occasional agitation. The water was sampled and analysed for contaminated metal content using atomic adsorption spectroscopy.

A control sample of clean used clothing was tested along with new unissued clothing. The levels of contamination were below significant levels as they represented minimal transfer to clothing and not actual dermal contamination which would be lower by inference.

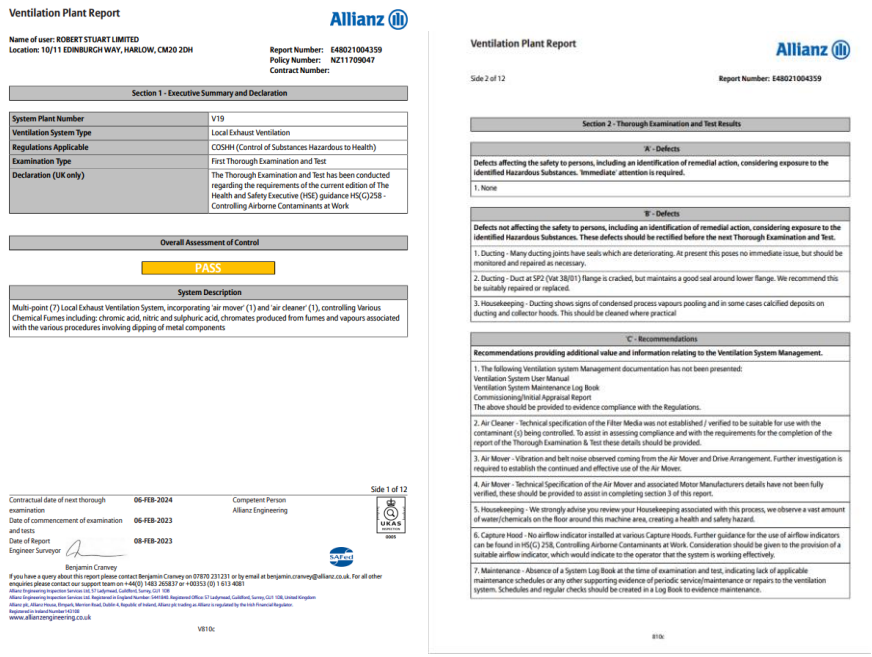
Installed Equipment to Mitigate Risk

All tanks which produce mist or fumes have a controlled freeboard, local exhaust ventilation (LEV) and where beneficial are fitted with hinged hoods further controlling the risk of inhalation.

The freeboard is controlled by the tank level indicators displaying a do not exceed tank level.

LEV is measured on a fortnightly Vacuum and Smoke Test Maintenance routine. Supporting the internal testing, external verification of the LEV system is carried out in accordance with statutory requirements as demonstrated in the Allianz LEV Monitoring Data.

Allianz issue RSL a report after testing to communicate all findings. Below is an example of one of these reports.



Ventilation Plant Report

Allianz

Name of user: ROBERT STUART LIMITED
Location: 10/11 EDINBURGH WAY, HARLOW, CM20 2DH

Report Number: E48021004359
Policy Number: NZ11709047
Contract Number:

Section 1 - Executive Summary and Declaration

System Plant Number	V19
Ventilation System Type	Local Exhaust Ventilation
Regulations Applicable	COSHH (Control of Substances Hazardous to Health)
Examination Type	First Thorough Examination and Test
Declaration (UK only)	The Thorough Examination and Test has been conducted regarding the requirements of the current edition of The Health and Safety Executive (HSE) guidance HS(G)258 - Controlling Airborne Contaminants at Work

Overall Assessment of Control

PASS

System Description

Multi-point (7) Local Exhaust Ventilation System, incorporating 'air mover' (1) and 'air cleaner' (1), controlling Various Chemical Fumes including: chromic acid, nitric and sulphuric acid, chromates produced from fumes and vapours associated with the various procedures involving dipping of metal components

Side 1 of 12

Contractual date of next thorough examination: 06-FEB-2024
Competent Person: Allianz Engineering
Date of commencement of examination and tests: 06-FEB-2023
Date of Report: 08-FEB-2023
Engineer Surveyor: Benjamin Cranvey

If you have a query about this report please contact Benjamin Cranvey on 07870 231231 or by email at benjamin.cranvey@allianz.co.uk. For all other enquiries please contact our support team on +44(0) 1483 265837 or +00353 (0) 1 613 4081

www.allianzengineering.co.uk

V810c

Ventilation Plant Report

Allianz

Side 2 of 12

Report Number: E48021004359

Section 2 - Thorough Examination and Test Results

'A' - Defects

Defects affecting the safety to persons, including an identification of remedial action, considering exposure to the identified Hazardous Substances. 'Immediate' attention is required.

1. None

'B' - Defects

Defects not affecting the safety to persons, including an identification of remedial action, considering exposure to the identified Hazardous Substances. These defects should be rectified before the next Thorough Examination and Test.

1. Ducting - Many ducting joints have seals which are deteriorating. At present this poses no immediate issue, but should be monitored and repaired as necessary.
2. Ducting - Duct at SP2 (Vat 38/01) flange is cracked, but maintains a good seal around lower flange. We recommend this be suitably repaired or replaced.
3. Housekeeping - Ducting shows signs of condensed process vapours pooling and in some cases calcified deposits on ducting and collector hoods. This should be cleaned where practical

'C' - Recommendations

Recommendations providing additional value and information relating to the Ventilation System Management.

1. The following Ventilation system Management documentation has not been presented:
Ventilation System User Manual
Ventilation System Maintenance Log Book
Commissioning/Initial Appraisal Report
The above should be provided to evidence compliance with the Regulations.
2. Air Cleaner - Technical specification of the Filter Media was not established / verified to be suitable for use with the contaminant (s) being controlled. To assist in assessing compliance and with the requirements for the completion of the report of the Thorough Examination & Test these details should be provided.
3. Air Mover - Vibration and belt noise observed coming from the Air Mover and Drive Arrangement. Further investigation is required to establish the continued and effective use of the Air Mover.
4. Air Mover - Technical Specification of the Air Mover and associated Motor Manufacturers details have not been fully verified, these should be provided to assist in completing section 3 of this report.
5. Housekeeping - We strongly advise you review your Housekeeping associated with this process, we observe a vast amount of water/chemicals on the floor around this machine area, creating a health and safety hazard.
6. Capture Hood - No airflow indicator installed at various Capture Hoods. Further guidance for the use of airflow indicators can be found in HS(G) 258, Controlling Airborne Contaminants at Work. Consideration should be given to the provision of a suitable airflow indicator, which would indicate to the operator that the system is working effectively.
7. Maintenance - Absence of a System Log Book at the time of examination and test, indicating lack of applicable maintenance schedules or any other supporting evidence of periodic service/maintenance or repairs to the ventilation system. Schedules and regular checks should be created in a Log Book to evidence maintenance.

810c

For full Allianz data, please see Appendix 4.

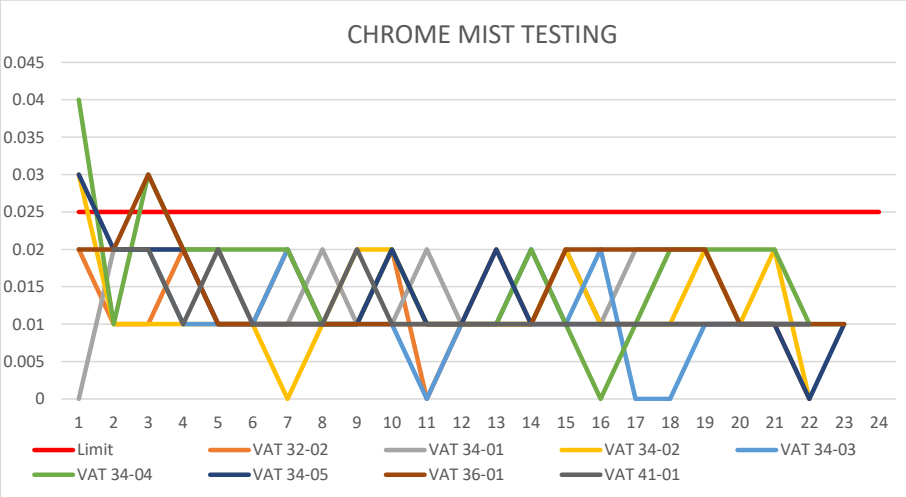
Chrome Mist Testing

RSL also performs Chrome mist testing for the LEV in accordance with MDHS 52/4 MDHS14/4 to maintain that the exposure limit remains below 0.025 mg/m3.

The below data are readings from the tanks at RSL. By undergoing this test every fortnight, RSL have to opportunity to adjust the LEV operation to maintain mist levels below legal requirements.

Week	Limit	VAT 32-02	VAT 34-01	VAT 34-02	VAT 34-03	VAT 34-04	VAT 34-05	VAT 36-01	VAT 41-01
1	0.025	0.02	CM Level	0.03		0.04	0.03	0.02	
2	0.025	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02
3	0.025	0.01	0.02	0.01	0.02	0.03	0.02	0.03	0.02
4	0.025	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01
5	0.025	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02
6	0.025	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
7	0.025	0.02	0.01	0	0.02	0.02	0.01	0.01	0.01
8	0.025	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
9	0.025	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02
10	0.025	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.01
11	0.025	0	0.02	0.01	0	0.01	0.01	0.01	0.01
12	0.025	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
13	0.025	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01
14	0.025	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01
15	0.025	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01
16	0.025	0.01	0.01	0.01	0.02	0	0.01	0.02	0.01
17	0.025	0.01	0.02	0.01	0	0.01	0.01	0.02	0.01
18	0.025	0.01	0.02	0.01	0	0.02	0.01	0.02	0.01
19	0.025	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.01
20	0.025	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
21	0.025	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01
22	0.025	0	0.01	0	0.01	0.01	0	0.01	0.01
23	0.025					0.01	0.01	0.01	
24	0.025								

This Data is then Complied info a graph that shows all readings against the limit set in the EH40/2005 Workplace Exposure Limits (Fourth Edition 2020). All reading over the limit stated will be notified to the Environmental Manager, the Chief Chemist, and the Maintenance Manager immediately with an investigation and retest in line with RSL internal instructions.



NOTE – Initial high reading in at week one were found to be due to a fault with the sampler after investigation.

Employee Health Surveillance Monitoring Data

Long term monitoring has been undertaken at the Harlow site for many years using static and individual personal air sampling devices, and by biological monitoring of the most at-risk employees.

Air Sampling

Air sampling has been undertaken at RSL to ensure that the risk via inhalation is below published exposure limits level to warrant concern. This sampling was undertaken in accordance with inhalation exposure monitoring strategies described in the Health and Safety Executive publication HS(G)173 – 'Monitoring Strategies for Toxic Substances'. Background samples were located at strategic positions to assess the effectiveness of the existing control. All samples taken by Green Air Monitoring is analysed by a UKAS accredited laboratory. The air sampling that is conducted at RSL checks for a combination of chemicals. For hexavalent Chromium, the method referenced is MDHS with a IOM head with alkaline treated filter.

The following statement has been extracted from the latest Grean Air Monitoring Report:

"The personal sample on (operator) in the anodising area gave a concentration of 0.0022mg/m3 for the 8-hour TWA concentration. This level is 22% of the workplace exposure limit for the 8 hour TWA concentration. Both the personal and static samples taken in the Hard Chrome plating area and the anodising area were all less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist."

The statement above it supported by the two segments of the two latest report.

For full report Please see the appendix.

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR HEXAVALENT CHROMIUM

Client: Robert Stuart Ltd
Date: 12th August 2022 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (µg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Sample 1 Personal sample on [redacted] working in Hard Chrome Area	2.0	259	518	Hexavalent Chromium	<0.3	<0.0006	<0.0006
Sample 2 Static sample middle of Hard Chrome Area	2.0	272	544	Hexavalent Chromium	<0.3	<0.0006	-
Sample 3 Static sample on work bench in Hard Chrome Area	2.0	271	542	Hexavalent Chromium	<0.3	<0.0006	-

Green Air Monitoring 2023

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR HEXAVALENT CHROMIUM

Client: Robert Stuart Ltd
Date: 11th June 2024 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (µg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Sample 9 Static sample in Hard Chrome Area	1.90	219	416.1	Hexavalent Chromium	<0.3	<0.0007	-
Sample 10 Personal sample on [redacted] in anodising area.	2.0	233	466	Hexavalent Chromium	1.1	0.0023	0.0022
Sample 11 Personal sample on [redacted] in Hard Chrome Area	2.0	232	464	Hexavalent Chromium	<0.3	<0.0006	<0.00058
Sample 12 Personal sample on [redacted] in anodising area	2.0	220	440	Hexavalent Chromium	<0.3	<0.0007	<0.00068
Sample 15 Static sample opposite hard chrome by tank Ankor 1127.	2.0	140	280	Hexavalent Chromium	<0.3	<0.001	-

Green Air Monitoring 2024

Biological Monitoring

Monitoring of personnel is maintained with a mature Occupational Health Program with all production operators being seen regularly by a registered occupational health organisation who take routine representative samples of urine for the purposes of Biological Monitoring.

AllHealthMatters
occupational health and general medical services

23rd March 2023

To Robert Stuart Health & Safety department

Between November and March 2023, the following employees underwent biological monitoring for exposure to heavy metals as part of their employment.

[redacted]

Chromium

[redacted]

Head Office: Castle House, Orchard Close Mews, Orchard Street, Canterbury CT2 8AP

COHPA · Care Quality Commission · Mindful Employer

AllHealthMatters
occupational health and general medical services

Summary of results

I am still waiting for Chromium results for [redacted] and we have had to repeat [redacted] Chromium test to confirm we have a reliable result. Otherwise, no employee was found to have a Chromium burden above the minimum value expected for occupational exposure. I will update this report once I have all pending results.

[redacted]

Yours sincerely,

Dr Frixos Kopsacheilis MD MFOM

e: admin@allhealthmatters.co.uk
t: 01227 451233

Head Office: Castle House, Orchard Close Mews, Orchard Street, Canterbury CT2 8AP

COHPA · Care Quality Commission · Mindful Employer

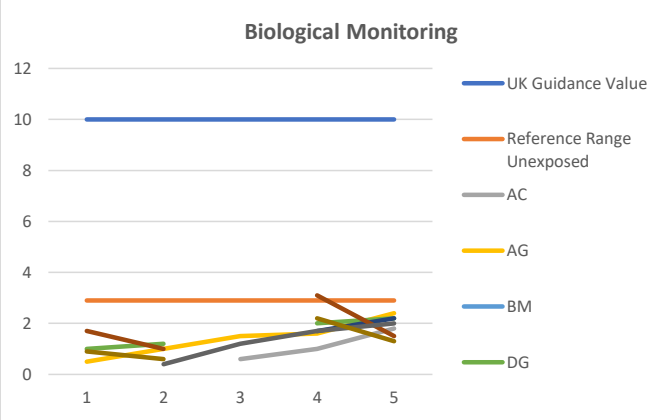
The results are communicated directly with the employees and the company is advised of the results and any appropriate action required. See the below Graph for the full data on the received in these reports or alternatively, see the appendix 5 for examples of redacted specimen copies of the HSE Labs analysis.

Consumers

RSL produces articles that are set to the specification of the design authority. The articles themselves are considered inert after production and thus will not have any effect on the customers.

Conclusion

The data in this report demonstrates that the current control measures in place for the use of Hexavalent Chromium substances are effective and that there is no notable impact on employees, the environment, or the wider population.



Appendix

1 – Outfall Trade Wastewater Analysis

The following data from ALS Environmental Ltd details the analysis of the site outfall waste water pumped to foul sewer as trade waste.

This service is used as reference analysis in support of the company's routine multiple daily checks on the wastewater quality from the Harlow site.

The analysis confirms the minimal levels of contaminants disposed of to foul sewer which meet Robert Stuart Ltd's legal consent to discharge licence.

ALS Laboratories (UK) Limited
Torrington Avenue
Coventry
CV4 9GU

T: +44 (0)24 7642 1213
F: +44 (0)24 7685 6575
www.alsenvironmental.co.uk

Mr Moore
Robert Stuart Ltd
10-11 Edinburgh Way
ROBERT-STUART LTD
Harlow CM20 2DH
Essex

02 February 2023

Test Report: COV/2432337/2023

Dear Mr Moore

Analysis of your sample(s) submitted on 27 January 2023 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0)24 7642 1213 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, please contact Customer Services. To arrange container delivery or sample collection, please call the Couriers Department directly on 024 7685 6562.

Thank you for using ALS Laboratories (UK) Limited and we look forward to receiving your next samples.

Yours Sincerely,

Signed:

Name: A. Zunzunegui

Title: Organics Chemistry Manager

Report Summary

Mr Bryan Moore
Robert Stuart Ltd
10-11 Edinburgh Way
ROBERT-STUART LTD
Harlow
Essex
CM20 2DH

Date of Issue: **02 February 2023**

Report Number: **COV/2432337/2023** Issue **1**

Job Description: Quotation 2022

Job Location: Harlow

Number of Samples included in this report: **1**

Job Received: **27 January 2023**

Number of Test Results included in this report: **5**

Analysis Commenced: **31 January 2023**

Signed:

Name: **A. Zunzunegui** Date: **02 February 2023**

Title: **Organics Chemistry Manager**

ALS Laboratories (UK) Limited was not responsible for sampling unless otherwise stated.

Information on the methods of analysis and performance characteristics are available on request.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. The results relate only to the items tested and where relevant sampled.
Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.
This test report is not a statement of conformity to any specification or standard.

ALS Laboratories (UK) Limited
Torrington Avenue, Coventry, CV4 9GU
Tel:+44 (0)24 7642 1213 Fax:+44 (0)24 7685 6575

Page 1 of 4

Certificate of Analysis

Report Number: **COV/2432337/2023** Issue **1**
Laboratory Number: **22460885** Sample **1** of **1**

Sample Source: **Robert Stuart Ltd**
Sample Point Description:
Sample Description: **Trade Effluent**
Sample Matrix: **Trade Effluent**

Sample Date: **26 January 2023** Sample Received **27 January 2023** Analysis Complete: **02 February 2023**

Test Description	Result	Units	Accreditation	Method
Mercury, Total as Hg	<0.00001	mg/l	M Cov	WAS013
COD (Total)	<11.0	mg/l	M Cov	WAS040
Cyanide, Free as CN	0.010	mg/l	Y Cov	WAS018
Chromium, total as Cr (mg/l)	0.0080	mg/l	M Cov	WAS076
Cadmium, total as Cd (mg/l)	0.00051	mg/l	M Cov	WAS076

Analyst Comments for 22460885: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG), F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: Name: **A. Zunzunegui** Date: **02 February 2023**
Title: **Organics Chemistry Manager**

ALS Laboratories (UK) Limited
Torrington Avenue, Coventry, CV4 9GU
Tel:+44 (0)24 7642 1213 Fax:+44 (0)24 7685 6575

Certificate of Analysis

UKAS TESTING 1314 | mCERTS | ALS

Report Number: **COV/2588856/2023** Issue **1**
Laboratory Number: **23538141** Sample **1** of **1**

Sample Source: **Robert Stuart Ltd**
Sample Point Description:
Sample Description: **Trade Effluent**
Sample Matrix: **Trade Effluent**

Sample Date: **14 December 2023** Sample Received **14 December 2023** Analysis Complete: **28 December 2023**

Test Description	Result	Units	Accreditation	Method
Mercury, Total as Hg	<0.00001	mg/l	M Cov	WAS013
COD (Total)	<11.0	mg/l	M Cov	WAS040
Cyanide, Free as CN	0.009	mg/l	Y Cov	WAS018
Chromium, total as Cr (mg/l)	0.0057	mg/l	M Cov	WAS076
Cadmium, total as Cd (mg/l)	0.00037	mg/l	M Cov	WAS076

Analyst Comments for 23538141: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG).
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: D. Lewis Name: **D. Lewis** Date: **28 December 2023**
Title: **Technical Inorganic Manager**

2 – Statutory Pollution Inventory Reporting Form Chromate Risk assessment

Following is Robert Stuart Ltd's PIR Form which details releases to Air, Land, Controlled Waters, Off-Site Transfers in Wastewater, and Off-Site Waste Transfers.

PIEDC: Pollution Inventory EDC reporting form

ENVIRONMENT AGENCY

Pollution Inventory reporting form
Annual releases to air, land, controlled waters, off-site transfers in wastewater, and off-site waste transfers
Pollution Prevention and Control Act 1999
The Pollution Prevention and Control (England and Wales) Regulations 2000 (SI 2000 No.1973) Regulation 28(2)

The form consists of eight parts
Part 1 About the operator and site
Part 2 Releases to air
Part 3 Releases to land
Part 4 Releases to controlled waters
Part 5 Off-site transfers in wastewater
Part 6 Off-site waste transfers
Part 7 Overseas waste transfers

Qualification Notes:
06-03-13 Higher than previous year due to increase in work, resulting in an increase in waste for this EWC. 11-01-11 Higher than previous year due to increases in work, resulting in an increase in waste for this EWC.

Part 1 About the operator and site

About the operator

1.1 Calendar year this report covers
2023

1.2 Authorisation,licence or permit number
BP4356IN

1.3 Operator's details
Robert Stuart Limited
Address Robert Stuart Plating Shop 10-11 EDINBURGH WAY ESSEX
Postcode CM20 2DH

1.4 Contact details
Title Mr First David
Surname Kerley
Position HSE Manager
Phone 07548237926
Fax
Email david.kerley@robert-stuart.co.uk

PI-1v10 BP4356IN: Robert Stuart Limited Page 1

PIEDC: Pollution Inventory EDC reporting form

About the site and its operation

1.5 NACE/NOSE-P

4-figure NACE code for the main economic activity	25.61
5-figure NOSE-P code for the main polluting process carried out on site	105.01
Other relevant NOSE-P codes for other polluting processes on the site	

1.6 How many employees did you have at 31 December of the reporting year?

85

1.7 How long was the facility operational during the period?

1992 hours

1.8 Please give email and/or web address for enquiries from the public

Email david.kerley@robert-stuart.co.uk

Web

1.9 Is some or all of the information confidential information? No

1.10 E-EPRTR codes

Main E-EPRTR code	2. (f) Installations for surface treatment of metals and plastic materials using an electrolytic or chemical process
Other relevant E-EPRTR codes	

1.11 Releases to air	Yes	**1.14 Off-site transfers in wastewater**	Yes
1.12 Releases to controlled waters	No	**1.15 Off-site waste transfers**	Yes
1.13 Releases to land	No	**1.16 Overseas waste transfers**	No

PIEDC: Pollution Inventory EDC reporting form

			Releases to air					
			Total releases		Method	Notifiable releases*		
CAS no.	Substance common name [alternative name]	Reporting threshold	n/a,brt or releases	Metric unit	M,C or E	Releases only	Metric Unit	Commercial in confidence?
7664-41-7	Ammonia	1000 kg	n/a					
1332-21-4	Asbestos	1 kg	n/a					
124-38-9	Carbon dioxide	1.0E+7 kg	n/a					
124-38-9	Carbon Dioxide From Qualifying Renewable Fuel Sources	0 kg	n/a					
630-08-0	Carbon monoxide	100000 kg	n/a					
74-90-8	Hydrogen cyanide	100 kg	brt		E			
10024-97-2	Nitrous oxide	10000 kg	brt		E			
2551-62-4	Sulphur hexafluoride	10 kg	n/a					
309-00-2	Aldrin	1 kg	n/a					
120-12-7	Anthracene	10 kg	n/a					
71-43-2	Benzene	1000 kg	n/a					
50-32-8	Benzo(a)pyrene	1 kg	n/a					
205-99-2	Benzo(b)fluoranthene	1 kg	n/a					
207-08-9	Benzo(k)fluoranthene	1 kg	n/a					
106-99-0	Butadiene (1,3-Butadiene)	100 kg	n/a					
56-23-5	Carbon tetrachloride (Tetrachloromethane)	10 kg	n/a					
57-74-9	Chlordane	1 kg	n/a					
143-50-0	Chlordecone	1 kg	n/a					
67-66-3	Chloroform (Trichloromethane)	100 kg	n/a					
50-29-3	Dichlorodiphenyltrichloroethane (DDT)	1 kg	n/a					
75-09-2	Dichloromethane (DCM) (Methylene chloride)	1000 kg	n/a					
60-57-1	Dieldrin	1 kg	n/a					
117-81-7	Di(2-ethylhexyl)phthalate (DEHP)	10 kg	n/a					
72-20-8	Endrin	1 kg	n/a					
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	1000 kg	n/a					
75-21-8	Ethylene oxide (1,2 Epoxyethane)	1000 kg	n/a					
76-44-8	Heptachlor	1 kg	n/a					
36355-01-8	Hexabromobiphenyl	0.1 kg	n/a					
118-74-1	Hexachlorobenzene (HCB)	1 kg	n/a					

PI-1v10 BP4356IN: Robert Stuart Limited Page 3

PIEDC: Pollution Inventory EDC reporting form

CAS no.	Substance common name [alternative name]	Reporting threshold	Releases to air: Total releases n/a,brt or releases	Total releases Metric unit	Method M,C or E	Notifiable releases* Releases only	Notifiable releases* Metric Unit	Commercial in confidence?
608-73-1	Hexachlorocyclohexane (HCH) -all isomers	1 kg	n/a					
193-39-5	Indeno(1,2,3-cd)pyrene	1 kg	n/a					
58-89-9	Lindane	1 kg	n/a					
74-82-8	Methane	10000 kg	n/a					
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	10 kg	n/a					
2385-85-5	Mirex	1 kg	n/a					
91-20-3	Naphthalene	100 kg	n/a					
608-93-5	Pentachlorobenzene	1 kg	n/a					
87-86-5	Pentachlorophenol (PCP)	1 kg	n/a					
79-34-5	Tetrachloroethane (1,1,2,2-Tetrachloroethane)	10 kg	n/a					
127-18-4	Tetrachloroethylene (PER)	100 kg	n/a					
8001-35-2	Toxaphene	1 kg	n/a					
12002-48-1	Trichlorobenzene - all isomers	1 kg	n/a					
79-01-6	Trichloroethylene	1000 kg	n/a					
75-01-4	Vinyl chloride	1000 kg	n/a					
7440-38-2	Arsenic	1 kg	n/a					
7440-43-9	Cadmium	1 kg	n/a					
7440-47-3	Chromium	10 kg	n/a					
7440-50-8	Copper	10 kg	n/a					
7439-92-1	Lead	100 kg	n/a					
7439-97-6	Mercury	1 kg	n/a					
7440-02-0	Nickel	10 kg	n/a					
7782-49-2	Selenium	100 kg	n/a					
7440-66-6	Zinc	100 kg	n/a					
	Brominated diphenylethers - penta-, octa- and deca- BDE	10 kg	n/a					
	Chlorine and inorganic chlorine compounds - as HCl	10000 kg	brt		E			
	Chlorofluorocarbons (CFCs)	1 kg	n/a					
	Dioxins and furans (PCDDs/PCDFs) - as WHO TEQ	0.00001 kg	n/a					
	Dioxins and furans (PCDDs/PCDFs) - as ITEQ	0.00001 kg	n/a					

PI-1v10 BP4356IN: Robert Stuart Limited Page 4

PIEDC: Pollution Inventory EDC reporting form

			Releases to air					
			Total releases		Method	Notifiable releases*		
CAS no.	Substance common name [alternative name]	Reporting threshold	n/a,brt or releases	Metric unit	M,C or E	Releases only	Metric Unit	Commercial in confidence?
	Fluorine and inorganic fluorine compounds - as HF	1000 kg	brt		E			
	Halons	1 kg	n/a					
	Hydrochlorofluorocarbons (HCFCs)	1 kg	n/a					
	Hydrofluorocarbons (HFCs)	100 kg	n/a					
	Nitrogen oxides (NO and NO2) as NO2	100000 kg	brt		E			
	Non-methane volatile organic compounds (NMVOCs)	10000 kg	brt		E			
	Particulate matter - PM2.5	1000 kg	n/a					
	Particulate matter - PM10	1000 kg	n/a					
	Particulate matter - total	10000 kg	n/a					
	Perfluorocarbons (PFCs)	10 kg	n/a					
	Polychlorinated biphenyls (PCBs)	0.1 kg	n/a					
	Polychlorinated biphenyls (PCBs) - as WHO TEQ	0.00001 kg	n/a					
	Sulphur oxides (SO2 and SO3) as SO2	100000 kg	brt		E			
	Other Individual Organic Compounds	n/a	n/a					
	Other Individual Halogens	n/a	n/a					
	Other Individual Acid Forming Gases	n/a	n/a					

PIEDC: Pollution Inventory EDC reporting form

CAS no.	Substance common name [alternative name]	Reporting threshold	Off-site transfers in wastewater: Total releases n/a,brt or releases	Total releases Metric unit	Method M,C or E	Notifiable releases* Releases only	Notifiable releases* Metric Unit	Notifiable releases* Commercial in confidence?
1332-21-4	Asbestos	0.1 kg	n/a					
15792-60-8	Alachlor	0.1 kg	n/a					
309-00-2	Aldrin	0.0005 kg	n/a					
120-12-7	Anthracene	0.1 kg	n/a					
1912-24-9	Atrazine	0.05 kg	n/a					
71-43-2	Benzene	10 kg	n/a					
50-32-8	Benzo(a)pyrene	1 kg	n/a					
205-99-2	Benzo(b)fluoranthene	1 kg	n/a					
191-24-2	Benzo(g,h,i)perylene	0.1 kg	n/a					
207-08-9	Benzo(k)fluoranthene	1 kg	n/a					
56-23-5	Carbon tetrachloride (Tetrachloromethane)	1 kg	n/a					
57-74-9	Chlordane	0.1 kg	n/a					
143-50-0	Chlordecone	0.1 kg	n/a					
470-90-6	Chlorfenvinphos	0.1 kg	n/a					
67-66-3	Chloroform (Trichloromethane)	5 kg	n/a					
2921-88-2	Chlorpyrifos	0.1 kg	n/a					
52315-07-8	Cypermethrin	0.005 kg	n/a					
50-29-3	Dichlorodiphenyltrichloroethane (DDT)	0.0005 kg	n/a					
75-09-2	Dichloromethane (DCM) (Methylene chloride)	10 kg	n/a					
62-73-7	Dichlorvos	0.0005 kg	n/a					
60-57-1	Dieldrin	0.0005 kg	n/a					
117-81-7	Di(2-ethylhexyl)phthalate (DEHP)	0.1 kg	n/a					
330-54-1	Diuron	0.05 kg	n/a					
115-29-7	Endosulfan	0.0005 kg	n/a					
72-20-8	Endrin	0.0005 kg	n/a					
100-41-4	Ethyl benzene	10 kg	n/a					
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	10 kg	n/a					
75-21-8	Ethylene oxide (1,2 Epoxyethane)	1 kg	n/a					
206-44-0	Fluoranthene	0.1 kg	n/a					

PIEDC: Pollution Inventory EDC reporting form

CAS no.	Substance common name [alternative name]	Reporting threshold	Off-site transfers in wastewater: Total releases n/a,brt or releases	Total releases Metric unit	Method M,C or E	Notifiable releases* Releases only	Notifiable releases* Metric Unit	Commercial in confidence?
76-44-8	Heptachlor	0.1 kg	n/a					
36355-01-8	Hexabromobiphenyl	0.1 kg	n/a					
25637-99-4	Hexabromocyclododecane	0.1 kg	n/a					
118-74-1	Hexachlorobenzene (HCB)	0.01 kg	n/a					
87-68-3	Hexachlorobutadiene	0.1 kg	n/a					
608-73-1	Hexachlorocyclohexane (HCH) -all isomers	0.01 kg	n/a					
193-39-5	Indeno(1,2,3-cd)pyrene	1 kg	n/a					
465-73-6	Isodrin	0.0005 kg	n/a					
34123-59-6	Isoproturon	0.01 kg	n/a					
58-89-9	Lindane	0.1 kg	n/a					
2385-85-5	Mirex	0.1 kg	n/a					
91-20-3	Naphthalene	1 kg	n/a					
608-93-5	Pentachlorobenzene	0.1 kg	n/a					
87-86-5	Pentachlorophenol (PCP)	0.05 kg	n/a					
	Perfluoro octanyl sulphate (PFOS)	0.1 kg	n/a					
122-34-9	Simazine	0.01 kg	n/a					
127-18-4	Tetrachloroethylene (PER)	1 kg	n/a					
108-88-3	Toluene	10 kg	n/a					
8001-35-2	Toxaphene	0.1 kg	n/a					
12002-48-1	Trichlorobenzene - all isomers	0.01 kg	n/a					
79-01-6	Trichloroethylene	1 kg	n/a					
1582-09-8	Trifluralin	0.001 kg	n/a					
75-01-4	Vinyl chloride	1 kg	n/a					
1330-20-7	Xylene - all isomers	10 kg	n/a					
7440-38-2	Arsenic	5 kg	n/a					
7440-43-9	Cadmium	1 kg	brt		M			
7440-47-3	Chromium	20 kg	brt		M			
7440-50-8	Copper	20 kg	brt		M			
7439-89-6	Iron	1000 kg	n/a					

PI-1v10 BP4356IN: Robert Stuart Limited Page 7

PIEDC: Pollution Inventory EDC reporting form

			Off-site transfers in wastewater					
			Total releases		Method	Notifiable releases*		
CAS no.	Substance common name [alternative name]	Reporting threshold	n/a,brt or releases	Metric unit	M,C or E	Releases only	Metric Unit	Commercial in confidence?
7439-92-1	Lead	20 kg	n/a					
7439-97-6	Mercury	0.1 kg	brt		M			
7440-02-0	Nickel	20 kg	brt		M			
7440-66-6	Zinc	100 kg	brt		M			
	Brominated diphenylethers - penta-, octa- and deca- BDE	0.1 kg	n/a					
16887-00-6	Chlorides - as Cl	2000000 kg	brt		E			
57-12-5	Cyanides - as CN	50 kg	brt		M			
	Dioxins and furans (PCDDs/PCDFs) - as WHO TEQ	0.0001 kg	n/a					
	Dioxins and furans (PCDDs/PCDFs) - as ITEQ	0.0001 kg	n/a					
	Fluorides - as F	2000 kg	brt		E			
	Halogenated organic compounds - as AOX	1000 kg	n/a					
	Nitrogen - as total N	50000 kg	brt		E			
	Nonylphenols and nonylphenol ethoxylates	1 kg	n/a					
1806-26-4	Octylphenols and octylphenol ethoxylates	1 kg	n/a					
	Organotin compounds - as Sn	5 kg	n/a					
	Phenols - total as C	20 kg	n/a					
	Phosphorus - as total P	5000 kg	n/a					
	Polychlorinated biphenyls (PCBs)	0.001 kg	n/a					
	Polychlorinated biphenyls (PCBs) - as WHO TEQ	0.0001 kg	n/a					
	Short chain (C10-13) chlorinated paraffins (SCCPs)	0.1 kg	n/a					
	Total organic carbon (TOC)	50000 kg	n/a					
	Tributyltin and compounds - as TBT	0.005 kg	n/a					
	Triphenyltin and compounds - as TPT	0.1 kg	n/a					

PIEDC: Pollution Inventory EDC reporting form

Waste transferred in tonnes

EWC codes	WFD disposal and recovery codes						C in C
	D9	D15					
06 01 06	9.44	56.22					
06 03 11		1.64					
06 03 13		3.3					
11 01 11	23.96						

3 – Chromate Risk assessment

This risk assessment report is provided in support of the REACH Application from Robert Stuart Limited for the continued use of Chromium based products within our plating processes. The Chromium based products currently used are listed in Table 1 below. The Chromium based products are all Chromium VI compounds, and as such the exposure to these products must be As Low As Reasonably Practicable (ALARP). The products listed below are used in a range of hot and ambient temperature processes directly.

Chromium compounds will also be found in drag out and rinse vats. Drag out vats are recycled back into the main process tanks. The contents of rinse vats, with Chromium compound concentrations typically less than 5% w/v are automatically recycled – the draining solutions being sent to the effluent treatment system.

Substance/Product	**Manufacturer/ Supplier**	**CAS No. of Substance/ Product**	**CAS no. of Chromium Element**	**MSDS Held**
Chromic Acid	Woburn Chemicals	1333-82-0	1333-82-0	Yes
Potassium Dichromate	Woburn Chemicals	7778-50-9	7778-50-9	Yes
Sodium Dichromate	Woburn Chemicals	10588-01-09	10588-01-09	Yes
Bonderite M-CR 1001 Aero	Henkel	NA	1333-82-0	Yes
Bonderite M-CR 1500	Henkel	NA	7738-94-5	Yes
Bonderite M-CR Alchrom 1200 Aero	Henkel	NA	1333-82-0	Yes
Bonderite M-CR 1200S	Henkel	NA	1333-82-0	Yes
Ankor 1127 Plus LR500	MacDermid Enthone	NA	1333-82-0	Yes

Table 1: Chromium based Products used by Robert Stuart Ltd

1. Workplace Exposure Limits

Workplace Exposure Limits are approved by the Health and Safety Executive and published in EH40. The current version of this document, EH40/2005 4th Edition, has been used here. These workplace exposure limits are included on the Safety Data Sheets (SDS) for each of the products. A copy of the SDS is provided by the manufacturer/supplier with each order.

Substance/Product	Short Term Exposure Limit (15-minute Reference Period)	Long Term Exposure Limit (8-hr TWA Reference Period	Source
Chromium	Not Assigned	0.5mg/m^3	EH40/2005 (4th Edition)
Chromium II Compounds	Not Assigned	0.5mg/m^3	EH40/2005 (4th Edition)
Chromium III Compounds	Not Assigned	0.5mg/m^3	EH40/2005 (4th Edition)
Chromium VI Compounds (Chromic Acid, Potassium Dichromate, Sodium Dichromate)	Not Assigned	0.01mg/m^3 0.025mg/m^3 (as process generated)	EH40/2005 (4th Edition)

Table 2: Workplace Exposure Limits

2. Hazard Identification & Classification

All Chromium VI Compounds are classified as a substance of very high concern (SVCH) and are included on the UK REACH Authorisation List (Annex 14). All the substances/products listed in Table 1 are Chromium VI compounds.

All the substances/products listed in Table 1 also appear in the Mandatory Classification and Labelling List, part of the Retained CLP Regulation (EU) No. 1272/2008 as amended for Great Britain (known as GB CLP). This list provides information on the classification and hazard labelling of the substance and is legally binding.

The following GHS Symbols have been assigned to the substances/products:


Health Hazard


Corrosive


Oxidizing


Harmful to the Environment


Acute Toxicity

Hazard Statements Assigned to Chromium elements.

Chromic Acid (including Bonderite and Ankor Products)

H272	May intensify fire; oxidiser.
H350	May cause cancer.
H340	May cause genetic defects.
H361f	Suspected of damaging fertility.
H330	Fatal if inhaled.
H311	Toxic in contact with skin.
H301	Toxic if swallowed.
H372	Cause damage to organs through prolonged or repeated exposure.
H314	Causes severe skin burns and eye damage.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317	May cause an allergic skin reaction.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

Potassium Dichromate & Sodium Dichromate

H272	May intensify fire; oxidiser.
H350	May cause cancer.
H340	May cause genetic defects.
H361FD	Suspected of damaging fertility. Suspected of damaging the unborn child.
H330	Fatal if inhaled.
H312	Harmful in contact with skin.
H301	Toxic if swallowed.
H372	Cause damage to organs through prolonged or repeated exposure.
H314	Causes severe skin burns and eye damage.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317	May cause an allergic skin reaction.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

Numerous supplementary precautionary statements are also applicable but are not mandatory for packaging and labelling but are listed in the SDS.

3. Description of Tasks and Use

Mixing/Blending of Formulations – Number of Persons Involved: 1

All blending of liquor formulations is undertaken by a qualified and competent Chief Chemist. They are the only person to have contact with substances/products in their undiluted form. These operations are undertaken outside of normal working hours to minimise exposure.

Where a vat requires to be emptied for maintenance and/or thorough examination this is again carried out by the Chief Chemist outside of normal working hours.

Plating Operations – Number of Persons Involved: 9

Operators prepare parts for plating by attaching to jigs/frames and where necessary mask areas not to be plated. Once prepared, the jig/frame is suspended above the tank ensuring that all parts to be plated are submerged and covered by the plating solution. During the plating process lids are kept closed on tanks heated above ambient temperature. Once the plating process is complete (as per customers specification), the parts are withdrawn from the plating solution and then go through a drag out and rinse process to remove excess plating solution from surfaces.

Operators also carry out routine maintenance tasks as detailed below.

Maintenance Operations – Number of Persons Involved: 4

Maintenance operations carried out on and around Chromate tanks are performed by plating operators and the maintenance team. Operator performed maintenance includes washing and wiping down of vertical/horizontal surfaces of the vat. All operators wear chemical splash resistant aprons, gloves, footwear and safety glasses when performing these tasks.

The maintenance team perform tasks above the level of the tank, such as LEV cleaning and electrical maintenance. Best efforts are made to use a mobile platform system for work adjacent to vats. Where a mobile platform cannot be used due to space constraints, A-Frame steps ladders are used. Where a task requires the maintainer to work directly above a vat, boards are placed over the vat to act as a working platform. No plating operations are carried out where maintenance is being performed directly above a vat. LEV is run to prevent exposure to residual chrome mists and PPE is always worn.

4. Handling and Storage

Precautions for Safe Handling

Only the Chief Chemist handles these substances/products in their undiluted form. All precautions listed on handling as indicated on the SDS are followed. After delivery, all substances/products are only handled within the bunded area which prevents accidental discharge to the wider environment. Spills within the bunded area are dealt with by use of commercial spill kits. Liquid spills are directed to the effluent treatment plant and eventually to bulk waste storage.

Conditions for Safe Storage

All substances/products are stored in tightly closed original containers in a cool, dry environment. Contact with direct sunlight is avoided. Storage areas for bulk chemicals is outside of the main building and is within a gully bunding system.

5. Managing Spillages

Primary containment is provided by the construction of the vats and bulk storage tanks. Secondary containment is provided in two ways – drainage gullies and bunding. External to the building, drainage gullies enclose the chemical storage areas. There are two $10m^3$ bulk storage tanks each sitting within their own $5m^3$ bunds, within the gully bunded area. The whole of the evaporative waste treatment plant sits within its own walled bunded area.

The main shopfloor sits upon a network of drainage gullies and pits that was created when the factory was built. These sit within a reinforced concrete plinth poured on a triple layer impermeable membrane designed to prevent seepage to soil and water table.

There are four drainage gully systems – two for acidic solutions and two for alkaline solutions. These systems direct all spillages, recycled rinse vat water and washdown water to the correct waste treatment stream. High level alarms are fitted within the gully system.

Spill kit bins are sited throughout the facility - internally and externally and training has been provided to staff in their use.

Drainage Gullies and Bunding Gullies Capacity

Total capacity of shop floor gully and drainage: $32m^3$ (32,000litres)

Total capacity of external gully bunding: $10m^3$ (10000litres)

Dry Compounds

Where dry compounds are accidentally spilled, the area is closed off and as much of the dry material as possible is collected and placed in an original container for disposal. The area is washed down, and the liquid is directed to the drains/gullies which then take the fluid to the waste treatment plant.

Wet Formulations

Small spillages occur as part of the plating process when parts are removed from vats for transfer to drag out and rinse vats. Horizontal vat surfaces are wiped down by operators on a frequent basis, and vat vertical surfaces and floors are washed down daily. All contaminated waste liquids are directed to the drainage gullies and then to the correct waste treatment stream.

Where a Chromium vat requires emptying for maintenance, this is pumped directly to the Acid Stream Bulk Storage Tank outside of the factory building.

Large Spillages

A large liquid spill within the building would be treated very much the same as a small spill, in that the spilled liquid would be contained within the shopfloor gully drainage system. Equipment within the spill kits would be used to prevent larger spills from spreading further than necessary.

Failure of the Bulk Waste Acid Tank can be contained within the tank bund and external gully containment. This tank is less than 2 years old (November 2022) and was designed, constructed and installed by **Forbes Technologies Limited, New Road, Crimplesham, Kings Lynn, PE33 9AS**. A static water test was undertaken following installation and the tank had a pre-installation inspection by the manufacturer and a post installation inspection by **Plant Reliability Solutions Ltd, 2 The Blackthorns, Broughton, Brigg, Lincolnshire, DN20 0BB**, prior to being put into use. The tank is fit for purpose in all respects and is unlikely to suffer mechanical failure if used for the purpose for which it was designed.

6. Routes of Exposure

All common routes of exposure are applicable in both raw form and as diluted process solutions.

Chromic Acid; Potassium Dichromate; Sodium Dichromate

Route of Entry	**Method of Entry**
Inhalation	Inhalable dust from dry substance. Fume/Vapour from process vat
Ingestion	Splashes from process activities entering mouth
Skin	Splashes from process activities onto hands and forearms
Eyes	Splashes from process activities into eyes

Bonderite Products

Inhalation	Not applicable. Product is in liquid form and used at ambient temperatures
Ingestion	Splashes from process activities entering mouth
Skin	Splashes from process activities onto hands and forearms
Eyes	Splashes from process activities into eyes

7. First Aid and Medical Information

With all of these substances/products being Chromium VI compounds, the first aid and medical information is broadly the same.

First Aid Measures

Inhalation	Move affected person to fresh air at once. Get medical attention. For breathing difficulties, oxygen may be necessary. If breathing stops, provide artificial respiration.
Ingestion	Rinse mouth thoroughly with water. Give plenty of water to drink. DO NOT induce vomiting. Get medical attention immediately.
Skin contact	Remove contaminated clothing immediately and wash skin with soap and water. Get medical attention immediately.
Eye contact	Rinse immediately with plenty of water. Remove any contact lenses and open eyelids wide apart. Continue to rinse for at least 15 minutes. Get medical attention immediately. Continue to rinse.

Medical Information

Inhalation	Toxic by inhalation. Coughing, chest tightness, feeling of chest pressure. Irritating to respiratory system. Sore throat. Burning sensation in mouth.

Ingestion Toxic if swallowed. Central and/or peripheral nervous system damage. Nausea, vomiting. Stomach pain. Diarrhoea. Shock.

Skin contact Toxic in contact with skin. Redness. Pain. Causes burns.

Eye contact Redness. Pain. May cause blurred vision and serious eye damage.

First Aiders are provided and have been trained in treating chemical injures/exposure, administration of oxygen, CPR and operation of the two Defibrillators on site. There is an emergency shower, eye wash bottles and Diphoterine (for chemical neutralisation) available. There is an on-site first aid room.

8. Firefighting Measures

Substance/Product	Firefighting Media
Chromic Acid	Use firefighting media suitable for surrounding fire
Potassium Dichromate	Use firefighting media suitable for surrounding fire
Sodium Dichromate	Use firefighting media suitable for surrounding fire
Bonderite M-CR 1001 Aero	Use firefighting media suitable for surrounding fire
Bonderite M-CR 1500	Use firefighting media suitable for surrounding fire
Bonderite M-CR Alchrom 1200 Aero	Carbon Dioxide or Dry Powder
Bonderite M-CR 1200S	Carbon Dioxide or Dry Powder
Ankor 1127 Plus LR500	Use firefighting media suitable for surrounding fire

Table 3 Firefighting Media

All the substance/products are not flammable, but will produce toxic and corrosive fumes/vapours due to thermal decomposition in a fire. Intact containers should be cooled with water to prevent heating and eventual rupture, possibly explosive due to pressure build up within the container.

Robert Stuart Limited is a Lower Tier COMAH site and as such governed by the requirements of the Control of Major Accident Hazards Regulations 2015. There is a MAPP in place, along with a Major Incident Plan. Documents relating to a major incident on site are held off site as well as in a fire proof lock box on the exterior of the main building adjacent to the entrance from Edinburgh Way. Information available includes Plume Predictions, prevalent wind directions, neighbour business information and domino site information.

Advice for Firefighters

Avoid breathing fire gases or vapours. Evacuate area. Keep upwind to avoid inhalation of gases, vapours, fumes and smoke. Ventilate closed spaces before entering them. Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. If a leak or spill has not ignited, use water spray to disperse vapours and protect men stopping the leak. Avoid discharge to the aquatic environment. Control run-off water by containing and keeping it out of sewers and watercourses. If risk of water pollution occurs, notify appropriate authorities.

Special protective equipment for firefighters should be considered as regular protection may not be safe. Wear chemical protective suit. Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing. Firefighter's clothing conforming to

European standard EN469 (including helmets, protective boots and gloves) will provide a basic level of protection for chemical incidents.

9. Control Measures

Elimination or Substitution of Harmful Substances

Currently elimination or substitution of substances containing Chromium VI is not possible. Plating operations are governed principally by the Prime Contractor. They will specify the process that has to be used for their parts.

Engineering/Administrative/PPE Controls

Robert Stuart Ltd uses a combination of engineering, administrative and PPE to control exposure to Chromium VI.

Local Exhaust Ventilation (LEV)

Chromate vats operated at temperatures above ambient have LEV to draw away fumes created during the plating process. Systems have a Thorough Examination and Test (TExT) every 14 months in accordance with the requirements of the Control of Substances Hazardous to Health Regulations 2005 by **Allianz Engineering Inspection Services Ltd, 57 Ladymead, Guildford, Surrey, GU1 1DB**. The systems are fitted with differential pressure gauges which provide operators with an indication of system performance.

Qualitative and Quantitative Testing of LEV

Routine maintenance is undertaken to a schedule of planned, preventative maintenance and breakdown maintenance is undertaken as needed. As part of routine maintenance/testing of LEV, fortnightly Chrome Mist Testing is undertaken in accordance with MDHS 52/4 and MDHS 14/4 - results show levels to be below that required for a process developed mist ($0.025mg/m^3$).

Fortnightly recording of Differential Pressure and Hood Velocity and completion of a smoke test is carried out. Back Washing of filters and scrubbers is carried out weekly.

Use of Surface Surfactant

Each of the Hard Chrome Tanks has a surface surfactant added to it to assist with fume suppression. The effectiveness of the surfactant is monitored by the Chief Chemist and testing of the surface tension is carried out.

Air Quality Monitoring

Air Quality Monitoring has been undertaken by **Green Air Monitoring, 19 Bourne Road, Bexley DA5 1LR** Testing is carried out in accordance with the principles set out in HS(G)173 – Monitoring Strategies for Toxic Substances. Personal and Static Samples are collected using alkaline treated PVDF filters for analysis by spectrophotometry in accordance with MDHS 14/4. **Marchwood Scientific Services, Unit 5, 60 Smithfold Lane, Worsley, Gtr Manchester, M28 0GP** carry out sample analysis on behalf of Green Air Monitoring. Marchwood Scientific Services are UKAS Accredited.

Reported levels of Hexavalent Chromium were below the limit of detection in August 2022.

Personal Protective Equipment (PPE)

All Chromate Operators wear PPE to the relevant ISO/BSEN Standard for that item of PPE. Details are provided below.

Personal Protective Equipment	British/International Standard
Wellington Boots	ISO 20345:2022 Safety Footwear Requirements ISO 13832:2018 Chemical Footwear
Gloves	EN 374-1 Protective Gloves against Chemicals and Micro-Organisms EN374-4 – Determination of resistance to Degradation by Chemicals EN16523 – Determination to Resistance to Permeation by Chemicals
Eye Protection	EN166 Class 2
Aprons	EN14605:2005 + A1:2009 Type PB4
Respiratory Protective Equipment (RPE)*	EN140 Half Masks & Quarter Masks EN143 Particle Filter Requirements

Table 4 Personal Protective Equipment

*The RPE is only worn by the Chief Chemist when preparing solutions and replenishing vats. RPE is not worn by operatives under normal working conditions.

Occupational Health Monitoring

All operatives working with Chromates are seen regularly as part of an Occupational Health Programme provided by **All Health Matters, Castle House, Orchard Close Mews, Orchard Street, Canterbury, CT2 8AP**. Chromate Operatives receive an annual health check which includes general health, skin examination and respiratory test. They are also required to provide a urine sample at the end of the working day/shift for the purposes of Biological Monitoring.

Urine Samples are sent to the **HSE Science & Research Centre, Harpur Hill, Buxton, SK17 9JN** for testing. HSE Science & Research Centre test to the Biological Monitoring Guide Value of 10 µmol chromium/mol creatinine in urine and provide results to All Health Matters. Operatives receive individual letters containing their test result and date of next test. The Company also receives a covering letter with all test results for a given period and advise on any required actions.

New operatives working with chromates are subjected to an enhanced programme of appointments to determine any susceptibility to absorption.

Instruction, Information, Training and Supervision

A Senior Plating Operator is the Shopfloor Foreman. Each Plating Team has a Team Leader, responsible for the supervision and training of those within their team. There is a General Manager with overall supervisory responsibility for production and a Health, Safety and Environmental Manager with supervisory responsibility for matters relating to health and safety.

Training in chemical process safety has been provided internally and externally in the past and this is in the process of being revised to take account of legislative changes and industry developments in recent years.

The following documents are available to Robert Stuart Limited and employees:

Control of Substances Hazardous to Health 2005
EH40/2005 (4th Edition) Workplace Exposure Limits
Control of Major Accident Hazards Regulations 2015
The Personal Protective Equipment Regulations 1992 (as amended 2022)
EEMUA 231 – The Mechanical Integrity of Plant Containing Hazardous Substances
PM86 – Thermoplastic Tank Integrity Management (HSE)
Hexavalent Chromium in Electroplating: Monitoring for Exposure (HSE/SEA)
Hexavalent Chromium in Electroplating: Prevention and control of Skin Exposure Risks (HSE/SEA)
Hexavalent Chromium in Electroplating: Prevention and control of Chromic Acid Mist (HSE/SEA)
Health Surveillance for Hexavalent Chromium compounds (HSE/SEA)
MDHS14/4 General methods for sampling and gravimetric analysis of respirable thoracic and inhalable aerosols (HSE)
MDHS53/4 Hexavalent chromium in chromium plating mists (HSE)
INDG346 Chromium and You (HSE)
RR963 Exposure to hexavalent chromium, nickel and cadmium compounds in electroplating industry
(HSE Laboratory 2013)
RR1042 Exposure to Carcinogens in surface engineering: Supplementary Report (HSE Laboratory 2015)

10. Waste Management

Bulk Acid Waste

There is a 10m^3 Bulk Acid Waste Storage Tank. This was installed in November 2022, replacing a similar tank that had reached end of life. The tank sits within a 5m^3 secondary containment bund. The storage tank and secondary containment bund are situated within external gully bunding system. Bulk Acid Waste is collected periodically by a Licenced Waste Contractor. The Licenced Waste Contractor is **Tradebe UK, Atlas House, Third Avenue, Globe Business Park, Marlow, SL7 1EY**. Bulk waste is transported by road to **Tradebe Gwent Waste Management Centre, Corporation Road, Gwent, NP19 4RD**. The Gwent Waste Management Centre has been issued with a permit to operate by Natural Resources Wales under the Environmental Permitting (England & Wales) Regulations 2010 with the permit number of EPR/SP3531SK.

Trade Effluent (Water Discharge)

Following treatment, water is discharged from the facility as trade effluent. Discharges are monitored by **ALS Laboratories (UK) Limited, Torrington Avenue, Coventry CV4 9GU,** a UKAS and MCerts accredited facility. Chromium discharges have been consistently below permitted levels *(reports for 2022 and 2023 included)*

Waste Reporting

Robert Stuart Ltd reports its waste discharges as part of the Environment Agency annual Pollution Inventory Reporting Process. This requires waste to be reported under 6 headings. For 2023, Robert Stuart Ltd reported the following for Chromium (all types):

Releases to Air	Not Applicable for Chromium
Releases to Land	Not Applicable for Chromium

Off-site transfers in wastewater	Below Reporting Threshold (see ALS Reports)
Releases to controlled waters	Not Applicable for Chromium
Off-site waste transfers	65660m^3 (mixed acid waste including chromium)
Overseas waste transfers	Not Applicable for Chromium

11. Assessment of Risk

Consideration has been given to the level of risk associated with the hazard of harm to employees from Hexavalent Chromium in two conditions – uncontrolled and controlled.

A standard 5 x 5 Risk Matrix has been used. No weighting factors have been used.

IMPACT	Catastrophic	**5**	5	10	15	20	25
	Major	**4**	4	8	12	16	20
	Moderate	**3**	3	6	9	12	15
	Minor	**2**	2	4	6	8	10
	Negligible	**1**	1	2	3	4	5
Action Priority Matrix			**1**	**2**	**3**	**4**	**5**
Extreme Risk (16-25) – take action to reduce risk within one month			Rare	Unlikely	Possible	Likely	Almost Certain (or Frequent)
High Risk (10-15) - take action to reduce risk within 3 months (or as indicated)			This will probably never happen/recur	Do not expect it to happen/recur but it is possible	Might happen or recur occasionally	Will probably happen/ recur	Highly likely to happen/ recur
Moderate Risk (5-9) - taken action to reduce risk within 6 months (or as indicated)							
Low Risk (1-4) manage and monitor risk, taking action as necessary			**LIKELIHOOD**				

In an uncontrolled condition the level of risk of exposure to hexavalent chromium at levels high enough to cause harm is assessed as extreme. This harm would be caused to multiple employees involved directly with the storage, handling, use and disposal of hexavalent chrome as well as a proportion of employees working on other parts of the shop floor.

Taking due consideration of the controls that have been put in place to minimize the risk of exposure reduces the risk considerably. By implementing the control measures that have been outlined in this risk assessment report, the risk to employees involved directly with the storage, handling, use and disposal of hexavalent chrome has been significantly reduced, and the risk to employees not directly involved in chromium-based operations has been almost entirely removed. The level of risk is assessed as low with a risk score of 4.

Whilst it would be desirable to completely remove the level of risk, ALARP does not require this.

4 – Local Exhaust Ventilation Monitoring Data

The following Allianz reports demonstrate and confirm the efficiency of the process LEV systems in controlling the shop atmosphere and protecting the shop operators from potentially harmful fumes or spray.

Ventilation Plant Report

Allianz

Name of user: ROBERT STUART LIMITED
Location: 10/11 EDINBURGH WAY, HARLOW, CM20 2DH

Report Number: E48021004359
Policy Number: NZ11709047
Contract Number:

Section 1 - Executive Summary and Declaration

System Plant Number	V19
Ventilation System Type	Local Exhaust Ventilation
Regulations Applicable	COSHH (Control of Substances Hazardous to Health)
Examination Type	First Thorough Examination and Test
Declaration (UK only)	The Thorough Examination and Test has been conducted regarding the requirements of the current edition of The Health and Safety Executive (HSE) guidance HS(G)258 - Controlling Airborne Contaminants at Work

Overall Assessment of Control

PASS

System Description
Multi-point (7) Local Exhaust Ventilation System, incorporating 'air mover' (1) and 'air cleaner' (1), controlling Various Chemical Fumes including: chromic acid, nitric and sulphuric acid, chromates produced from fumes and vapours associated with the various procedures involving dipping of metal components

Contractual date of next thorough examination **06-FEB-2024**
Date of commencement of examination and tests **06-FEB-2023**
Date of Report **08-FEB-2023**
Engineer Surveyor

Benjamin Cranvey

Competent Person
Allianz Engineering

UKAS INSPECTION 0005

SAFed

If you have a query about this report please contact Benjamin Cranvey on 07870 231231 or by email at benjamin.cranvey@allianz.co.uk. For all other enquiries please contact our support team on +44(0) 1483 265837 or +00353 (0) 1 613 4081

Allianz Engineering Inspection Services Ltd, 57 Ladymead, Guildford, Surrey, GU1 1DB
Allianz Engineering Inspection Services Ltd. Registered in England Number: 5441840. Registered Office: 57 Ladymead, Guildford, Surrey, GU1 1DB, United Kingdom
Allianz plc, Allianz House, Elmpark, Merrion Road, Dublin 4, Republic of Ireland, Allianz plc trading as Allianz is regulated by the Irish Financial Regulator.
Registered in Ireland Number 143108
www.allianzengineering.co.uk

V810c

Ventilation Plant Report

Allianz

Name of user: ROBERT STUART LIMITED
Location: 10/11 EDINBURGH WAY, HARLOW, CM20 2DH

Report Number: E48021004382
Policy Number: NZ11709047
Contract Number:

Section 1 - Executive Summary and Declaration

System Plant Number	V20
Ventilation System Type	Local Exhaust Ventilation
Regulations Applicable	COSHH (Control of Substances Hazardous to Health)
Examination Type	Thorough Examination and Test
Declaration (UK only)	The Thorough Examination and Test has been conducted regarding the requirements of the current edition of The Health and Safety Executive (HSE) guidance HS(G)258 - Controlling Airborne Contaminants at Work

Overall Assessment of Control

PASS

System Description

Multi-point (16) Local Exhaust Ventilation System, incorporating 'air mover' (1) and 'air cleaner' (1), controlling Various Chemical Fumes including: nickel salts, boric acid, sulphuric acid, nitric acid & cpper pyrophosphate produced from fumes and vapours associated with the dipping of components into various chemicals

Contractual date of next thorough examination	**06-FEB-2024**	Competent Person Allianz Engineering	UKAS INSPECTION 0005
Date of commencement of examination and tests	**06-FEB-2023**		
Date of Report	**12-FEB-2023**		
Engineer Surveyor	Benjamin Cranvey		SAFed

If you have a query about this report please contact Benjamin Cranvey on 07870 231231 or by email at benjamin.cranvey@allianz.co.uk. For all other enquiries please contact our support team on +44(0) 1483 265837 or +00353 (0) 1 613 4081

V810c

Ventilation Plant Report

Allianz

Name of user: ROBERT STUART LIMITED
Location: 10/11 EDINBURGH WAY, HARLOW, CM20 2DH

Report Number: E48021004361
Policy Number: NZ11709047
Contract Number:

Section 1 - Executive Summary and Declaration

System Plant Number	V22
Ventilation System Type	Local Exhaust Ventilation
Regulations Applicable	COSHH (Control of Substances Hazardous to Health)
Examination Type	Thorough Examination and Test
Declaration (UK only)	The Thorough Examination and Test has been conducted regarding the requirements of the current edition of The Health and Safety Executive (HSE) guidance HS(G)258 - Controlling Airborne Contaminants at Work

Overall Assessment of Control

PASS

System Description

Multi-point (4) Local Exhaust Ventilation System, incorporating 'air mover' (1) and 'air cleaner' (0), controlling Various Chemical Fumes, including: Chromates, nickel acetate, dichromates & caustic soda. produced from fumes associated with the electrolysis of metal components

Contractual date of next thorough examination	**06-FEB-2024**	Competent Person Allianz Engineering	UKAS INSPECTION 0005
Date of commencement of examination and tests	**06-FEB-2023**		
Date of Report	**06-FEB-2023**		
Engineer Surveyor	Benjamin Cranvey		SAFed

If you have a query about this report please contact Benjamin Cranvey on 07870 231231 or by email at benjamin.cranvey@allianz.co.uk. For all other enquiries please contact our support team on +44(0) 1483 265837 or +00353 (0) 1 613 4081

V810c

Ventilation Plant Report

Allianz

Name of user: ROBERT STUART LIMITED
Location: 10/11 EDINBURGH WAY, HARLOW, CM20 2DH

Report Number: E48021004360
Policy Number: NZ11709047
Contract Number:

Section 1 - Executive Summary and Declaration

System Plant Number	V23
Ventilation System Type	Local Exhaust Ventilation
Regulations Applicable	COSHH (Control of Substances Hazardous to Health)
Examination Type	Thorough Examination and Test
Declaration (UK only)	The Thorough Examination and Test has been conducted regarding the requirements of the current edition of The Health and Safety Executive (HSE) guidance HS(G)258 - Controlling Airborne Contaminants at Work

Overall Assessment of Control

PASS

System Description

Multi-point (5) Local Exhaust Ventilation System, incorporating 'air mover' (1) and 'air cleaner' (0), controlling Hydroflouric/ nitric acid, Sulphuric acid, sodium dichromate etch, waste acid/chrome chemical fume produced from fumes associated with the electrolysis of metal components

Contractual date of next thorough examination **06-FEB-2024**
Date of commencement of examination and tests **06-FEB-2023**
Date of Report **06-FEB-2023**
Engineer Surveyor

Benjamin Cranvey

Competent Person
Allianz Engineering

UKAS INSPECTION 0005

SAFed

If you have a query about this report please contact Benjamin Cranvey on 07870 231231 or by email at benjamin.cranvey@allianz.co.uk. For all other enquiries please contact our support team on +44(0) 1483 265837 or +00353 (0) 1 613 4081

V810c

Ventilation Plant Report

Allianz

Name of user: ROBERT STUART LIMITED
Location: 10/11 EDINBURGH WAY, HARLOW, CM20 2DH

Report Number: E48021004362
Policy Number: NZ11709047
Contract Number:

Section 1 - Executive Summary and Declaration

System Plant Number	V32
Ventilation System Type	Local Exhaust Ventilation
Regulations Applicable	COSHH (Control of Substances Hazardous to Health)
Examination Type	First Thorough Examination and Test
Declaration (UK only)	The Thorough Examination and Test has been conducted regarding the requirements of the current edition of The Health and Safety Executive (HSE) guidance HS(G)258 - Controlling Airborne Contaminants at Work

Overall Assessment of Control

PASS

System Description
Multi-point (5) Local Exhaust Ventilation System, incorporating 'air mover' (1) and 'air cleaner' (1), controlling Fumes associated with heating of process media - Chromic acid produced from Treatment Tank(s)

Contractual date of next thorough examination	**06-FEB-2024**	Competent Person Allianz Engineering	UKAS INSPECTION 0005
Date of commencement of examination and tests	**06-FEB-2023**		
Date of Report	**08-FEB-2023**		
Engineer Surveyor			SAFed

Benjamin Cranvey

If you have a query about this report please contact Benjamin Cranvey on 07870 231231 or by email at benjamin.cranvey@allianz.co.uk. For all other enquiries please contact our support team on +44(0) 1483 265837 or +00353 (0) 1 613 4081

V810c

5 – Employee Individual Personnel Monitoring Data For Chromium Compound Adsorption

The following redacted heath reports detail the analysis for creatin in urine carried our for the most exposed and at risk staff at Robert Stuart Ltd.

This demonstrates the minimal levels of personal exposure and adsorption of chromium compounds by each tested member of staff.

AllHealthMatters
occupational health and general medical services

10th September 2019

Dear [redacted]

I am happy to report that almost all of the results from the blood and urine sampling performed amongst Robert Stuart employees between 21st and 23rd August 2019, as part of biological monitoring for exposure to heavy metals at work, were within the range of values expected for people who are not exposed to [redacted] Chromium.

The employees tested for [redacted] and Chromium were:

[redacted] and [redacted]

The employees tested for Chromium only* were:

[redacted] and [redacted]

[redacted]

There was one result above the 'unexposed' range for Chromium [redacted]

With regards to [redacted] and [redacted], whose results remained within the UK guidance range of values for workers professionally exposed to these metals, their working practices may need reviewing to try and achieve levels of exposure similar to the rest of their colleagues.

[redacted]

Head Office: Castle House, Orchard Close Mews, Orchard Street, Canterbury CT2 8AP

COHPA · CareQuality Commission · MINDFUL EMPLOYER

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Registered Office: Bank Chambers, Canterbury Road, Lyminge, Kent CT18 8HU

AHM/KTM/SJ 07/03/16

AllHealthMatters
occupational health and general medical services

[redacted]

I will be informing the employees of their results in writing, and also provide leaflets with advice for working with heavy metals.

[redacted] all tests should be repeated in one year barring unforeseen circumstances.

Please feel free to contact All Health Matters if you have any questions regarding this letter.

Yours Sincerely,

Dr Frixos Kopsacheilis MD MFOM

14th October 2019

Addendum – To include the following:

- [redacted]
- [redacted] Chromium urine tests for [redacted] and [redacted]
- [redacted]

I am happy to report that all results for [redacted] and [redacted] were within the 'unexposed' range for [redacted] Chromium.

[redacted]

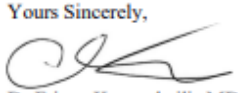
[redacted]

[redacted]

Please feel free to contact All Health Matters if you have any questions regarding this letter.

AllHealthMatters
occupational health and general medical services

Yours Sincerely,



Dr Frixos Kopsacheilis MD MFOM

AllHealthMatters
occupational health and general medical services

3rd September 2020

To whom it may concern

This letter aims to summarize the test results from biological monitoring undertaken in February 2020 for Robert Stuart employees. This involved work with [redacted] Chromium. Unfortunately, the service disruption caused by the Covid-19 pandemic only made the sum of all results available to occupational health yesterday.

[redacted] was tested for Chromium exposure and his results were within the "unexposed" range. This means that exposure controls for his job role are satisfactory.

[redacted]

[redacted]

[redacted]

Current guidance is to re-test one year from the previous measurement.

Please feel free to contact All Health Matters if you have any questions about this letter.

Yours sincerely,

Dr Frixos Kopsacheilis MD MFOM

e: admin@allhealthmatters.co.uk
t: 01227 451233

AllHealthMatters
occupational health and general medical services

22nd October 2020

[redacted]

I am happy to report that [redacted] all of the results from the blood and urine sampling performed amongst Robert Stuart employees between 18th August and 28th September 2020, as part of biological monitoring for exposure to heavy metals at work, were within the range of values expected for people who are not exposed to [redacted] Chromium.

The employees tested for [redacted] and Chromium were:

[redacted] and [redacted]

[redacted]

The employees tested for Chromium only were:

[redacted] and [redacted]

[redacted]

[redacted]
All results were within the 'unexposed' range for Chromium [redacted]

[redacted]

[redacted]

[redacted]

AllHealthMatters
occupational health and general medical services

[redacted]

[redacted] all tests should be repeated in one year barring unforeseen circumstances.

Please feel free to contact All Health Matters if you have any questions regarding this letter.

Yours Sincerely,

Dr Frixos Kopsacheilis MD MFOM

Head Office: Castle House, Orchard Close Mews, Orchard Street, Canterbury CT2 8AP

AHM/ATM/SJ 07/03/16

AllHealthMatters
occupational health and general medical services

16th August 2022

Dear [redacted]

As you are aware, we recently collected urine samples from [redacted] and [redacted] (in June), as well as [redacted] and [redacted] (in July) to test for Chromium levels.

[redacted] and [redacted] results were within the non-exposed range.

[redacted] result at **3.1** mmol/mol Creat. was slightly above the lower threshold of exposure (**2.9** mmol/mol Creat.).

[redacted] result at **5.9** mmol/mol Creat. was higher than the lab's guidance value (**4.1** mmol/mol Creat. – 90% of the lab's results are lower than this value) but still within the UK guidance value (**10** mmol/mol Creat.).

All tests should be repeated in one year unless the working conditions change significantly. I do recommend that [redacted] reviews his working practices so that his next result matches those of his colleagues'.

Please feel free to contact All Health Matters if you have any questions regarding this letter.

Yours Sincerely,

Dr Frixos Kopsacheilis MD MFOM

AllHealthMatters
occupational health and general medical services

28th September 2022

Dear [redacted]

As you are aware, we recently (22nd August) collected urine samples from [redacted] to test for Chromium [redacted]

The results for [redacted] were all within the non-exposed range. [redacted] There was evidence of exposure to Chromium, which at 4.0 umol/mol creat. remained within the UK guidance value (10) and the lab's current 90th Percentile of results (4.1). The latter means that 90% of the samples tested by the lab are at or below 4.1 umol/mol creat. and all results in this range indicate best working practices.

All tests should be repeated in one year unless the working conditions change significantly.

Please feel free to contact All Health Matters if you have any questions regarding this letter.

Yours Sincerely,

Dr Frixos Kopsacheilis MD MFOM

AllHealthMatters
occupational health and general medical services

23rd March 2023

To Robert Stuart Health & Safety department

Between November and March 2023, the following employees underwent biological monitoring for exposure to heavy metals as part of their employment.

[redacted]

Chromium

[redacted]

AllHealthMatters
occupational health and general medical services

Summary of results

I am still waiting for Chromium results for [redacted] and we have had to repeat [redacted] Chromium test to confirm we have a reliable result. Otherwise, no employee was found to have a Chromium burden above the minimum value expected for occupational exposure. I will update this report once I have all pending results.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Yours sincerely,

Dr Frixos Kopsacheilis MD MFOM

e: admin@allhealthmatters.co.uk
t: 01227 451233

Harpur Hill, Buxton, SK17 9JN, UK

HSE

Analytical Test Report

DR FRIXOS KOPSACHEILIS
ALL HEALTH MATTERS
CASTLE HOUSE, ORCHARD CLOSE MEWS
ORCHARD ST, CANTERBURY
CT2 8AP
admin@allhealthmatters.co.uk

Sample Reception
Telephone: 0203 028 3383

Our Ref 84619

Date sample received: 23/10/2023
Date sample collected: 19/10/2023

Firm name: ROBERT STUART LTD

Name	Date of Birth	Lab Number	Results					Comments
			Cr(U)					
			µmol/mol creatinine					
AG250181.	1981	202311830	2.4					

Reference Range Unexposed	<2.9 µmol/mol creat.					
UK Guidance Value	10 µmol/mol					
EU / German Guidance Value						
American Guidance Value	~40 µmol/mol creat.					
90% of our results are less than	4.0 µmol/mol creatinine					
Technique	ICP-MS with collision cell technology (BMOP01) Creatinine (SOP23)					
Detection Limit	1 nmol/L					
Analytical Precision	4%					

Requestor's Comments: PPE WORN AND LEV IN OPERATION. ELECTROPLATING

Notes -

Cr(U) Chromium in urine (UKAS accredited)

Further information on understanding your report is available at:
http://www.hsl.gov.uk/online-ordering/analytical-services-and-assays/biological-monitoring/your-report-explained

Date of report 30/10/2023
Analysts Initials: JH(26/10/2023), SI(24/10/2023)
Authorised Signatory: Dr. J. Morton, Principal Scientist (0203 028 1997)

UKAS TESTING 0665

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

Results reported are related to the sample supplied/tested.
Sample handling prior to receipt at HSE is the responsibility of the customer to maintain sample integrity.

Page 2 of 2

Harpur Hill, Buxton, SK17 9JN, UK

HSE

Analytical Test Report

DR FRIXOS KOPSACHEILIS
ALL HEALTH MATTERS
CASTLE HOUSE, ORCHARD CLOSE MEWS
ORCHARD ST, CANTERBURY
CT2 8AP
admin@allhealthmatters.co.uk

Sample Reception
Telephone: 0203 028 3383

Our Ref 85133

Date sample received: 24/11/2023
Date sample collected: 22/11/2023

Firm name: ROBERT STUART LTD

Name	Date of Birth	Lab Number	Results					Comments
			Cr(U)	Ni(u)				
			µmol/mol creatinine	µmol/mol creatinine				
BM29051964.	1964	202313683	1.0	5.0				

Reference Range Unexposed	<2.9 µmol/mol creat.	< 10.7 µmol/mol			
UK Guidance Value	10 µmol/mol				
EU / German Guidance Value		~64 µmol/mol			
American Guidance Value	~40 µmol/mol creat.				
90% of our results are less than	4.0 µmol/mol creatinine	14 µmol/mol creatinine			
Technique	ICP-MS with collision cell technology (BMOP01) Creatinine (SOP23)	ICP-MS (BMOP01) Creatinine (SOP23)			
Detection Limit	1 nmol/L	1 nmol/L			
Analytical Precision	4%	5%			

Requestor's Comments:

Notes -

Cr(U)	Chromium in urine (UKAS accredited)
Ni(u)	Nickel in urine (UKAS accredited)

Further information on understanding your report is available at:
http://www.hsl.gov.uk/online-ordering/analytical-services-and-assays/biological-monitoring/your-report-explained

Date of report 04/12/2023
Analysts Initials: JH(30/11/2023), JS(04/12/2023), RK(24/11/2023)
Authorised Signatory: Dr. J. Morton, Principal Scientist (0203 028 1997)

UKAS TESTING 0665

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

Results reported are related to the sample supplied/tested.
Sample handling prior to receipt at HSE is the responsibility of the customer to maintain sample integrity.

6 – HSE Toxicology Guidance

Contents

Main points

Kinetics and metabolism

Important information includes:

- uptake of chromium depends on the valency (III or VI) and solubility of the chromium-containing compound
- about 0.5% to 1% of chromium (III) present in the normal diet is adsorbed by the gastrointestinal tract, while chromium (VI) is more readily absorbed by both inhalation and oral routes
- insoluble inhaled chromium particles can remain in the lung for a long time
- absorbed chromium is distributed to all tissues of the body.
- chromium (VI) is unstable in the body, and is rapidly reduced to chromium (V), chromium (IV) and ultimately to stable chromium (III) by endogenous reducing agents
- absorbed chromium is excreted primarily in the urine and to a lesser extent in faeces

Health effects of acute exposure

Important information includes:

- the respiratory tract is the primary target organ for inhaled chromium
- ingestion of large amounts of chromium (VI) can lead to severe respiratory, cardiovascular, gastrointestinal, hepatic and renal damage and potentially death
- chromium (VI) may cause occupational asthma in sensitised individuals

Health effects of chronic exposure

Important information includes:

- chronic inhalation of chromium (III) salts causes a range of inflammatory changes in the respiratory tract
- chronic inhalation of high levels of chromium (VI) (in poorly controlled occupational settings) may cause nasal septum ulceration and perforation, respiratory irritation, lung cancer and possible renal effects
- dermal contact in chromium-sensitised individuals can lead to allergic dermatitis and chronic dermal exposure can result in deeply penetrating skin ulcers if left untreated
- chromium (VI) compounds have mutagenic potential
- chromium (VI) compounds are carcinogenic to humans but chromium (III) compounds are not classifiable as to their carcinogenicity to humans
- potassium dichromate may be toxic to the reproductive system and the developing foetus – there is not sufficient evidence to suggest that chromium (III) compounds are reproductive or developmental toxicants

Summary of health effects

The toxicity of chromium depends on the oxidation state, chromium (VI) being more toxic than the trivalent form chromium (III). In addition, chromium (VI) is the more readily absorbed by both inhalation and oral routes.

The respiratory tract is the primary target for inhaled chromium following acute exposure, although effects on the kidney, gastrointestinal tract and liver have also been reported.

Acute ingestion of high doses of chromium (VI) compounds, the exact quantity of which is not usually known, results in acute, potentially fatal, effects in the respiratory, cardiovascular, gastrointestinal, hepatic, renal, and neurological systems.

Due to the corrosive nature of some chromium (VI) compounds, dermal exposure can lead to dermal ulcers and at high doses, systemic toxicity leading to effects on the renal, haematological and cardiovascular system and death.

Studies of the effects of chronic occupational exposure to chromium compounds have proven difficult due to co-exposures to other toxic substances in the relevant working environments. Occupational exposure to some inhaled chromium (VI) mists may cause nasal septal ulceration and perforation, respiratory irritation and inflammation, dyspnoea, cyanosis and gastrointestinal, hepatic, renal, haematological effects and lung cancer. Chronic exposure to chromium (VI) compounds can also cause allergic responses (for example, asthma and allergic dermatitis) in sensitized individuals.

Chronic exposure to chromium (III) resulted in weight loss, anaemia, liver dysfunction and renal failure

Chromium (VI) compounds are positive in the majority of in-vitro mutagenicity tests reported and may cause chromosomal aberrations and sister chromatid exchanges in humans. The mechanism of genotoxicity has been proposed to be a result of sequential reduction of chromium (VI) within the cells to chromium (III) and the binding of chromium (III) to macromolecules, including DNA.

Chromium (III) is not considered to be mutagenic in most cellular systems and there is no firm evidence that in vivo it is mutagenic to humans or experimental animals. Studies have not shown chromium (III) to be carcinogenic.

Chromium (VI) has been classified as a Group 1 known human carcinogen by the inhalation route of exposure and chromium metal and chromium (III) compounds are not classifiable as to their carcinogenicity to humans (Group 3) due to inadequate evidence in humans.

Potassium dichromate may be toxic to the reproductive system and the developing foetus. There is not sufficient evidence to suggest that chromium (III) compounds are reproductive or developmental toxicants.

Kinetics and metabolism

Absorption

In mammals, chromium (III) is an essential trace element involved in lipid and glucose metabolism [1]. It is usually considered that almost all the chromium in food is present as chromium (III) [1]. About 0.5% to 1% of chromium (III) present in the normal diet is absorbed [2], although this appears to vary depending on the amount of chromium in the diet, more being absorbed at low levels of chromium intake [1]. Absorption of ingested chromium (VI) compounds is greater than for chromium (III) compounds, ranging from approximately 2% to 8% [1 3], although most of ingested chromium (VI) is considered to be reduced to chromium (III) in the stomach prior to absorption[3].

The behaviour and toxicity of chromium is strongly dependent on the valency, physical-chemical properties of the substance, the particle characteristics and the route of exposure/administration [2 3]. For example, chromium (III) is generally poorly absorbed and mainly taken up by cells when organically complexed [2]. Chromium (VI) chromate ions are transported into cells, whereas chromium (III) compounds enter into cells by passive diffusion and phagocytosis [3]. Furthermore, water-soluble chromium (III) aerosols of respirable size are more efficiently absorbed from the respiratory system than from the gastrointestinal tract, with approximately 5% being absorbed within hours of exposure, followed by further slow systemic absorption over weeks or months [2]. Uptake of deposited and retained insoluble chromium (III) oxide particles is a very slow process and particles containing chromium may be retained in the lung for years following occupational exposure [2]. In contrast, once deposited in the lungs, chromium (VI) compounds are generally transferred to the systemic circulation more readily than chromium (III) compounds [1].

Chromium (VI) is more efficiently absorbed through the skin than chromium (III) compounds [3]. Transfer rates of chromium (VI) across forearm skin in volunteers exposed to sodium chromate (0.01, 0.1 and 0.2 M) were 1, 6 and 10 µg chromium (VI) cm-2 h^{-1} [1]. Water soluble chromium (III) salts are able to penetrate the skin but have not been shown to reach the systemic circulation [2].

Distribution

In the blood, 95% of chromium (III) is bound to large molecular mass proteins (for example, transferrin), while a small proportion associates with low molecular mass oligopeptides [2]. Chromium compounds are widely distributed in the body, with a greater distribution reported following exposure to chromium (VI) compounds compared to chromium (III), reflecting the greater tendency of chromium (VI) to cross plasma membranes[3].

Metabolism

Chromium (VI) is unstable in the body and is reduced to chromium (V), chromium (IV), and ultimately to chromium (III) by endogenous substances such as ascorbate and glutathione and it is believed that the toxicity of chromium may result from damage to cellular components during this process (for example, through the generation of free radicals) [1 3].

Excretion

In humans, absorbed chromium is excreted primarily via urine. The half-life for elimination of chromium when given as potassium chromate (0.05 mg chromium (VI) kg^{-1} in drinking water) is estimated to be approximately 35 to 40 hours [3].

Sources of exposure

Chromium occurs naturally in the Earth's crust, predominately in the trivalent, chromium (III), form, and it is ubiquitous in air, water, soil and biological materials [4]. Chromium (VI) compounds are essentially anthropogenically-produced and do not occur naturally in the environment. Large amounts are produced through a range of activities, including:

- the production of chromates and bichromates
- stainless steel
- welding
- chromium plating
- ferrochrome alloys and chrome pigment production
- material tanning
- the combustion of coal and oil
- cement works
- and waste incineration – with the global production of the major chromium (VI) compounds estimated at about 1,942 kT year^{-1}, and a proportion of this, estimated to be about 17.5 T year^{-1}, will be released into various environmental media [4] [5]

The releases of chromium (VI) from any source are expected to be reduced via abiotic and biotic processes to chromium (III) in most situations in the environment, and the impact of the chromium (VI) form is therefore likely to be limited to the area around an exposure source [4]. In biological systems, the oxidation of chromium (III) to chromium (VI) never occurs [1]. In foodstuffs, chromium is generally considered to be present as chromium (III) [1].

The general population may be exposed to chromium by inhaling ambient air, or ingesting food and drinking water that contain chromium. Exposure may also occur through skin contact with certain consumer products containing chromium, for example, some wood preservatives, cement, cleaning materials, textiles and leather tanned using chromium [6], and via cigarette smoke (the chromium content of cigarette tobacco from the USA has been reported to be 0.24 to 6.3 mg kg^{-1}) [7].

Chromium (III) is regarded as an essential element and has an important role in the maintenance of normal carbohydrate, lipid and protein metabolism [4]. Daily exposure from food sources, excluding supplements, is estimated at about 0.1 mg [4]. Absorption from the intestines is low (0.5% to 2%) and is thought to involve a mechanism other than passive diffusion [4]. The Expert Group on Vitamins and Minerals (EVM) noted that the Committee on the Medical Aspects of Food and Nutrition Policy (COMA) has not set a Reference Nutrient Intake (RNI) but did suggest that an adequate intake for chromium (III) was above 0.025 mg day^{-1} for adults and between 0.00001 and 0.001 mg kg^{-1} day^{-1} for children and adolescents. While the US National Research Council (NRC) had published an Estimated Safe and Adequate Daily Dietary Intake (ESADDI) of 0.05 to 0.2 mg kg bw $^{-1}$ day^{-1} for adults and 0.01-0.04 mg day^{-1} for infants of up to 6 months of age. However, the EVM considered that there was insufficient data to derive a Safe Upper Level for chromium but noted that a total daily intake of approximately 0.15 mg kg^{-1} day^{-1} (or 10 mg person^{-1}) would be expected to be without adverse effects [4]. Signs of chromium deficiency, which is rare, are impaired glucose tolerance and glucose utilisation, weight loss, neuropathy, altered plasma fatty acid profile and nitrogen metabolism, and depressed respiratory quotient [4].

The average daily intake of chromium from foodstuffs for a UK adult has been estimated as approximately 117 µg day^{-1}, and the intake from drinking water at no more than 10 µg (based on consumption of 2 L day^{-1}, and an assumed concentration in drinking water of no more than 5 µg L^{-1} [1]. Based on a UK atmospheric level of chromium 3 ng m^{-3} and assuming an inhalation rate of 20 m^3 day^{-1}, the daily intake of chromium via inhalation for an adult has been estimated as 0.06 µg [1].

Workers in industries that use chromium can be exposed to higher levels of chromium than the general population. For example, Table 1 summarises data for the period 1986 to 1990 from the Health and Safety Executive (HSE) on personal occupational exposure levels to chromium (VI) during the manufacture of chromate compounds [5]. Based on these and other data, the European Chemicals Bureau (ECB) estimated reasonable worst-case occupational exposures for a range of manufacturing activities; these included was 0.02 mg m^{-3} during manufacturer of the major chromates; 0.5 mg m^{-3} during chrome pigment weighing and mixing, 0.007 mg m^{-3} during chrome tanning; and 0.01 mg m^{-3} during manufacture of chromium metal [5].

Table 1. Personal exposure during the manufacturer of chromate compounds, nd = not detected

Activity	Range (mg m-3 chromium (VI))	Geometric mean (mg m-3 chromium (VI))
Packing/unpacking	nd to 0.07	0.0093
Impregnating	0.011 to 0.14	0.028
Kilning	0.001 to 0.12	0.0046
Leaching plant	0.01 to 0.05	0.0031
Crystal plant	0.001 to 0.54	0.0098
Evaporation	0.001 to 0.05	0.0043
Chromic acid plant	0.001 to 0.13	0.0038

Activity	Range (mg m-3 chromium (VI))	Geometric mean (mg m-3 chromium (VI))
Potassium dichromate plant	0.002 to 0.08	0.011
Chromium trioxide plant	0.001 to 0.01	0.0026
Chrome tan plant	0.001 to 0.005	0.0017
General plant	0.001 to 0.05	0.006

The Health and Safety Commission (HSC) has established a workplace exposure limit (WEL) of 0.5 mg m^{-3} (8-h TWA) for chromium (III) compounds (as chromium metal), and 0.05 mg m^{-3} (8-hour TWA) for chromium (VI) compounds (as chromium metal), based upon dermal ulceration, sensitisation potential and carcinogenicity as constituting the critical toxic properties of chromium (VI) compounds [8].

Health effects of acute or single exposure

Human data

Inhalation

The respiratory tract is the primary target for inhaled chromium [9] although effects on the kidney, gastrointestinal tract and liver have also been reported. No reports of fatalities resulting from inhalation of chromium compounds were found.

There is no unequivocal evidence that exposure to chromium (III) compounds induces asthma and chromium (III) compounds are not regarded as respiratory sensitizers [2].

Ingestion

Accidental or intentional ingestion of high doses of chromium (VI) compounds, the exact quantity of which is not usually known, results in acute, potentially fatal, effects in the respiratory, cardiovascular, gastrointestinal, hepatic, renal, and neurological systems [3 5 9]. Some of these effects can be attributed to the corrosive nature of the compound [8]. For example, in one case a 17 year old male died 14 hours from respiratory distress with severe haemorrhages after ingesting potassium dichromate (29 mg chromium (VI) kg^{-1}) in an attempted suicide. Caustic burns in the stomach and duodenum and gastrointestinal haemorrhage were noted [9].

Several other cases have reported fatalities following ingestion of lower doses of chromium (VI). In one case, a 14 year old boy suffered gastrointestinal ulceration and severe liver and kidney damage and died 8 days after hospitalisation after ingesting potassium dichromate (7.5 mg chromium (VI) kg^{-1}), while in another case, a 44 year old man died of severe gastrointestinal hemorrhage one month after ingesting chromic acid (4.1 mg chromium (VI) kg^{-1}) [9]. Reports of poisoning cases have not reported respiratory or cardiovascular effects at non lethal doses [9], although clinical manifestations of liver and renal damage have been reported among individuals surviving beyond 24 hours [8]. A number of case reports have indicated that the lethal oral dose of dichromates and chromium trioxide is within the range 2.5 to 195 mg chromium (VI) kg^{-1} [5].

There are fewer documented cases of chromium (III) poisoning. In one fatal case, a woman who ingested 400 ml of a leather tanning solution containing 48 g basic chromium sulphate died of cardiogenic shock 36 hours after hospital admission despite haemodialysis treatment [2]. Post-mortem revealed haemorrhagic erosive gastroenteritis of the entire gut, severe haemorrhagic pancreatitis, pulmonary congestion and oedema, peritonitis, ascites and widespread petechial haemorrhages.

Dermal or ocular exposure

Several case studies have reported effects on the renal, haematological and cardiovascular system, gastric mucosa hyperaemia and death following dermal exposure to chromium (VI) compounds, although indications of the exposure amount were not given and in most instances, subjects had pre-existing medical conditions (carcinoma of the face, scabies infection), which may have contributed to the reported effects [9]. Broken skin or skin damaged during chromium (VI) exposure by the corrosivity of the compound, or high temperature, probably facilitated absorption in these cases [5].

Animal and in-vitro data

Inhalation

Symptoms of chromium (IV) toxicity following inhalation exposure include irritation of the respiratory tract and respiratory distress and decreased body weight gain [3 5]; female rats appear slightly more sensitive to most chromium (VI) compounds than males with the exception of sodium chromate for which toxicity is similar in both sexes and chromium trioxide, where males appear to be more sensitive (Table 2) [3]. These differences are of doubtful biological significance

Table 2. Acute inhalation LC50 values in rats exposed to chromium (VI) aerosols for 4h [3 5]

Chromium (VI) compound	Sex	Inhalation LC50 (mg chromium (VI) m-3)
Sodium chromate, sodium dichromate, potassium dichromate, ammonium dichromate	M	33 to 82
	F	29 to 45
Chromium trioxide	M	87
	F	137

Death occurred in rats following a 6 h exposure to potassium dichromate aerosols >13 mg m^{-3} chromium (VI), while no deaths were reported at 11 mg m^{-3} chromium (VI) [5]. Lung oedema, inflammation and tracheal epithelium necrosis were reported in rats exposed to sodium chromate (9 mg m^{-3} chromium (VI)) for 24 hours, while only minimal effects (reduction in glycoprotein secretion in the trachea) were noted at 3 mg m^{-3} chromium (VI) [5].

No acute inhalation toxicity information is available for chromium (III) compounds.

Ingestion

For chromium (VI), acute oral lethal doses in rats are compound specific and, as for inhalation toxicity, show a slight sex difference in susceptibility although this is of doubtful biological significance (Table 3).

Chromium (III) oxide has low oral toxicity because it is insoluble in water and poorly absorbed. In rats dosed with 5 g kg^{-1} of chromium (III) oxide no deaths or pathological changes were

noted after 14 days (LD50 > 5 g kg^{-1}) [2]. In male Wister II rats given a single oral dose of 10 or 15 g/kg chromium oxide the only sign reported was ruffled hair (LD50 >15 g kg^{-1}) [2]. Other LD50 values reported for rats include: 3.5 g kg^{-1} (CI 3.19 to 3.79 g kg^{-1}) for chromium sulphate; 11.3 g kg^{-1} for chromium (III) acetate; 3.3 g kg^{-1} for chromium nitrate; and 1.5 g kg^{-1}chromium nitrate nonahydrate [2].

Table 3. Acute oral LD50 values in rats [3, 5, 9].

Chromium (VI) compound	Sex	Oral LC50 (mg chromium (VI) kg-1)
Sodium chromate, sodium dichromate, potassium dichromate, ammonium dichromate	M	21 to 28*
	F	13 to 19*
Chromium trioxide	M	29**
	F	25
Calcium chromate	M	249

Chromium (VI) compound	Sex	Oral LC50 (mg chromium (VI) kg-1)
	F	108
Strontium chromate	M	811 (N/A)
	F	21 to 28*

N/A Not available

*Pulmonary congestion and corrosion of gastrointestinal tract mucosa noted at necropsy

**Bleeding and stomach ulcerations noted

Dermal / ocular exposure

Dermal exposure to aqueous chromium (VI) compounds results in acute toxicity. In New Zealand rabbits, given single dermal exposures to chromium (VI) as sodium chromate, sodium dichromate, potassium dichromate or ammonium dichromate, LD50 values ranged from 36 to 553 mg chromium (VI) kg^{-1} in females and 336 to 763 mg chromium (VI) kg^{-1} in males [3 9]. Reported signs of toxicity included: dermal necrosis, eschar formation, oedema and erythema, diarrhoea and hypoactivity. A dermal LD50 of 30 mg chromium (VI) kg^{-1} has been reported for chromium trioxide [5]. Neutralised sodium chromate solution was not irritating to the rabbit eye [5].

No indication of skin irritation or corrosion was found in rabbits exposed to chromium (III) oxide (500 mg moistened with water) under an adhesive patch for 4 h and chromium (III) oxide is not irritating to the eye [2]. It has also been reported that chromium sulphate is not irritating to eye and skin in rabbits [2].

Health effects following chronic or repeated exposure

Human data

General toxicity

The metallurgical, refractory and chemical industries are the prime users of chromium and many occupational studies on workers chronically exposed (for several months or years) to chromium (VI) dust or vapour have reported effects of the respiratory system such as:

- nasal irritation
- itching and soreness
- sneezing
- rhinorrhea
- nose bleeds
- nasal mucosa lesions, for example:
- septum atrophy
- ulcerations and perforations
- bronchitis
- reduced lung function
- damage to the skin, such as ulcerations and dermatitis [3 5 9]

In some chromium-sensitive individuals occupational exposure to airborne chromium (VI) may result in asthma [3].

Exposure to multiple chemical agents in the workplace and the presence of chromium (VI) in chromium (III) compounds makes assessment of the toxicity of chromium (III) difficult [2 9].

Inhalation

Case reports have shown that occupational inhalation of aqueous chromium (VI) mists (levels in air not reported) can result in irritation and inflammation of the respiratory tract, dyspnoea and cyanosis [5]. Two subjects inhaling 'massive amounts' of chromium (VI) trioxide developed dyspnoea, cough and wheeze, with marked hyperaemia of the nasal mucosa but not nasal septum perforation [3].

A study on chrome plating workers occupationally exposed to chromic acid (mean 2 to -200 µg m^{-3} chromium (VI) for 8 h day for 0.2 to 23.6 years) found that at low concentrations (mean <2 µg m^{-3} chromium (VI)) workers developed smeary, crusty and atrophied septum mucosa and at higher concentrations (2 to 200 µg m^{-3} chromium (VI)) nasal irritation, mucosa ulceration and atrophy and septum perforation was observed [3], although these effects may not have resulted from exposure levels actually measured, but may have occurred from earlier exposures [9]. Another study on electroplating workers exposed to chromic acid (>0.1 mg m^{-3} chromium (VI)) for less than 1 year reported frequent incidences of coughing, expectoration, nasal irritation, sneezing, rhinorrhea, nose-bleed, nasal septum ulceration and perforation.

Evidence suggests that exposure to chromium (VI) may induce occupational asthma and chromate sensitive workers acutely exposed to chromium (VI) compounds may develop asthma and other signs of respiratory distress [2 3 9]. For example, a study of 5 individuals with a history of contact dermatitis to chromium, found that exposure via nebuliser to a potassium dichromate aerosol containing 0.035 mg ml^{-1} chromium (VI) resulted in decreased forced expiratory volume, facial erythema, nasopharygeal pruritis, blocked nose, coughing and wheezing [2 9].

Some studies of workers exposed to airborne chromium (VI) have found increased levels of low-molecular-weight urinary proteins, such as retinol binding protein, β2-microglobulin and

tubular antigens, indicative of early kidney changes, for example one such study identified a LOAEL of 4 µg m^{-3} chromium (VI) [9]. Other studies have found no association.

Work-related cough or dyspnoea, production of phlegm, and shortness of breath was also noted in workers exposed to dust containing chromium oxide at an approximate concentration of 240 to 480 µg m^{-3} chromium (III) [2].

Ingestion

There are few human data on the adverse effects of chronic chromium (VI) intake. One study of 155 villagers living in the vicinity of a chromium smelting plant in China, whose well-water was contaminated with approximately 20 mg L^{-1} chromium (VI), reported an association between water consumption and various health effects, principally of the gastrointestinal tract (oral ulcer, diarrhoea, vomiting, abdominal pain and indigestion) and the blood (leucocytosis and immature neutrophils [9]. However, it was not possible to derive a dose-response relationship in this study.

Chromium (III) is an essential element involved in carbohydrate and lipid metabolism, although there is some evidence that repeated intake above the recommended dose may cause toxic effects. In one case an individual developed renal failure after taking 12 to 14 times the normal chromium (III) intake in the form of chromium picolinate supplement (600 µg day^{-1} for 6 weeks), which was attributed to chromium (III) ingestion [4]. In another case, ingestion of 1,200 to 2,400 µg day^{-1} of chromium (III) picolinate for 4 to 5 months was reported to result in weight loss, anaemia, haemolysis, liver dysfunction (elevated aminotransferases and total bilirubin) and renal failure [4]. The subject received hospital treatment (transfusions and haemodialysis and all measured parameters returned to normal within one year.

Dermal / ocular exposure

Dermal exposure to chromium (VI) and to a lesser extent chromium (III) compounds, can cause contact dermatitis and eczema in chromium sensitised individuals [2 3 9]. The allergen is considered to be the chromium (III)-protein complex, but chromium (VI) is more readily able to cross the dermal barrier [1]. While occupational exposure to chromium compounds appears to be the major cause of contact dermatitis [2], clinical evidence on the allergenic potential of soluble chromium (III and VI) relating to the wearing of leather articles tanned with chromium, has been noted [9].

Chronic occupational exposure to chromium (VI) compounds can cause chrome holes (sores or dermal ulcers), which if left untreated, may penetrate deeply into the skin and under prolonged exposure conditions can be very slow to heal. Skin contact with chromate salts may cause rashes [3].

Limited studies suggest that chromium sulphate is a moderate (Grade III) sensitizer and potassium dichromate is an extreme sensitizer (Grade V) [2].

Genotoxicity

Most in-vivo studies concerned with occupational exposure have involved exposure to other suspected genotoxic agents besides chromium (III and VI), which makes the assessment of the genotoxicity of chromium difficult. Furthermore, the few studies reported here are limited in that the exposure concentrations were not always known and in many cases the group size was too small [9].

No difference in nasal cell micronuclei was reported in a study on Finnish workers exposed to chromite ore (median personal exposure level 22 µg m^{-3}), in which no chromium (VI) could be detected and no increase in total chromosomal aberrations was found in cultured peripheral lymphocytes of tannery workers in comparison to controls [2]. Another study on residents living near a waste site for chromium slags and chromite ores found a significant increase in the number of DNA-protein cross-links in mononuclear leukocytes in comparison to unexposed controls [2].

No increase in strand breaks or oxidative damage to DNA of lymphocytes was found in workers exposed to chromium (VI) during bichromate production [9]. In contrast, other studies on electroplaters and stainless steel welders have reported increased incidences of chromosomal aberrations and sister chromatid exchanges compared with controls [4 9].

Carcinogenicity

The International Agency for Research on Cancer (IARC) have classified chromium (VI) as carcinogenic to humans (Group 1) based on sufficient evidence in humans as encountered in the chromate production, chromate pigment production and chromium plating industries [7].

Epidemiology studies clearly indicate the link between exposure to chromium (VI) compounds and lung cancers [3 4 9 10]. Studies of workers in the production of chromate and chromate pigments have consistently shown excess risks for lung cancer, while other studies have reported an excess of lung cancer in workers in the chromium plating industry, particularly among those with at least 10 years of employment at chrome baths, although workers in this industry have been exposed to soluble chromium (VI) compounds and possibly also to nickel [7].

Several studies have identified an excess risk of rare sinonasal cancer associated with workers in primary chromate and chromate pigment production and chromium plating [7].

IARC have considered chromium metal and chromium (III) compounds as not classifiable as to their carcinogenicity to humans (Group 3) due to inadequate evidence in humans [7].

Reproductive and developmental toxicity

There is some limited evidence to suggest that chromium (VI) compounds may be toxic to the male reproductive system. One study of 21 electroplating workers in Henan, China, significant ($p<0.05$) decreases in sperm count and motility, and significantly increased follicle stimulating hormone concentrations were found in workers exposed to chromium (VI) exposure compared with controls [3]. Furthermore, a limited study which assessed semen quality in 57 welders in India, where exposures to chromium and nickel were suggested, reported significant correlations with chromium blood concentrations and increased tail defects, decreased sperm count, rapid linear progressive motility and sperm vitality, although nothing was known about the exposure of control subjects [3]. There is no adequate data for assessing the effect of chromium on female reproduction.

Existing studies have not produced convincing evidence on the development toxicity of chromium (III) compounds.

Animal and in-vitro data

Inhalation

Repeated exposure of animals to chromium (VI) compounds causes similar effects to those observed in humans, that is irritant and inflammatory effects on the respiratory system and immunological changes such as increased serum immunoglobulin and white blood cell count, and alveolar macrophage and spleen lymphocyte activities [3] [5].

Longer-term exposure to chromium (VI) compounds (1 to 1.5 years in mice and 1.5 to 2 years in rats) can cause thickening of septa of the alveolar lumen, interstitial fibrosis bronchopneumonia, and lung abscesses (rats) and nasal septum perforation, emphysema, epithelial necrosis and hyperplasia in the large and medium bronchi, with numerous openings in the bronchiolar walls (mice)[3].

No treatment-related deaths or clinical signs were noted in rats exposed to chromium (III) oxide aerosols at approximately 4.4, 15, 44 mg m^{-3} (3, 10 and 30 mg m^{-3} chromium (III)) for 6 hours day^{-1}, 5 days $week^{-1}$, for 13 weeks [2]. Pathological changes were limited to pigment deposition and mild inflammation in the lungs. The Lowest Observed Adverse Effect Level (LOAEL) was 3 mg m^{-3} chromium (III). Studies with inorganic chromium (III) salts have established a systemic No Observed Adverse Effect Level (NOAEL) of 3 mg m^{-3} chromium (III) sulphate (based on decreased body weight and altered haematology), but a NOAEL was not established for respiratory inflammation effects since effects occurred at the lowest dose (3 mg m^{-3} chromium (III)) [2].

Ingestion

Sub-chronic and chronic oral exposure of animals to chromium (VI) compounds does not appear to result in significant toxicological effects; some studies have reported minimal or transient changes in body weight gain, haematological indices and the immune system, while others have not [3] [5].

Low toxicity of chronic exposure to chromium (III) compounds can be expected due to poor bioavailability [1]. For example, no adverse effects were seen in rats fed chromium oxide at up to 1,368 mg kg^{-1} day^{-1} chromium (III) for 90 days, or in rats fed up to approximately 7 mg kg^{-1} chromium (III) as chromium chloride for 20 weeks, although the latter study was limited by the small number of animals used and endpoints assessed [2].

Genotoxicity

Soluble chromium (VI) compounds have been found to be mutagenic in virtually all in-vitro test systems [3] [5] [10], while negative results have been reported for chromium (III) in the majority of in-vitro tests in bacteria and mammalian cells, even though chromium (III) is generally more reactive with isolated DNA than chromium (VI) [2] [10].

Chromium (VI) compounds have been reported to cause DNA damage, DNA strand cross-links, DNA-protein cross-links, sister chromatid exchanges and chromosomal aberrations in vivo [3] [10], while there is no adequate evidence to suggest that chromium (III) compounds are genotoxic in vivo [2] [10].

Organic chromium (III) picolinate (up to 2,500 mg kg bw^{-1}) administered to male rats once a day for 3 days by gavage was negative in the in vivo bone marrow micronucleus test [2]. Based on the available in-vitro data, the COM concluded in 2004, that chromium (III) picolinate should be regarded as not being mutagenic in vitro, and considered that since the available in-vivo tests in mammals are negative, no further in-vivo testing is currently required [10].

Carcinogenicity

The IARC has concluded that there is sufficient evidence in experimental animals for the carcinogenicity of the following chromium (VI) compounds: calcium chromate, zinc chromates, strontium chromate and lead chromates and that the evidence is limited for chromic acid and sodium dichromate [7].

Lung tumours were observed in 3/19 male Wister rats exposed for 22 hours day^{-1} 7 days $week^{-1}$ for 18 months to 0.1 mg m^{-3} chromium (VI) as sodium dichromate, followed by 12 months of observation. The tumours included 2 adenomas and one adenocarcinoma. No lung tumours were observed in controls or the rats exposed to ≤0.05 mg m^{-3} chromium (VI). The increased incidence of lung tumours in the treated rats was significant by the Fisher Exact Test (P=0.03) [9].

The IARC has also concluded that the evidence for carcinogenicity of barium chromate and chromium (III) compounds is inadequate [7].

Reproductive and developmental toxicity

A number of oral studies have reported developmental toxicity following premating and/or in utero exposure. Potassium dichromate(VI) given in drinking water to female rats (37 to 87 mg kg^{-1} day^{-1} chromium (VI)) and mice at (52 to 169 mg kg^{-1} day^{-1} chromium (VI)) for 20 or 90 days followed by mating with unexposed males, resulted in foetal mortality (post-implantation loss, resorption and decreased number of live foetuses), developmental retardation (decreased fetal body weight and crown-rump length), reduced ossification, subdermal hemorrhagic patches, and kinky tails [3]. No developmental effects were noted in a multigeneration study in which rats were exposed by inhalation exposure to sodium dichromate at 0.2 mg m^{-3} chromium (VI) [3].

No reproductive or developmental effects were reported in rats given 1,500 mg kg bw^{-1} chromium (III) for 60 days prior to mating and throughout gestation [1,2]. In contrast, chromium (III) chloride administered to mice via drinking water reduced both male and female fertility at an approximate dose of 150 mg kg bw^{-1} chromium (III), and foetal toxicity in male offspring of pregnant females exposed to approximately 31 to 36 mg kg bw^{-1} chromium (III) during gestation and lactation [1]. Although the validity of these results has been questioned due to insufficient reporting and inconsistent findings [2] and therefore there is no adequate evidence to indicate that chromium (III) compounds are reproductive or developmental toxicants.

References

1. Department for Environment Food and Rural Affairs (DEFRA) and Environment Agency (EA), Contaminants in soil: Collation of toxicological data and intake values for humans. Chromium. , in R&D Publications TOX 4. . 2002, Environment Agency: Bristol.

2. International Programme on Chemical Safety (IPCS), Inorganic chromium (III) compounds. Draft. Concise International Chemical Assessment Document 2006, WHO: Geneva.

3. International Programme on Chemical Safety (IPCS), Inorganic chromium (VI) compounds. Draft. Concise International Chemical Assessment Document 2006, WHO: Geneva.

4. Expert Group on Vitamins and Minerals (EVM), Safe Upper Levels for Vitamins and Minerals. 2003, Food Standards Agency.

5. European Chemicals Bureau (ECB), European Union Risk Assessment Report. Chromium trioxide, sodium chromate, sodium dichromate, ammonium dichromate and potassium dichromate Risk Assessment. EUR Report No. 201508 EN. 2005, ECB.

6. International Programme on Chemical Safety (IPCS), Chromium. Environmental Health Criteria 61. 1998, WHO: Geneva.

7. International Agency for the Research on Cancer (IARC), Chromium, nickel and welding. Vol 49. , in IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. 1997, IARC: Lyon.

8. Health and Safety Executive (HSE), EH40/2005 Workplace Exposure Limits. 2005.

9. Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological profile for chromium. 2000, US department of Health and Human Services: Atlanta, US.

10. Committee on Carcinogenicity of Chemicals in Food Consumer Products and the Environment (COC), COM/04/S3. Statement on the mutagenicity of trivalent chromium and chromium picolinate 2004.

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7 – Green Air Monitoring 2024 Report

Occupational Hygiene Monitoring Report

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for

[redacted]
Health & Safety Manager and Environmental Manager

by

Survey by:	**Michael Gray MRSC, LFOH Principal Occupational Hygienist**
Report by:	**Michael Gray MRSC, LFOH.** **Principal Occupational Hygienist** **Green Air Monitoring Ltd**
Survey Date:	**11th June 2024**

CONTENTS

EXECUTIVE SUMMARY

As part of their ongoing commitment to comply with Health and Safety legislation, Robert Stuart Ltd commissioned Green Air Monitoring Ltd to carry out air quality monitoring study in the plating shop at 10-11 Edinburgh Way, Harlow, Essex CM20 2DH.

The study was undertaken by Michael Gray of Green Air Monitoring Ltd on the 11th June 2024.

A strategy of background sampling was undertaken, in accordance with principles described in HS(G)173 – 'Monitoring Strategies for Toxic Substances', published by the Health and Safety Executive, to assess occupational exposure to various processes within the factory.

Findings

Inhalable/Respirable Dust
The personal inhalable dust level in the shot blast area for [redacted] was 1.94mg/m^3 which is 19% of the workplace exposure limit for the 8-hour time weighed average concentration. The respirable dust level was low at 0.49mg/m^3 and the static sample gave low levels of both inhalable and respirable dust.

Hexavalent Chromium Levels
The personal sample on [redacted] in the anodising area gave a concentration of 0.0022mg/m^3 for the 8-hour TWA concentration. This level is 22% of the workplace exposure limit for the 8-hour TWA concentration.

Both the personal and static samples taken in the Hard Chrome plating area and the anodising area were all less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist. As control measure the hexavalent chromium mist concentration above the vat is carried out every two weeks by Robert Stuart Ltd staff.

Cadmium Levels
The personal sample on [redacted] was 0.00155mg/m^3 which is 6.2% of the WEL for the 8-hour TWA concentration.

The highest static sample taken in the Cadmium plating area was 12% of the WEL with the other static sample less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist.

Nickel Levels in the Nickel/Zinc Plating Area
Both the personal and static samples taken in the Nickel/Zinc plating area were all less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist.

Nickel Levels in the Electroless Nickel Plating Area
Both the personal and static samples taken in the electroless plating area were less than the limit of detection and hence below any WEL concentration.

Robert Stuart Ltd carry out health surveillance for toxic metals in urine and blood and have now added nickel to the program.

I. INTRODUCTION

As part of their ongoing commitment to comply with Health and Safety legislation, Robert Stuart Ltd commissioned Green Air Monitoring Ltd to carry out air quality monitoring study in the plating shop at 10-11 Edinburgh Way, Harlow, Essex CM20 2DH.

Scope of Works

- One personal and one static sample were collected for respirable and inhalable dust in the shot blast area
- One personal and two static samples were collected for Hexavalent Chromium in the hard chrome plating area.
- Two personal samples were collected for Hexavalent Chromium in the anodising areas.
- One personal and two static samples were collected for Cadmium in the cadmium plating area.
- One personal and two static samples were collected for Nickel in the Electrolytic Nickel/Zinc plating area.
- One personal and one static sample were collected for Nickel in the Electroless Nickel plating area.

The monitoring was carried out over a period of time sufficient to collect a representative sample of the conditions prevailing.

2. METHODOLOGY

General

In general, sampling was undertaken in accordance with generally approved inhalation exposure monitoring strategies described in the Health and Safety Executive publication HS(G)173 – 'Monitoring Strategies for Toxic Substances'. Background samples were located at strategic positions to assess the effectiveness of the existing control. All samples taken were analysed in the Marchwood Scientific Services Ltd a UKAS accredited laboratory in Manchester.

Hazardous Substance	Method Reference	Capture Media/Sampling Head
Inhalable/Respirable dust	MDHS 14/4	IOM Heads with GFA PUF filters
Hexavalent Chromium	MDHS 14/4	IOM Heads with alkaline treated filters
Cadmium	MDHS 14/4	IOM Heads with MCE filters
Nickel (Soluble)	MDHS 14/4	IOM Heads with MCE filters

3. RESULTS

3.1 Evaluation Criteria

Contaminant	Long-term Exposure Limit (8-hour ref period) mg m^{-3}	Short-term Exposure Limit (15-minute ref period) mg m^{-3}	Type of Limit	Risk Phrases	Notes
Inhalable Dust	10	-	WEL	-	EH40
Respirable Dust	4.0	-	WEL	-	EH40
Hexavalent Chromium	0.01	-	WEL	Carc, Sen	EH40
Cadmium	0.025	-	WEL	Carc	EH40
Nickel (Soluble)	0.1		WEL	Sk, Carc	EH40

Notes:
$mg.m^{-3}$ Milligrammes per cubic meter
WEL Workplace Exposure Limit
ppm Parts per million

4.0 DISCUSSION AND CONCLUSIONS

4.1 Inhalable/Respirable Dust

The personal inhalable dust level in the shot blast area for [redacted] was 1.94mg/m^3 which is 19% of the workplace exposure limit for the 8-hour time weighed average concentration. The respirable dust level was low at 0.49mg/m^3 and the static sample gave low levels of both inhalable and respirable dust.

4.2 Hexavalent Chromium Levels

The personal sample on [redacted] in the anodising area gave a concentration of 0.0022mg/m^3 for the 8-hour TWA concentration. This level is 22% of the workplace exposure limit for the 8 hour TWA concentration.

Both the personal and static samples taken in the Hard Chrome plating area and the anodising area were all less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist.

As a control measure the hexavalent chromium mist concentration above the vat is carried out every two weeks by Robert Stuart Ltd staff.

4.3 Cadmium Levels

The personal sample on [redacted] was 0.00155mg/m^3 which is 6.2% of the WEL for the 8 hour TWA concentration.

The highest static sample taken in the Cadmium plating area was 12% of the WEL with the other static sample less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist.

4.4 Nickel Levels in the Nickel/Zinc Plating Area

Both the personal and static samples taken in the Nickel/Zinc plating area were all less than the limit of detection showing that the local exhaust ventilation systems are efficient at reducing plating mist.

4.5 Nickel Levels in the Electroless Nickel Plating Area

Both the personal and static samples taken in the electroless plating area were less than the limit of detection and hence below any WEL concentration.

Robert Stuart Ltd carry out health surveillance for toxic metals in urine and blood and have now added nickel to the program.

Recommendations

General

The results from this survey should be presented and explained to operators on site. Educate and train operatives in the nature of exposure, the hazards and risks from the substances used or encountered. Document and keep records of all training.

Occupational Exposure

- All Operators should use the local exhaust ventilation systems supplied.

In all the areas the situation should be reviewed wherever there is any evidence to suspect that the measurements taken are no longer valid. This may be due to significant changes in the work such as:

(a) In the substances used.
(b) Plant modification.
(c) In the process or methods of work.
(d) In the volume or rate of production.

Additionally, the situation may need to be reviewed due to external reasons such as new information on the health risks or a revised Workplace Exposure Limit.

This report should be kept on record for a period of 40 years.

APPENDIX I

Occupational Exposure Monitoring Record Form

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR INHALABLE/RESPIRABLE DUST

Client: Robert Stuart Ltd
Date: 11th June 2024 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (mg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Filter N640 Personal sample on [redacted]	2.0	246	492	Respirable dust Inhalable dust	0.25 0.98	0.51 2.0	0.49 1.94
Filter N639 Static sample close by in Shot Blast area	2.0	246	492	Respirable dust Inhalable dust	0.17 0.53	0.35 1.08	- -

Static samples are not calculated as 8-hour TWA concentration.
The working hours on site 08-00hrs to 16-45hrs with one hour of breaks, making the total hours worked is 7 hours 45 minutes.

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR HEXAVALENT CHROMIUM

Client: Robert Stuart Ltd
Date: 11th June 2024 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (µg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Sample 9 Static sample in Hard Chrome Area	1.90	219	416.1	Hexavalent Chromium	<0.3	<0.0007	-
Sample 10 Personal sample on [redacted] in anodising area.	2.0	233	466	Hexavalent Chromium	1.1	0.0023	0.0022
Sample 11 Personal sample on [redacted] in Hard Chrome Area	2.0	232	464	Hexavalent Chromium	<0.3	<0.0006	<0.00058
Sample 12 Personal sample on [redacted] in anodising area	2.0	220	440	Hexavalent Chromium	<0.3	<0.0007	<0.00068
Sample 15 Static sample opposite hard chrome by tank Ankor 1127.	2.0	140	280	Hexavalent Chromium	<0.3	<0.001	-

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR CADMIUM

Client: Robert Stuart Ltd
Date: 11th June 2024 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (µg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Sample 3 Static sample on Jigging bench	1.95	248	483.6	Cadmium	1.6	0.003	-
Sample 4 Personal sample on [redacted] in Cadmium Plating Area	2.0	249	498.0	Cadmium	0.8	0.0016	0.00155
Sample 5 Static sample far end in Cadmium Plating Area	2.0	248	496.0	Cadmium	<0.1	<0.0002	-

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR NICKEL in ELECTROLYTIC NICKEL/ZINC PLATING AREA

Client: Robert Stuart Ltd
Date: 11th June 2024 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (µg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Sample 6 Static sample on bench in Nickel/Zinc plating area.	2.0	226	452	Nickel	<1.0	<0.0022	-
Sample 7 Static sample far end of Nickel/Zinc Plating area.	2.0	229	458	Nickel	<1.0	<0.0022	-
Sample 8 Personal sample on Archie Russell in Nickel/Zinc Plating area.	2.0	225	450	Nickel	<1.0	<0.0022	<0.0022

OCCUPATIONAL EXPOSURE MONITORING RECORD FORM FOR ELECTROLESS NICKEL PLATING

Client: Robert Stuart Ltd
Date: 11th June 2024 **Site:** 10-11 Edinburgh Way, Harlow, Essex CM20 2DH

Operator Name/ Sample Location	Average Sample Rate Lts/min	Time Minutes	Total Volume Litres	Analyte for Analysis	Amount Detected (µg)	Conc'n (mg m^{-3})	8- Hour TWA Conc'n (mg m^{-3})
Sample 13 Personal sample [redacted] in Electroless Nickel Plating area	2.0	141	282	Nickel	<1.0	<0.0035	<0.0034
Sample12 Static sample by Electroless Nickel Vat Plating Area	2.0	141	282	Nickel	<1.0	<0.0035	-

APPENDIX II

Legislation

LEGISLATION

Health and Safety at Work Etc Act (1974)

Employers' and Employees' responsibilities for health and safety are laid down by the Health and Safety at Work Etc Act (1974). This Act seeks to protect all persons at work whether employers, employees or members of the general public affected by the work activities.

The Control of Substances Hazardous to Health (COSHH) Regulations (Sixth Edition) L6 2002

The COSHH Regulations lay down requirements that may be described in summary:

Regulation 6
Assessment of the risk to health created by work involving substances hazardous to health
Undertake an assessment, which evaluates the risk to health created by the use of hazardous substances in the workplace and documents the necessary precautions to be taken to ensure that the risk is adequately controlled.

Under the revised regulations, the following information shall be considered within the assessment:

- Control measures required to control exposure and the effect of these measures.
- The hazardous properties and health hazards of the substance.
- Level, type and duration of exposure.
- Circumstances of work including the quantities used.
- Relevant Workplace Exposure Limits.
- Maintenance activities.
- Results of health surveillance and exposure monitoring.
- Additive or synergistic effects of exposure to substances simultaneously.
- Approved classification of any biological agent.

Regulation 7
Prevention or control of exposure to substances hazardous to health
Exposure to substances hazardous to health must be prevented or adequately controlled. To secure prevention, consideration should be given to substituting with a less hazardous substance or less hazardous form of the substance. Adequate control shall also be achieved by means other than personal protection. Preference should be given to controlling exposure at source, providing suitable processes and systems of work and limiting the number of personnel and duration of those potentially exposed. Suitable general ventilation should be provided.

For substances deemed to be a carcinogen under COSHH the following hierarchy of control must be adopted.

Table 2 - GHS/CLP carcinogen classification system Category	Definition
Category 1A	Chemicals *known* to have carcinogenic potential for humans
Category 1B	Chemicals *presumed* to have carcinogenic potential for humans
Category 2	Chemicals *suspected* to be human carcinogens

Hierarchy of Control

- Totally enclose the process and handling systems unless this is not reasonably practical.
- Prohibit eating, drinking and smoking in areas contaminated by carcinogens.
- Clean of floors, walls and other surfaces at suitable intervals.
- Designate areas contaminated by carcinogens.
- Storing, handling and disposing of carcinogens safely.

Regulation 8
Use of control measures etc

Every employer shall ensure that, where control measures are provided to control exposure such control measures should be properly used or applied. Similarly, the COSHH Regulations place a duty upon employees to look after and report defects on, and make full and proper use of, any control measure provided.

Regulation 9
Maintenance, examination and testing of control measures

Where engineering controls such as local exhaust ventilation are used to control exposure to hazardous substances, a documented systematic approach to the maintenance, examination and testing should be carried out to ensure that they continue to provide effective and efficient control. Specified controls are required to be checked on a routine basis as detailed within the regulations.

Regulation 10
Monitoring exposure at the workplace

The Workplace Exposure Limits for the quantities of substances within the atmosphere are defined by the Health and Safety Commission and published by the Health and Safety Executive in document EH40/2011. There is one type of limit: Workplace Exposure Limits (WEL)

The majority of assessments may be carried out simply by examination of the hazard data sheets available on the substances used and employing appropriate control measures. However, not all substances may be assessed as easily. Monitoring for the levels of hazardous substances in the atmosphere should be carried out where requisite; for example:

- demonstrate that an WEL is not exceeded;
- show that control measures are adequately reducing exposure below WELs; or
- where substances are listed in Schedule 4 of the COSHH Regulations.

Regulation 11
Health surveillance

Health surveillance should be carried out where appropriate, eg where adverse changes can be detected early, or where results can assist in the evaluation of the effectiveness of control measures employed. Health surveillance may involve simple skin checks, lung function tests or more extensive blood and urine tests. Results of health surveillance should be documented and kept for forty years.

Regulation 12
Information, instruction and training for persons who may be exposed to substances hazardous to health

Information, instruction and training should be provided to all employees involved in the handling of substances hazardous to health.

- Information regarding the nature of the hazards and the risks.
- Instruction on how to work safely with hazardous substances.
- Training on how to fully comply with the Regulations, make use of the control measures provided etc.

Regulation 13
Arrangements to deal with accidents, incidents and emergencies

Arrangements to deal with accident, incidents, and emergencies (without prejudice to management regulations)

- Procedures (including First Aid and Safety Drills) prepared
- Information on emergency arrangements including
  1. Details of work hazards/identification arrangements
  2. Specific hazards likely to arise
- Establish suitable warning and communication systems to enable an appropriate response

APPENDIX III

Analysis Certificates

GreenAir MONITORING
INDOOR AIR QUALITY

Marchwood
part of Cawood

CERTIFICATE OF ANALYSIS

MSSL reference: 24-72815

Report date: 24-06-2024

Customer reference: Robert Stuart, 10-11 Edinburgh Way, Harlow Essex CM20 2DH
Customer PO: -
Customer sampling date: 11-06-2024
Date received: 13-06-2024
Analysis started: 14-06-2024
Analysis complete: 24-06-2024
Conforming: Yes

This report shall not be reproduced except when in full without approval of the laboratory.
Results only relate to the items tested. Results apply to the samples as received.
Conformance is contingent upon accurate information being provided by the customer and customer compliance with relevant sample handling and storage conditions prior to receipt at the laboratory.
All opinions and interpretations expressed within this report are outside Marchwood's scope of accreditation.

Accreditation Key:
Y : ISO 17025 UKAS M : MCERTS
N : Non Accredited (S) : Subcontracted

Notes:

Reported by: Rosie Daffern
Position: Senior Analytical Chemist

Approved by: Sebastian Dahl
Position: Laboratory Manager
For/on behalf of Marchwood Scientific Services Ltd

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www.cawood.co.uk

Analysis of inhalable and respirable particulates by gravimetry from GFA + PUF IOM. (WI 3045)

	MSSL sample ref:	24-72815-001	24-72815-002
	Customer sample ref:	N639	N640

Determinand	Units	LOD	Acc.		
Respirable particulates	mg	0.05	Y	0.17	0.25
Inhalable particulates	mg	0.50	Y	0.53	0.98

Page 2 of 4

GreenAir MONITORING
INDOOR AIR QUALITY

Analysis of metal(s) by ICP/OES from MCE filter(s) (WI 3054)

	MSSL sample ref:	24-72815-003	24-72815-004	24-72815-005
	Customer sample ref:	3	4	5

Determinand	Units	LOD	Acc.			
Cd	µg	0.1	Y	1.6	0.8	<0.1

	MSSL sample ref:	24-72815-006	24-72815-007	24-72815-008	24-72815-009
	Customer sample ref:	6	7	8	13

Determinand	Units	LOD	Acc.				
Ni	µg	1.0	Y	<1.0	<1.0	<1.0	<1.0

	MSSL sample ref:	24-72815-010
	Customer sample ref:	14

Determinand	Units	LOD	Acc.	
Ni	µg	1.0	Y	<1.0

Page 3 of 4

GreenAir MONITORING
INDOOR AIR QUALITY

Analysis of hexavalent chromium from alkaline-treated PVDF filter(s) by spectrophotometry

	MSSL sample ref:	24-72815-011	24-72815-012	24-72815-013	24-72815-014
	Customer sample ref:	9	10	11	12

Determinand	Units	LOD	Acc.				
Cr(VI)	µg	0.3	N	<0.3	1.1	<0.3	<0.3

	MSSL sample ref:	24-72815-015
	Customer sample ref:	15

Determinand	Units	LOD	Acc.	
Cr(VI)	µg	0.3	N	<0.3

Page 4 of 4