

# Detecting and Neutralizing Hexavalent Chromium with HexChecks

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Chief Scientist  
Figure Engineering





Introductions

About Hexavalent Chromium

Test and Sampling Methods

Introduction to HexChecks Testing Swabs

Introduction to HexChecks Neutralizer

Demos

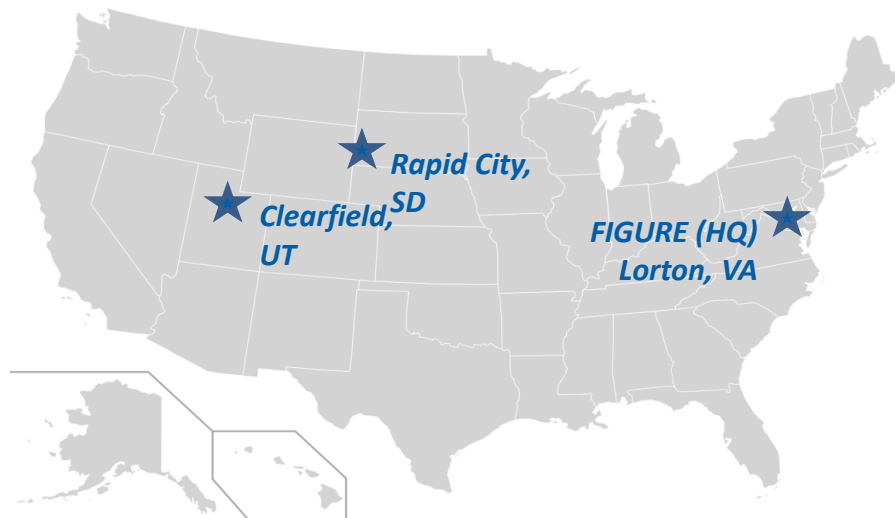
Questions and Answers

# About Figure Engineering



FIGURE ENGINEERING

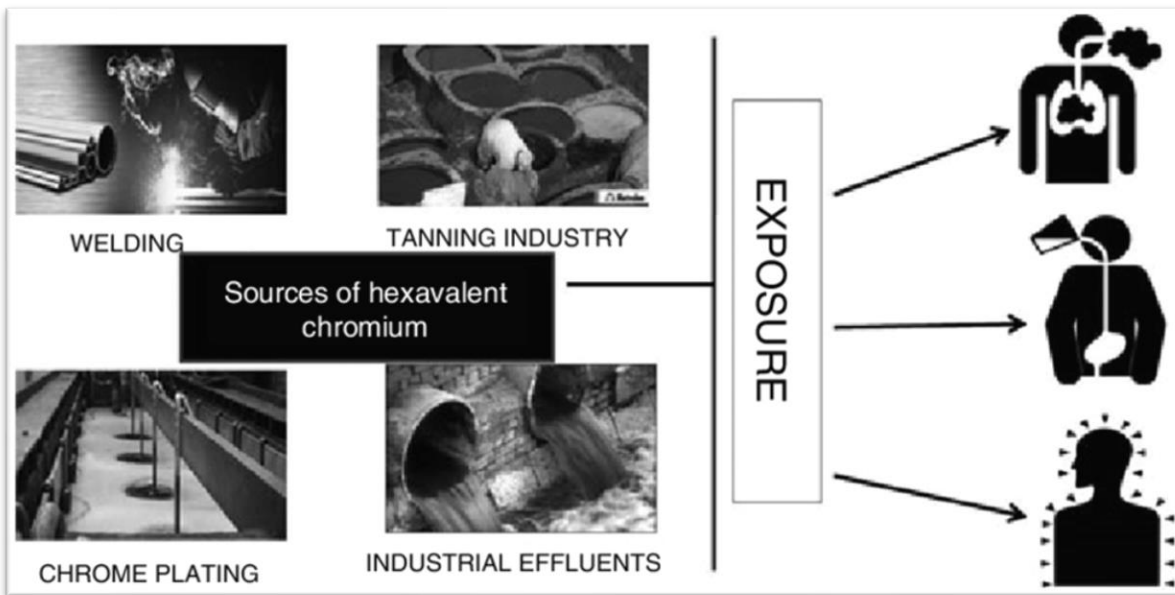
- Founded in 2007
- Develop tools to enhance effectiveness, health, and safety of personnel
- Engineered solutions trump Administrative & PPE solutions
- Proven technological solutions with the support of the US Air Force:
  - Smart ventilation systems
  - Hazardous material tracking
  - Hazardous material sensing
  - Mitigation, Decon facilities, Design and eval services



# Dangers of Hexavalent Chromium



FIGURE ENGINEERING

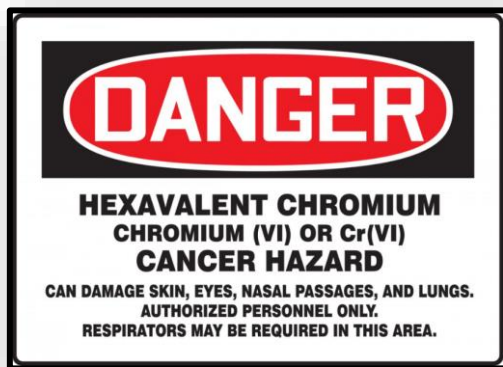


## What is Hexavalent Chromium (Hex-Chrome)?

- Hexavalent chromium is a toxic form of chromium which can cause severe health effects to workers, including lung cancer
- It is difficult to detect as it is odorless and tasteless

## What are the health effects of long-term exposure of Hex-Chrome?

- Skin irritation, dermatitis, ulceration
- Asthma, bronchitis, respiration irritation, allergic skin reaction
- Nasal irritation, nosebleeds, holes in the nasal septum
- Nasal cancer and lung cancer



# Where Hexavalent Chromium is Found



## FIGURE ENGINEERING

### Anti-corrosive use cases

- Primers
- Conversion coatings
- Anodize Sealing
- Chrome plating

### Others

- Hot works welding
- Cutting, hard facing chromium alloys
- Textile dyeing, paint pigments
- Leather tanning
- Portland cement production
- Reaction with lubricants with steel



# Aerospace Example



## FIGURE ENGINEERING

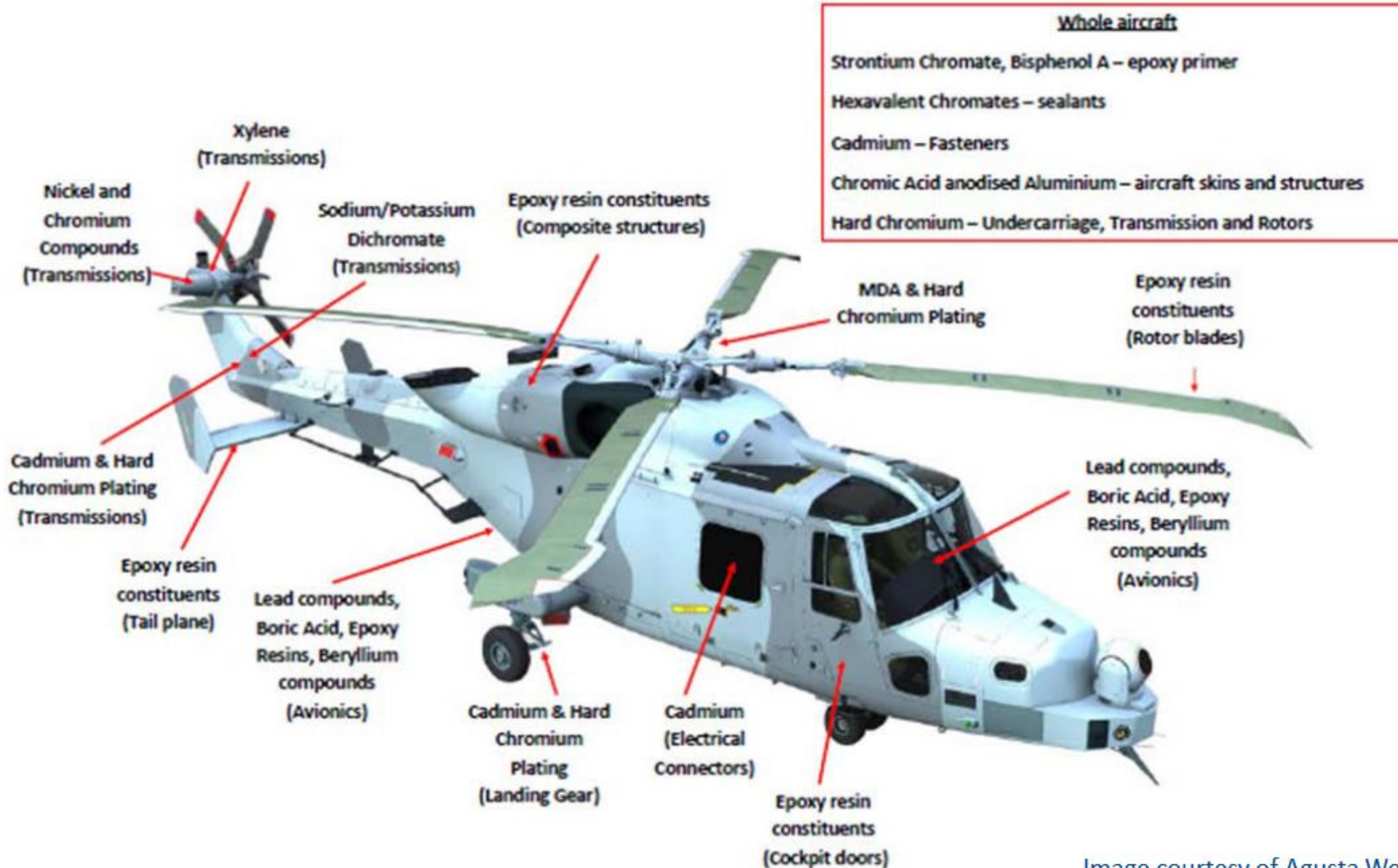


Image courtesy of Agusta Westland

# Hexavalent Chromium Regulation



FIGURE ENGINEERING

## US OSHA Regulations - 1910.1026

- OSHA requires “clean as practical” approach to exposure mitigation

## EU ROHS and REACH legislation

## Australia WHS Regulations

- “Risks to health and safety from exposures to hazardous chemicals must, so far as is reasonably practicable, be eliminated. Where elimination is not practicable, PCBU's must ensure that no person at the workplace is exposed to a substance above its exposure standard and must reduce exposures so far as is reasonably practicable.”



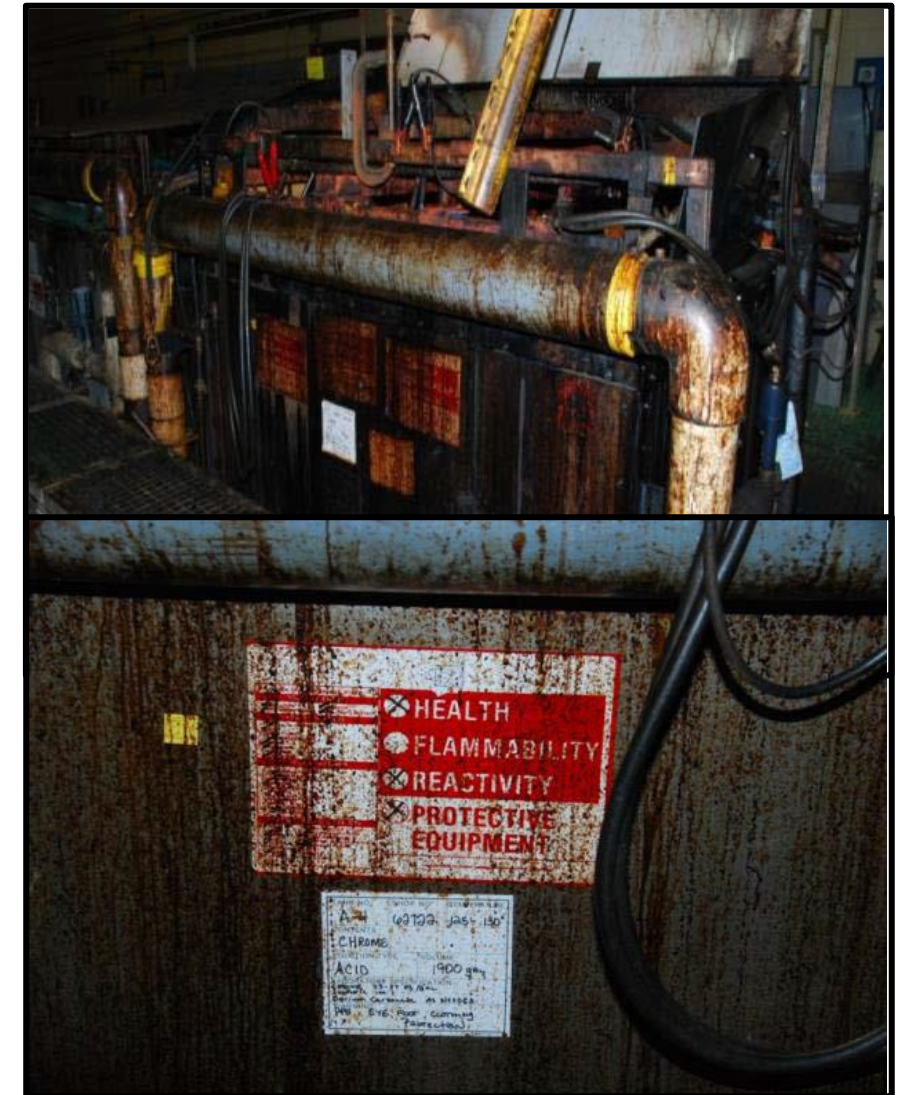
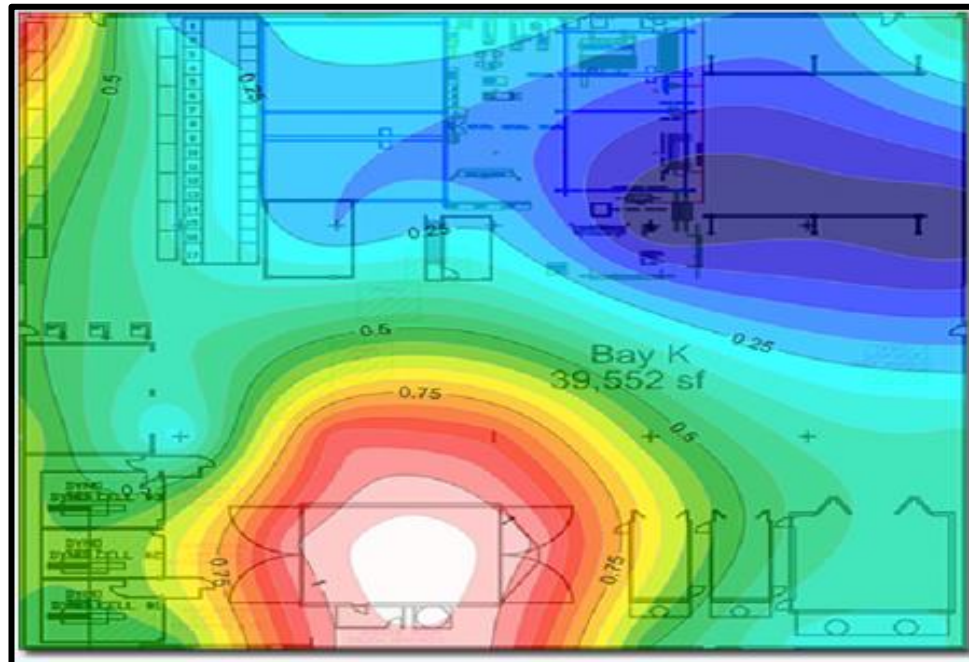
# Hexavalent Chromium Spread



## FIGURE ENGINEERING

Ways Hexavalent Chromium can spread around a facility

- Migration of dusts, fumes, and mists
- Transportation by workers
- Foot traffic
- Doff areas





# Reducing Spread



## FIGURE ENGINEERING

- Regulated Areas
- Change Rooms / Washing Facilities
- Controlling Access
- Routine Housekeeping



BREAK ROOM AND LUNCH ROOM DAILY CLEANING LOG						
<b>SECTION I - BASIC INFORMATION</b>						
1. SBT	2. BREAK ROOM NUMBER & LOCATION	3. DATE				
		DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>SECTION II - A SHIFT</b>						
1. CLEAN ALL SURFACES OF THE FOLLOWING ITEMS (Initial each block DAILY once completed):						
a. Interior & exterior parts of doors (including handles & knobs)						
b. All food preparation surfaces						
c. Tables/chairs/benches (including legs)						
d. Refrigerators, coffee pots, toasters, ice machine						
e. Vending machines (including key pads & doors)						
f. Microwave ovens (including handles & keypad)						
g. Shelving/Cabinets						
h. Televisions, radios, fan guards & blades						
i. All other horizontal surfaces (molding, chair rails, window/door & picture frames, pipe/conduit/ducts, bulletin boards etc.) (8 feet & below)						
2. Mop floor - HEPA vacuum first if necessary, DO NOT DRY SWEEP						
3. Ensure tacky mats are still effective						
4. A SHIFT CLEANER - AFTER ALL ITEMS ARE CLEANED AND INITIALED, PRINT NAME & SIGN	PRINT NAME					
	SIGNATURE					



Daily Breakroom Cleaning Checklist

# Sampling Hex Chrome



FIGURE ENGINEERING

Surface sampling



Airborne collection



### Methods

- Chromatography
- Colorimetry
- Spectroscopy (total Cr only)

### Major Test Standards

- OSHA ID215
- NIOSH 7600
- OSHA W4001 (surface sampling)



# Introducing HexChecks Testing Swabs



FIGURE ENGINEERING



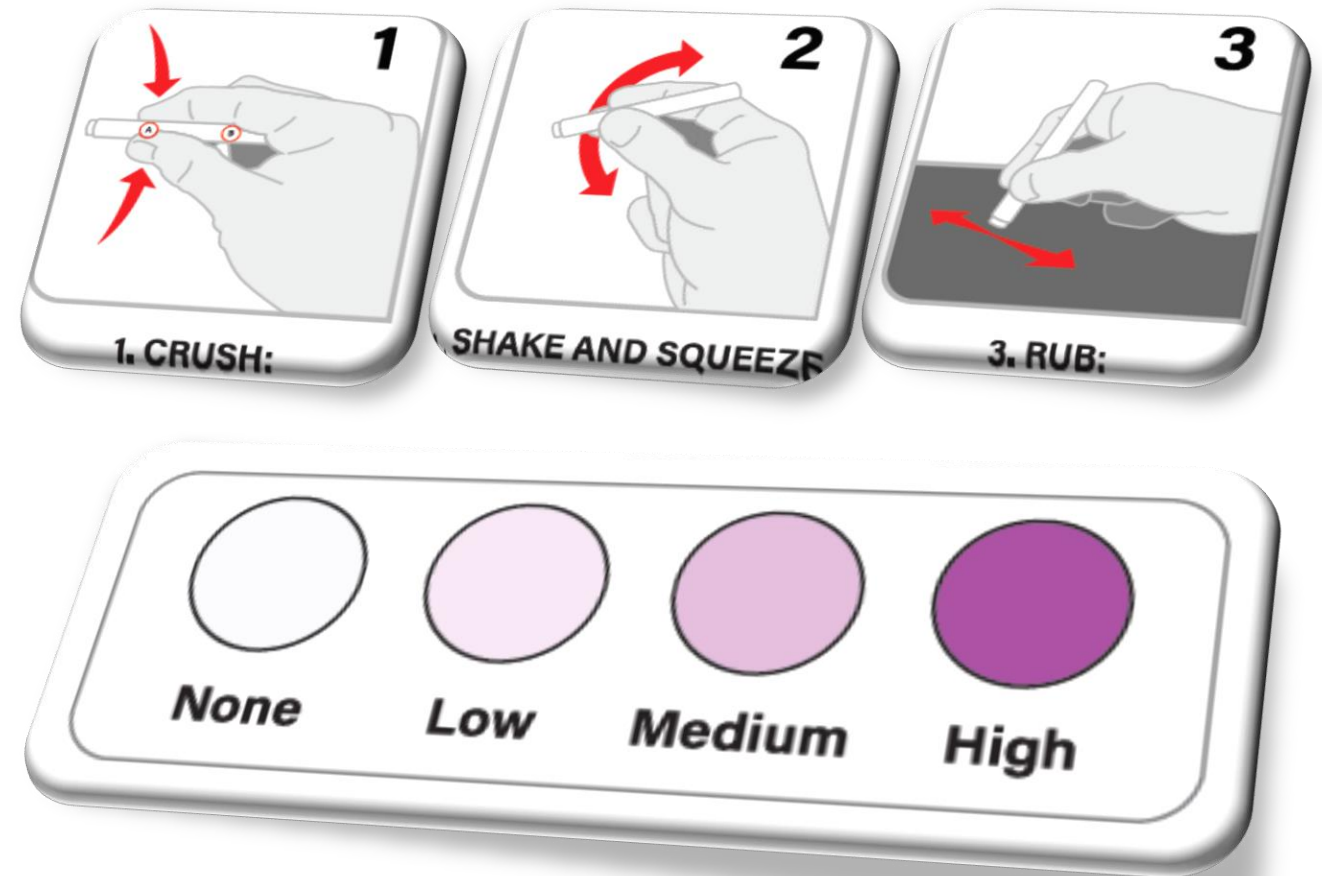
# Introducing HexChecks Testing Swabs
























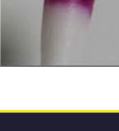
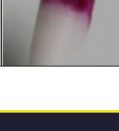
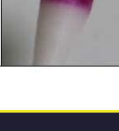
FIGURE ENGINEERING

## HexChecks Testing Swabs provides:

- Clear visual indication of the presence of hexavalent chromium
- Easy-to-Use with instant results
- Quick and affordable spot check
- Early contamination detection
- Consumable product, with no hazardous
- On-Demand Testing
- Instant awareness
- Non-invasive, Low waste product.



HexChecks Testing Swab turn from **white to pink** in the presence of **Hex-Chrome**.  
The **darker the color**, the **higher the hexavalent chromium concentration**

Cr(VI) $\mu\text{g}$	Replicate 1	Replicate 2	Replicate 3
Blank			
0.01			
0.05			
0.10			
0.30			
0.50			
0.75			
1.0			

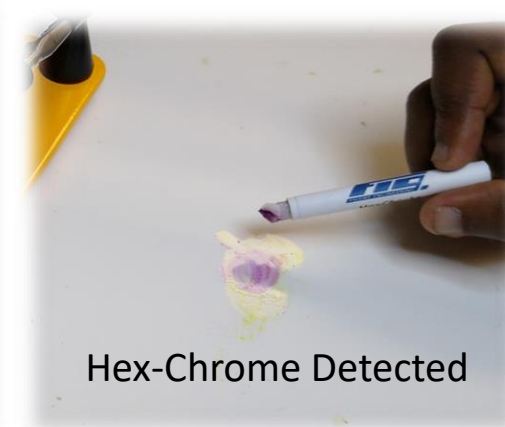
Independent validation performed by United States Air Force School of Aerospace Medicine



Tested at the request of multiple AF bases looking for a rapid hexavalent chromium test

### HexChecks Testing Swab Sensitivity

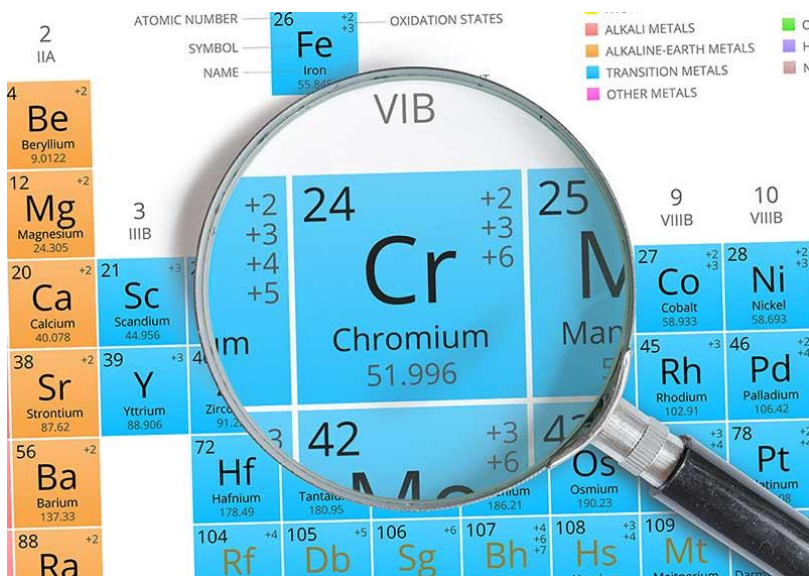
HexChecks reliably detects levels of hexavalent chromium below 0.1 micrograms. Low levels of hexavalent chromium show as light pink. Higher levels of hexavalent chromium will show as darkening pink to purple color development.



## HexChecks Testing Swab Specificity

HexChecks are highly specific to hexavalent chromium.

To demonstrate selectivity and understand any interferences, HexChecks were tested against a selection of metals and metal salts that may be encountered at worksites



Material	Concentration	Color Change
Iron [as Iron(III) Nitrate]	10mg/mL	None
Tin [as Tin(II) Chloride]	10mg/mL	None
Copper [as Copper(II) Sulfate]	10mg/mL	None
Cadmium [as Cadmium(II) Nitrate]	10mg/mL	None
Zinc [as Zinc(II) Nitrate]	10mg/mL	None
Silver [as Silver(I) Nitrate]	10mg/mL	None
Cobalt [as Cobalt(II) Nitrate]	10mg/mL	None
Magnesium [as Magnesium(II) Nitrate]	10mg/mL	None
Nickel [as Nickel(II) Nitrate]	1mg/mL	None
<b>Chromium [as Ammonium Dichromate(VI)]</b>	<b>1mg/mL</b>	<b>Purple</b>
<b>Chromium [as Strontium Chromate(VI)]</b>	<b>1mg/mL</b>	<b>Purple</b>
Chromium [as Chromium(III) Oxide]	10mg/mL	None
Lead [as Lead(II) Nitrate]	1mg/mL	None
Aluminum [as Aluminum(III) Chloride]	1mg/mL	None
Selenium [as Selenium(IV) Oxide]	1mg/mL	None
Arsenic [as Arsenic (III) Nitrate]	1mg/mL	None
Titanium [as Titanium (IV) Chloride]	1mg/mL	None
Thallium [as Thallium(I) Nitrate]	1mg/mL	None
Iron [metallic]	bar stock	None
Aluminum [metallic]	bar stock	None
Copper [metallic]	bar stock	None
Chromium [metallic]	bar stock	None
Silver [metallic]	bar stock	None
Titanium [metallic]	bar stock	None



## Shelf Life

- All components packaged under Argon
- Indefinite shelf life
- Short term testing 8 hours at 95C
  - Simulate possible jobsite storage

## Temperature

- Testing between -65C and 70C
- Active from -5C to 70C

Temperature (°C)	Result
-65	Frozen, no color
-50	Frozen, no color
-30	Frozen, no color
-20	Frozen, no color
-15	Frozen, no color
-10	liquid, no color
-5	liquid, light purple
0	purple
10	purple
20	purple
30	purple
40	purple
50	purple
60	purple
70	light purple, flash evaporation of liquid



# HexChecks Neutralizer

FIGURE ENGINEERING



Rapid neutralizer for hexavalent chromium

- Converts hexavalent chromium into trivalent chromium
- Non-toxic ingredients
- Fast acting

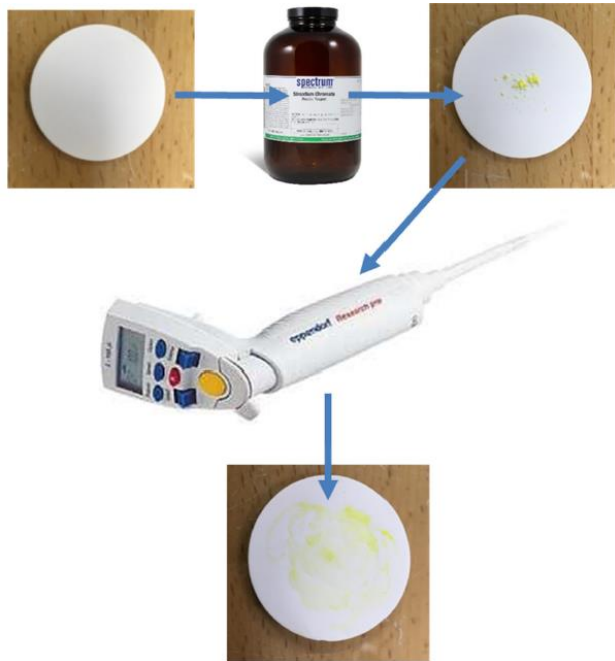


# Neutralizer 3<sup>rd</sup> Party Testing



FIGURE ENGINEERING

- Samples tested in accordance with OSHA W4001
- Control tested using distilled water



SGS		LABORATORY ANALYSIS REPORT		
GALSON		Client : Figure Engineering	Account No.: 35054	
6601 Kirkville Road	Site : NS	Login No. : L522705		
East Syracuse, NY 13057	Date Sampled : 02-NOV-20	Date Analyzed : 05-NOV-20		
(315) 432-5227	Date Received : 03-NOV-20	Report ID : 1217999		
FAX: (315) 437-0571				
www.sgsgalson.com				
<b>Hexavalent Chromium (Painting/Pigment)</b>				
Sample ID	Lab ID	Area cm <sup>2</sup>	Total ug	Conc ug/cm <sup>2</sup>
CONTROL	L522705-1	100	350	3.5
CK10	L522705-2	100	11	0.11
CK20	L522705-3	100	6.1	0.061
HEXOFF	L522705-4	100	430	4.3

Results: 97.5% average reduction of hexavalent chromium



Any Questions?

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