

ANOCHROME GROUP

HEXAVALENT CHROMIUM

FREE FINISHES

Presentation by

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Apart from normal development of finishes, the main driver over the last 8 years has been the EEC directive for end of life vehicles.

Directive 2000/53/EC 18th September 2000.

ELV Directive (Summary)

- Every year End of Life Vehicles generate 8-9 million tonnes of waste.
- The Directive is to “encourage” recovery, re-use and recycling.
- To facilitate recycling and avoid hazardous waste, lead, mercury, cadmium and HEXAVALENT CHROMIUM shall be prohibited (see Article 4.2).
(See Annex 11)

ELV Directive (Summary)

- Re-use or recovery.

85% by weight per vehicle must be re-cycled or recovered by 2006 -
95% by 2015.

Other sectors

- Heavy Trucks and Buses are NOT affected

-but producers would be wise to look at use of materials prohibited under Article 4.2.

- Components **ARE** included in material restrictions from July 2003 (Art. 4.2)

-but not service parts for older models which will not be sold after July 2003 (expected interpretation).

- Components **ARE** to be included in collection schemes (Art. 5.1)

-but only existing schemes and if it makes environmental sense.

ELV Directive

Changes introduced 27th June 2002 affecting finishing.

**HEXAVALENT CHROMIUM - NOT ALLOWED ON
ANY VEHICLE SOLD FROM JULY 2007**

A trace of up to 0.1% by weight per homogeneous material shall be tolerated provided not intentionally introduced.

Assuming that the Hexavalent Chromium is concentrated in the surface layer of a clear trivalent passivate and this is 50 nm thick (homogeneous layer) this allows a trace of approximately 0.3mg/m² of Cr⁶⁺.

W E E Directive (Electrical Industry)

- NO CHROMIUM FROM APRIL 2006

ELV DIRECTIVE (CHANGES)

**LEAD IN GALVANISED STEEL UP TO 0.35%
BY WEIGHT.**

As there is about 1.0% of lead in galvanised coatings, as long as the weight of steel is about 4 x weight of galvanising. The galvanised part would be acceptable.

HEXAVALENT CHROMIUM.

Cr⁶⁺ - WHAT IS IT ?

Chromium (as a compound) can exist in three moderately stable forms, according to how it will combine with other substances.

These are:-

Cr³⁺ - Trivalent Chromium. Green in solution.

Cr⁴⁺ - Quadravalent Chromium.

Cr⁶⁺ - Hexavalent Chromium is bright yellow.

Cr⁴⁺ is very unstable and rarely exists.

Cr⁶⁺ is known to be carcinogenic and it is very reactive.

Cr³⁺ is stable, unreactive and not regarded as harmful.

Metallic Chromium is hard, stable and not regarded as toxic.

HEXAVALENT CHROMIUM.

Cr⁶⁺ - WHAT IS IT ?

Cr⁶⁺ has been used in the electroplating and leather tanning industries for many years.

It is not now used with leather and is under strict control in electroplating (and as such, the supply of it in coatings is effectively banned from July 2007)

HEXAVALENT CHROMIUM. Cr⁶⁺ - WHAT IS IT USED FOR?

Hexavalent Chromium is used to increase corrosion resistance in top coats of most Zinc coatings and some Zinc flake coatings.

e.g. Zinc and Yellow chromate, Dacromet® and Dorrtech®.

Approximately 70% of Zinc electroplate was supplied as “Yellow” passivate.

Zinc Electroplating Hexavalent Chrome free systems.

- Clear (lightweight) trivalent passivate (conversion coat).
- Iridescent (pale green, heavyweight) trivalent passivate.
- Either of above with seal coat.
- Trivalent and black organic (usually applied as dip-spin coating).
- Trivalent or phosphate and coloured organic.
- Same finishes can be used on mechanical plating.

ZINC FINISHES

RESULTS OF PRODUCTION TRIALS – SALT SPRAY TESTS

	HOURS TO WHITE C.P.	HOURS TO RED C.P.	APPROX. COST (Material)
<i>LIGHT WEIGHT</i> <i>Room Temp.</i> <i>MacDermid</i> ELV BLUE	48 - 72	240 - 360	0.5p / kg.
<i>HEAVYWEIGHT</i> <i>60-70°C Soln. Temp..</i> MacDermid ELV 1000	96 - 216	408 - 1200	1.5p / kg.
Taschem SURTEC 680	72 - 96	1200	2.1p / kg.
Atotech ECO-TR1	72	810+	0.9p / kg.

Top Coats

- Since Hexavalent chromium replacements are not self healing, damage resistance will need to be enhanced by the addition of a protective layer.
- Fasteners are required to be lubricated, which can be incorporated in a top coat.
- For parts processed in bulk, this can be accomplished fairly easily, either in a barrel, or by dipping and spinning, depending upon the coating to be applied.

Torque -Tension Performance

TOP COATS – Chance to apply lubricants in top coats

- **Car companies have taken the opportunity to re-specify T-T requirements. (e.g. Ford WZ100 now WZ101)**
- **New lubricants developed, more consistent performance than old.**
- **Due to tighter requirements close adherence to fastener dimensions is important.**
- **There are still 2 groups of requirements:-**

Coefficient of Friction 0.12 -- 0.18

0.09 – 0.14

Zinc Electroplated Finishes (8µm Zinc)

	SALT	SPRAY	
FINISH	WHITE CORROSION	RED CORROSION	SPECIFICATIONS
<i>Yellow Chromate CONTAINS Cr6+</i>	<i>48 – 72 hrs.</i>	<i>96 – 120 hrs.</i>	<i>S309 / GME 00252 B3 / RES 21.ZS.01 PtC</i>
Clear Trivalent*	4	72	GMW 3044 / 9K96/24
Clear Blue Trivalent	48	120	GMW 3044 MGRES 21 ZS 01
Iridescent Trivalent	96	240	BMW GS 90010 ZNT TRW TS 2-21-71A (& 79A)
Clear Trivalent + Seal*	24	96	GMW 3044 / MGRES 21 ZS 01 TRW TS 2-21-71B (& 79B)
Iridescent Trivalent + Seal *	120	384	GMW 3044 / FORD S437 TRW TS 2-21-71B (&79B)

Coefficients of friction can be supplied in the range 0.12 – 0.18 and 0.09 to 0.14

to suit most requirements.

* Preferred finishes

ZINC ELECTRO PLATE -PRODUCTION

The system chosen for production is

MACDERMID ZINKLAD – ELV 1000(2000 FOR MECHANICAL) + TnT15 (or 12)

- * Production trials show good performance and costs.
- * MacDermid have an accreditation scheme.
- * Anochrome Group Approved ZINKLAD coater.
- * Only process specified by Ford Motor Co.
- * Acceptable to GM and BMW, etc.

ZINC ELECTRO PLATE -PRODUCTION

Production work is being processed regularly to
BMW GS 90010 ZnT Ford S437 and GMW 3044.

Typical test results:
96 – 120 hrs. w.c.p.
300 - 400 hrs. to rust.

Torque tension (using TnT15) – S437
Coefficient of Friction 0.13 to 0.16 (toWZ101) over range
of fasteners

For GMW 3046 use Delta clear as top coat.

Coefficient of friction 0.11 – 0.13.

ZINC ALLOY COATINGS

The only production proved trivalent conversion coatings for Zinc Alloys are:

- Black for Zinc Iron, giving 120 hrs. wcp, 380 hrs. rust
- Clear for Zinc Nickel, giving 200 hrs. wcp, 600+ hrs. rust

BLACK FINISHES

Black conversion coat finishes on zinc, or zinc nickel contain Hex. Chromium. Newly developed coatings without Hex. Chromium are unproven except for zinc iron and black.

Hex. Chromium free black coatings can be obtained using organic top coats.

BLACK FINISHES

	S/S HRS. TO W.C.P.	HRS. TO RUST
ZINC & E-COTE	72	144
ZINC & E-COTE & SEAL	144	240
XYLAN*	N/A	240+
ZINC-NICKEL & E-COTE & SEAL	240 Slight white	720

* New Water Based Coating

PROCESSES BEING DEVELOPED

- Zinc-Iron + Trivalent Clear Passivate.
- Zinc-Iron + Black (Zinklad)
- Zinc + Room Temp Heavyweight Trivalent Passivate.

ZINC FLAKE COATINGS

- The Anochrome Group Has Supplied Zinc Flake Coated Parts For The Last Twenty Years

ZINC FLAKE COATINGS

Give improved corrosion resistance than zinc electroplated coatings

Do not induce Hydrogen embrittlement

Give better coverage on complex shapes

ZINC FLAKE COATINGS

A New Generation Of Coatings Has Been Developed Without Chromium.

These Are:

- GEOMET – (Dacromet replacement)
- MAGNI 565 or 560 – (DorrItech replacement)
- DELTA PROTECT (Deltatone replacement)

These “new” coatings give increased corrosion resistance compared to superseded coatings

ZINC FLAKE COATINGS ALL CHROMIUM FREE

COATING	SALT SPRAY	SPECIFICATIONS
PERFORMANCE		
GEOMET®	500 hrs	FORD S447 / GME 00252
GEOMET®	>720 hrs.	FORD S438 / GMW 3359 / BMW GS90010 ZNS3 / DAIMLER CHRYSLER DBL 9440 & PS 7626 / L/ROVER LRES 21 ZS 05 / TRW TS 2-25-60
MAGNI® 565	720 – 1000 hrs.	FORD S439 / GMW 3359 / PS 10378 / DX 551801 / TRW TS 2-25-60
MAGNI® 560		
Zinc Plate +		
B18 Top Coat	720 – 1000 hrs.	FORD S440 GMW 4707
DELTA- . PROTEKT	480 – 720 hrs.	GMW 3359 / DAMILER CHRYSLER DBL 9440 /PS 10633 / BMW GS90010 ZNS3 / L.RES 21 ZS 05

Coefficient of friction can be supplied appropriate to above specifications.

APPROXIMATE COST RATIOS

HEXA VALENT CHROMIUM vs HEXA VALENT CHROMIUM FREE COATINGS

	Zinc & Iridescent Trivalent Clear & Seal	Zinc & Iridescent Trivalent		Zinc & Clear Trivalent	Mechani cal Zinc & Trivalent & Seal	Geomet	Magni 560/565	Delta Protekt
Colour	Silver	Pale Yellow-green		Silver	Silver	Silver	Silver	Silver
NSS hrs.	120 wcp 384 rust	96/120 wcp 240 rust		6 wcp 96 rust	72 wcp 120 rust	480- 1000 rust	480- 1000 rust	480- 1000 rust
Cost Ratio	1.0-1.3	1.8-2.0		0.75	1.5	Similar to current market	Similar to current market	Similar to current market
Location	Anochrome BGP FMF WEP	WEP		Anochrome BGP FMF WEP	WEP	BGP WEP	BGP Inlex	BGP WEP

Cost ratio compares with Zinc + Yellow Chromate Passivate

Anochrome Group Preferred Cr6+ Coatings

ZINC Flake

- Geomet
- Magni
- Delta Protect

Zinc(Electro or mechanical) plate

- Trivalent clear
- Trivalent clear + seal
- Trivalent iridescent + seal
- Trivalent + Black Organic (E-Cote)

Switchover Status

Cars sold after July 2007 must be Hexavalent Chromium free.

- Zinc electroplated finishes slow to change, about 30% changed.

Perhaps due to:

- expense
 - different appearance
- Zinc Flake more changed (Delta does not have to change in some cases).
 - No or small price increase.
 - Appearance the same.

PPAP's present some problems!

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More information can be obtained from
Anochrome Group Design Guide
www.anochrome-group.co.uk

ANOCHROME GROUP

THANK YOU FOR WATCHING
THIS
PRESENTATION