

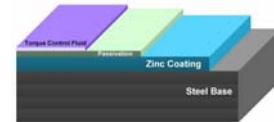
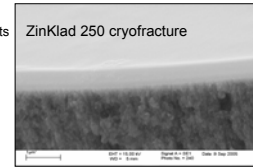
## Managing the Transition to Hexavalent Chromium free Anti-corrosion coatings

Michael Wyrostek  
MacDermid Inc



## Factors that influence finish performance

- Chemistry requirements
  - Hexavalent chrome free
  - Minimum performance requirements
- Process line
  - Best practice cycle
  - Equipment
  - Control systems
- Analytical control
  - Analysis procedures
  - Proper operating parameters
  - Corrective action
- Quality control
  - Thickness testing
  - Corrosion testing
  - Thermal shock
  - Friction



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## Applicator approval program

- Applicator and chemical supplier partnerships to manage technology change.
  - Establish and maintain 'Best Practice' procedures
  - Optimize performance
  - Monitor quality
  - Cost competitive
- MacDermid has adopted a ZinKlad Approved Plater (ZAP) program

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## ZinKlad initial audit overview

- ZinKlad "core" requirements
  - Approved chemistry
  - Process control
  - Demonstrate ability
- Process line
- Process control / analytical capability
- Quality control
- Sample validation

Audit form front page

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## ZinKlad Follow up Audits

- Audits
  - Performed once per quarter for all active ZinKlad customers
  - Three performed by local representative, one by corporate representative
  - 2 part audit
    - Confirm initial ZinKlad requirements
    - Confirm parts meet specifications
  - Completed audit form must accompany sample parts
  - Parts must be submitted for thickness, salt spray, hex chrome, topcoat and torque testing

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## ZinKlad Web Site

www.zinklad.com



# ZinKlad

high performance coatings

Great Protection without 'Hex' chrome

- ZinKlad® describes a range of high performance coatings developed by MacDermid, to meet or exceed the most demanding corrosion resistant specifications of today's manufacturing industry, without the use of hexavalent chrome compounds. ZinKlad® products represent the Best available technique for meeting the End of Life Vehicle requirements (EOLV) set out by European governments in response to increasing environmental pressures. In harmony with this new legislation, most of the world's major automotive manufacturers have announced their intention to limit or inhibit the use of hexavalent chromium in surface coatings and passivation films.

ZinKlad® defines the way the surface finishing industry can meet the performance requirements of OEM's whilst complying with the latest environmental pressures.

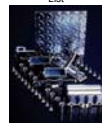
ZinKlad® coatings are zinc-based finishes, topcoats and lubricants specifically developed to enhance corrosion protection, heat resistance and provide controlled torque-tightening properties.



Click here for our

ZinKlad Approved Platers

List




- ➔ ZinKlad 96 - technical data
- ➔ ZinKlad 250 - technical data



## IRIDITE NCP NON-CHROMIUM PASSIVATE FOR ALUMINIUM


Robert Berry  
MacDermid, Inc.



## Iridite NCP

### *R&D Design Criteria & Results*


- Similar coating mechanism and corrosion properties compared to hexavalent chromates
- Free of any listed hazardous metals
- Totally inorganic composition, no polymers
- Concentrated liquid allows low make-up volumes



## Iridite NCP


### *Product Benefits for DoD Applications*

- NSS corrosion resistance equal to chromate on low copper aluminum alloys
- Conductive coating per Mil-DTL-5541 Class 3
- Spray, immersion or wipe application
- Drop in replacement for hex-chromates
  - ND Supreme Soak, Isoprep 184 Deoxidize, Iridite NCP

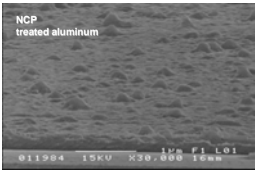


## Conversion Coating Parameters

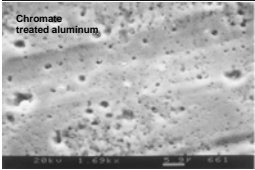
	Hex-Chromate	NCP
<b>Concentration</b>	6 - 15 g/l (0.75 - 2 oz/gal)	3 - 8% by volume
<b>pH</b>	1.3 - 1.6	3.2 - 5.5
<b>Temperature</b>	16 - 38°C (60 - 100°F)	21 - 49°C (70 - 120°F)
<b>Time</b>	15 sec. - 6 min	30 sec - 10 min
<b>Additives</b>	HNO <sub>3</sub> & NaOH for pH control	Iridite NCP
<b>Hot rinse to enhance drying</b>	<71°C (<160°F)	<100°C (<212°F)



## Coating Overview




NCP treated aluminum



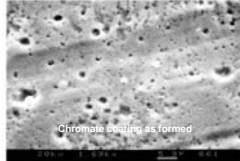
Chromate treated aluminum

### *Hex-Chromate VS NCP*

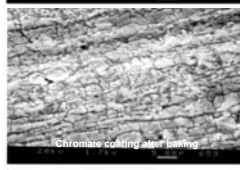
- Both coatings are totally inorganic
- Both coatings are amorphous in structure
- Both coatings are visible
- NCP is self limiting and will not become powdery



## Temperature Resistance of Chromate




Chromate coating as formed



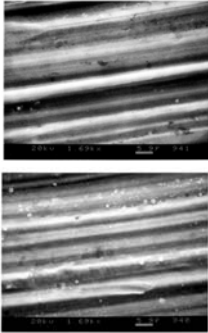
Chromate coating after baking

### *Effects of Baking a Chromate Coating*

- Water is an integral component of a yellow chromate coating.
- Yellow chromate coatings crack and are destroyed by heating over 70°C.
- Cracked coatings lose their corrosion resistance.




### Temperature Resistance of NCP




**Effects of Baking an NCP Coating**

- The NCP coating is resistant to temperatures up to 350°C and will not crack.
- This feature allows higher dry off and operating temperatures.



### Corrosion Resistance Data

Aluminium Alloy	% Copper in Alloy	Salt Spray Hours	
		Chromate	Iridite NCP
5052	0.10	1128+	1128+
6022-T4	0.11	1128+	1128+
3003-HT14	0.20	168	1128+
1100	0.20	432	1128+
6111	0.90	432	1128+
6061	0.40	648	1000+
A356	0.25	1000+	576
7075-T6	2.0	672	<72
A380	4.9	72	<72
2024	4.0	168	<24




### Electrical Resistance Data

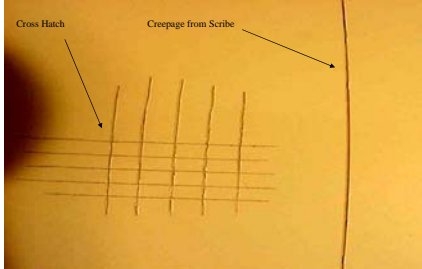
**Electrical Resistance VS. Neutral Salt Spray**

168 HOURS, NSS NCP IMMERSION TIME VS. PITS/PANEL	AVERAGE MILLOHMS BEFORE NSS	AVERAGE MILLOHMS AFTER NSS
One minute exposure 12 pits	0.92	0.96
Two minute exposure 4 pits	0.80	0.81
Three minute exposure 1 pit	0.80	0.86
Four minute exposure 0 pits	0.33	0.48
Five minute exposure 0 pits	0.19	0.35


Test data from Trace Labs



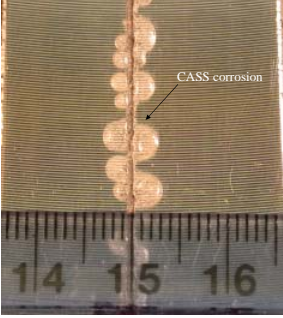
### Paint Adhesion Tests



Alloy 6061 coated in Iridite NCP and painted after over 1000 hrs salt spray




### Paint Adhesion Tests



**CASS Test  
ASTM B368**

- 168 hrs CASS exposure
- <3 mm creep from scribe



### MacDermid Solutions for DoD

- MacDermid developed commercially available solutions for hex-chrome free conversion coatings on aluminum applications
- Chromium free product for Mil-DTL-5541 Class 3
- R&D efforts continue to investigate the latest technological advances
- Trivalent chromium additive being scheduled for testing for Mil-DTL-5541 Class 1

