DIPSOL OF AMERICA, INC.
TECHNICAL DATA SHEET

DIPSOL IZ-C17+

Alkaline LHE (Low Hydrogen Embrittlement)
Zinc-Nickel Plating

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Contents

All previous revisions are obsolete.

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TECHNICAL DATA SHEET

The **Dipsol IZ-C17+** alkaline zinc-nickel alloy electroplating process is qualified and approved and for use under the following specifications:

Boeing
BAC 5680
BAC 5637

U.S. Air Force
Drawing #201027456

MIL-DTL 32648

Safran Landing Systems PR-1131

UTC Aerospace Systems
LGPS1106 (Landing Systems)

Heroux-Devtek
HPS-138

SAE AMS 2417

Bell Helicopter
Specification #4554

Moog Inc. – Aircraft Group

Bombardier
BAPS 160-047

Curtiss-Wright
CPS 8203

1.1 SCOPE OF APPLICATION

DIPSOL IZ-C17+ is a non-embrittling alkaline type, cyanide free, zinc-nickel alloy electroplating process approved and qualified as stated in previous page for high and low strength steel applications, as well as other substrates. It also meets the requirements for a non-embrittling process per **ASTM F519**.

The process has excellent throwing power, covering power, and is a virtual drop-in replacement for cadmium plating. The deposit consists of a uniform zinc alloy containing **12 -15**% nickel and has excellent heat and corrosion resistance especially in high atmospheric temperature applications.

1.2 FEATURES

DIPSOL IZ-C17+ offers the following features:

- Approved to the Aerospace High and Low Strength Steel Applications.
- Capable of meeting requirements in **AMS 2417** for All Other Steels and Substrates Application.
- Low Hydrogen Embrittlement process (non-embrittling to high strength steels).
- Excellent throwing and covering power due to alkaline non-cyanide bath. Comparable to LHE Cadmium.
- Provides the highest corrosion resistance in Zn-Ni alloy plating.
- Excellent adhesion and corrosion resistance in high temperature applications.
- **DIPSOL IZ-264** trivalent chromate conversion coating can be easily applied, prior to the embrittlement relief bake, to further enhance appearance and corrosion resistance.

1.3 PHYSICAL CHARACTERISTICS

Physical Appearance
Silver-White with dull, matte to semi-bright finish.

Co-Deposition Rate and Corrosion Resistance
The deposit from **DIPSOL IZ-C17+** consists of 12-15% nickel.
The corrosion resistance is the highest among Zinc Alloys in the industry.

Thermal Corrosion Resistance
The deposit from **DIPSOL IZ-C17+** provides superior corrosion resistance in high temperature atmospheres, among existing zinc and zinc-base alloy plating.

Plating Speed
The plating speed is related to metal concentration and operating conditions.
In a standard solution, it is approximately 0.35-0.45 µm/min at 5A/dm^2 (46.5 ASF) in cathode current density.

Hardness
The deposit is the hardest among existing zinc and zinc-base alloy plated deposit at HV 350-450 in Vickers Hardness and has high scratch resistance.

Residual Stress
The deposit from **Dipsol IZ-C17+** produces plating with compressive residual stresses that is beneficial for not reducing the fatigue life when applied to high strength steel parts.

Covering Power
DIPSOL IZ-C17+ has superior covering power and throwing power due to the alkalinity of the solution. It provides excellent corrosion resistance on many complicated shapes of parts.

1.4 CHEMICAL PROPERTIES

PROPERTIES OF DIPSOL IZ-C17+ (LHE ZINC NICKEL) COMPONENTS			
Product	**Purpose**	**Properties**	**Specific Gravity (25˚C)**
DIPSOL IZ-C17+MS	Concentrated solution for Make-Up	Clear and Bluish-Violet Liquid, NaOH = 10% w/w	1.17
DIPSOL IZ-C17+Ni	Concentrated Ni solution for replenishment	Blue Liquid	1.17
DIPSOL IZ-C17+B	Ni stabilizer	Light Yellow Liquid	1.03
DIPSOL NZ-777	Concentrated Zn solution for replenishment	Clear Viscous Liquid NaOH = 34%	1.56
DIPSOL F-0529	Additive for Make-Up and replenishment.	Clear Liquid	1.20

PROPERTIES OF DIPSOL IZ-264 (TRIVALENT CHROMATE CONVERSION COATING SYSTEM) COMPONENTS			
Product	**Purpose**	**Properties**	**Specific Gravity (25˚C)**
DIPSOL IZ-264	For Make-up and Maintenance	Dark-Red Liquid	1.18
DIPSOL IZ-264 T	For Make-up and Maintenance	Dark-Green Liquid	1.23

1.5 OPERATIONS

Read Special Handling Instructions and SDS before proceeding with solution make up.

1.5.1 Solution Make Up Using Individual Components

For make up using individual components, please follow the make up process below:

CONCENTRATION FOR MAKE-UP	
DIPSOL NZ-777	80 g/L (51.3 mL/L)
NaOH (powder) (*)	103 g/L (13.8 oz/gal)
DIPSOL IZ-C17+B	57.5 g/L (55.8 mL/L)
DIPSOL IZ-C17+Ni	21.6 g/L (18.45 mL/L)
DIPSOL F-0529	4.8 g/L (4.0 mL/L)

(*) Liquid caustic (50%) membrane or standard grade (sp.gr. = 1.56) can also be used at (132 mL/L)
Make-up of the solution should be done according to the following procedures using municipal treated water supply. When using well water or industrial water, please contact us in advance.

1. Fill plating tank to 1/2 its capacity with water and dissolve 103 g/L of powder Caustic Soda. **Caution: An exothermic reaction will occur.**
2. Cool the bath to less than 50ºC (122ºF) and add 80 g/L (51.3 mL/L) of **DIPSOL NZ-777**.
3. Cool the bath to less than 30ºC (86ºF) and add 57.5 g/L (55.8 mL/L) of **DIPSOL IZ-C17+B** and 21.6 g/L (18.45 mL/L) of **DIPSOL IZ-C17+Ni**.
4. Add water to working level and agitate fully.
5. Analyze plating solution and adjust if necessary.
6. Take 500 mL of the plating solution. Add 4 mL/L of **DIPSOL F-0529** in the 500 mL solution and perform long hull cell test at 4A - 20min - 25ºC (77ºF) to confirm everything is normal. Adjust the bath if necessary.
7. Confirm that the bath temperature is approximately 25ºC (77ºF) and add 4 mL/L (4.8 g/L) of **DIPSOL F-0529** into the actual tank.
8. Perform Dummy plating at 0.2 to 0.5 A/dm2 (2 - 5) ASF for one to twenty four (1 - 24) hours on 1 to 3 sq.ft./100 GAL of solution.
9. The plating bath is ready for plating at this point.

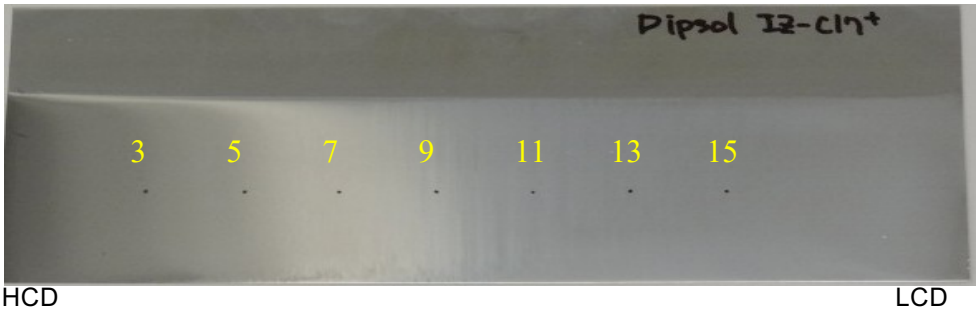
1.5.2 Solution Make Up Using DIPSOL IZ-C17+ MS Concentrate

For make up using DIPSOL IZ-C17+MS, please follow the make up process below:

CONCENTRATION FOR MAKE-UP	
DIPSOL IZ-C17+MS	225 g/L 19.23 % of total bath volume (192.3 mL/L)
NaOH (powder) (*)	103 g/L (13.75 oz/gal)
DIPSOL NZ-777	20 g/L (12.82 mL/L)
DIPSOL IZ-C17+B	22.5 g/L (21.8 mL/L)
DIPSOL F-0529	4.8 g/L (4.0 mL/L)

(*) Liquid caustic (50%) membrane of standard grade (sp.gr. = 1.56) can also be used at (132 mL/L) Make-up of the solution should be done according to the following procedures:

1. Municipal treated water supply is acceptable for make-up. When using well water or industrial water, please contact us in advance.
2. Fill plating tank 1/2 its capacity with water and dissolve 103 g/L (13.75 oz/gal) of powder Caustic Soda. **Caution: An exothermic reaction will occur.**
3. Cool the bath to less than 50ºC (122ºF) and add 20 g/L (12.82 mL/L) of **DIPSOL NZ-777**.
4. Cool the bath to less than 30ºC (86ºF) and add 225 g/L (192.3 mL/L) of **DIPSOL IZ-C17+MS**.
5. Add 22.5 g/L (21.8 mL/L) of **DIPSOL IZ-C17+B**. Add water to working level and agitate fully.
6. Analyze plating solution and adjust if necessary.
7. Take 500 mL of the plating solution. Add 4.8 g/L (4 mL/L) of **DIPSOL F-0529** in the 500 mL solution and perform long Hull Cell test at 4amp - 20min - 25ºC (77ºF) to confirm everything is normal. Adjust the bath if necessary.



HCD LCD

The above picture shows the appearance of the long Hull Cell test panel (4amp - 20min, 25˚C) after plating with a new **DIPSOL IZ-C17+** system. As seen, low current density is clear of any dullness or gray deposit. The table below shows typical thickness and Ni co-deposition along the length of this test panel measuring from the left hand side of the Panel (edge of the HCD).

	3 cm	5 cm	7 cm	9 cm	11 cm	13 cm	15 cm
Thickness (micron)	26.6	17.8	11.1	6.4	3.2	1.6	0.9
Ni (%)	13.3	13.8	13.7	13.8	15.4	15.1	17.6

Thickness and nickel co-deposition values measured on-site can vary from those noted above. Hull cell testing is used as a reference and guide as to where the thickness, nickel co-deposition percentage, and the deposit appearance scopes are. It is used as a tool to help understand the bath performance. Hull cells are primarily used for determination of the aesthetic properties of the zinc-nickel deposit, while Q-panels and notch bars should be used as the primary tools to determining the functionality of the bath.

8. Confirm the plating bath temperature is approximately 25˚C (77˚F) and add 4 mL/L of **DIPSOL F-0529**.
9. Perform Dummy plating at 0.2 to 0.5 A/dm^2 (2.0 - 5.0 ASF) for one to twenty four (1 - 24) hours on 1 - 3 sq.ft./100 gal of solution.
10. The solution is ready for plating at this point.

1.5.3 Tank Make Up For Trivalent Chromate Conversion Coating System

Using DIPSOL IZ-264 for Solution Make Up

CONCENTRATION FOR MAKE-UP	
DIPSOL IZ-264	94.4 g/L (80 mL/L)
DIPSOL IZ-264 T	49.2 g/L (40 mL/L)

1. Make-up of the solution should be done according to the following procedures. City water is acceptable for make-up. When using well water or industrial water, please contact us in advance.
2. Fill plating tank 1/2 its capacity with water and add 94.4 g/L (80 mL/L) of **DIPSOL IZ-264** and 49.2 g/L (40 mL/L) of **DIPSOL IZ-264T**. Please add IZ-264 first and then IZ-264T.
3. Add water to working level and mildly agitate the solution. The pH of the new trivalent chromate solution will require few hours to settle down. Twenty percent (20%) diluted 67% Nitric Acid (ACS grade) or 10% NaOH can be added to adjust to the required optimum pH=4.2 value.
4. The solution is ready for the trivalent conversion coating application at this point.

1.6 SOLUTION PARAMETERS AND COMPOSITION

LHE Zinc Nickel, DIPSOL IZ-C17+ SOLUTION COMPOSITION

	Optimum	Range
Zinc	8 g/L (1.07 oz/gal)	7– 9 g/L (0.93 - 1.2 oz/gal)
Nickel	1.2 g/L (0.16 oz/gal)	1.1 – 1.3 g/L (0.14 - 0.17 oz/gal)
Zinc/Nickel Ratio	6.67	5.4 – 8.2
NaOH	130 g/L (17.4 oz/gal)	100 – 150 g/L (13.4 – 20 oz/gal)
DIPSOL IZ-C17+B	60 g/L	50 – 80 g/L
DIPSOL F-0529	4.0 mL/L	3.0 – 7.0 mL/L

The Zinc to Nickel ratio has to be within 5.4 to 8.2 to achieve the 12 to 15% Nickel co-deposit along with maintaining the Zinc and Nickel within the ranges stated above.

1.7 OPERATING CONDITIONS

1.7.1 DIPSOL IZ-C17+ OPERATING CONDITIONS AND EQUIPMENT

	Optimum	Range
Temperature	25°C 77°F	20 - 26°C 68 - 78°F
Cathode Current Density	5 A/dm^2 45 ASF	3 - 6 A/dm^2 28 - 56ASF
Anode Current Density[*1]	8 A/dm^2 74 ASF	> 8 A/dm² More than 74 ASF
Anodes	Nickel slab anodes are recommended, however nickel rod, bar , Nickel 200 or sheet may also be used. Ni plated steel is acceptable[*2] Titanium anodes are not recommended due to poor conductivity. Steel anode cannot be used. 99.9% Zn anodes can be used in a generator tank to control zinc concentration in IZ-C17+ solution.	
Filtration	Continuous filtration through a size of 10 - 20 microns is necessary (2 - 3 turnovers/hr). Filters with carbon capabilities are highly recommended.	
Cathode Rocker	Necessary (1 - 3 meter/min), (3.33 - 10 feet/min).	
Agitation	Solution movement through eductors, and barrel rotation.	
Plating Tank & Generator Tank	Steel lined with PVC, Polyethylene, Polypropylene, FRP is recommended (alkaline-resistant). Rubber and Fiberglass lined tank is not recommended[*3].	
Exhaust	Should be well ventilated.	
Pipes inside the Plating Bath	PVC, or polypropylene is recommended. Steel and stainless steel pipes are acceptable outside the plating bath. Glued PVC or CPVC is not recommended.	
Na_2CO_3 Removal Apparatus	Maintain Na_2CO_3 concentration less than 60 g/L (8.0 oz/gal).	
Temperature Control	Maintain solution temperature between 20 - 26°C (68 - 78°F)	
Rectifier	12 - 15 V, 3-phase full wave rectifier with less than 5% ripple requirements.	
Barrel Rectification	15 Volts rectifier, with less than 5% ripple requirements.	
Heaters/Chillers	Titanium Heaters, or PTFE Coils, or heat exchangers.	
Automatic Feeding	Amp-Hour Dosing pumps is recommended to ensure consistent plating speed.	

Notes:

1. Low anode current density will effect consumption of **DIPSOL IZ-C17+B** which causes burning at high current density (HCD) area and dullness at low current density (LCD) area. This appears on the hull cell in the LCD area as dullness and gray appearance.

2. It is recommended to use Nickel slab anodes or semi-bright sulfur free Nickel-plated steel anodes with thickness ranges from (50 - 100 microns). It is important to make sure that there are no pinholes on the nickel-plating deposit. Using steel anodes or the presence of pinholes causes burning and high consumption of additives. It is required to check for pinholes on the anodes periodically using Ferroxyle Test procedure below:
   a. Prepare "Ferroxyle Solution" as follows:
      Potassium Ferrocyanide, $K_4[Fe(CN)_6]$, 10 g/L
      Potassium Ferricyanide, $K_3[Fe(CN)_6]$, 10 g/L
      Sodium Chloride, NaCl, 60 g/L
   b. Soak filter paper in the solution
   c. Place the wet filter paper on the anode surface for 5 min
   d. If pinholes are present on the anode surface, blue dots appear on the filter paper.

3. Testing should be performed in advance in consideration of the type of liner to be used. High temperatures generated during the thermal reaction when adding caustic-soda to water, might attack certain liners and cause its breakdown and the contamination of the solution with plasticizer and such. This will cause gray deposits in the LCD area.

1.7.2 DIPSOL IZ-264, Trivalent Chromate Conversion Coating

Item		Optimum	Range
Concentration	**DIPSOL IZ-264 (mL/L)**	80	70 - 100
	DIPSOL IZ-264T (mL/L)	40	35 - 50
pH		4.2	4.0 - 4.4
Co Content		3.4 g/L 0.43 oz/gal	2.8 – 4.0 g/L 0.37 – 0.53 oz/gal
Cr content		2.1 g/L 0.28 oz/gal	1.8 – 2.6 g/L 0.24 – 0.35 oz/gal
Temperature		77 ºF 25 ºC	61 – 89.6 ºF 16 - 32 ºC
Time		90 sec	30 - 120 sec
Drying		More than 5 min. at (80 - 100ºC)	
Agitation		Very Mild	
Tank		PVC or Lined Steel.	
Basket for Barrel Operation		Lined steel, stainless steel, polypropylene Basket. Stainless Steel can be used.	
Filter		>50 µm Filter[*1], 1 – 3 times/hour[*2]	

Notes:

*1.During the chromate operation, the solution makes precipitation of Hydroxide, which may cause roughness, therefore, filtration is required in the chromate tank.
*2. Continuous agitation is required using either air or mechanical agitation with filtration (50 micrometers or smaller) at a minimum of one turnover per hour after make-up of solution is complete. Agitation should be turned off when solution is not in use.

1.8 APPLICATION

1.8.1 Application of DIPSOL IZ-C17+ LHE Zinc-Nickel to *HIGH Strength Steel Parts* with DIPSOL IZ-264 Trivalent Chromate Conversion Coating System

Step	Process	Description
1	Degrease	Vapor Degrease or Solvent Clean with suitable solvent to remove grease and oil
2	Grit Blast	Grit Blast with aluminum oxide (80 to 150) grit Aluminum Oxide at 40 to 60 psig per **MIL STD 1504** (or equivalent)
3	Clean	Remove grit blast residue with clean compressed air. Handle the part with clean gloves. Plate within (1) hour after grit blast
4	Mask	Mask part as required
5	Rinse and Clean	Water Rinse for 90 seconds at room temperature and scrub part with clean Nylon bristle brush inside the water rinse tank to remove any grit left
6	Inspect	Check for water-break free surface
7	Acid Activate	Immerse Part in 0.1% HCL for up to 30 seconds or until gassing observed. Do not exceed 30 seconds immersion time
8	Rinse*	Water Rinse for minimum of 90 seconds. Proceed to Plating Tank
9	Plating (a)	**Rack Process**: Apply Zn-Ni Plating, at a range of (3 - 6 A/dm^2) (28 to 56 ASF) – up to 25 minutes plating to produce 0.3 - 0.6 mils (8 to 15 microns) of Zn-Ni coating deposit. Solution Operating temperature is between 68 and 78 ºF
10	Rinse*	Water Rinse for minimum of 90 seconds, thoroughly
11 (b)	Demask (b)	If Bleed-out is a concern from the fixture - test specimens must stay wet during demasking
12	Rinse	Water Rinse for minimum of 30 seconds if demasked
13	Acid Activate	Immerse in 0.1% HCL until gassing observed. Do not exceed 30 seconds immersion time.
14	Rinse*	Water Rinse for minimum of 30 seconds
15	Trivalent Chromate Conversion Coating	Apply **DIPSOL IZ-264** system for (30 to 120 seconds) at operating temperature of (61 – 89.6)ºF. **DIPSOL IZ-264** @ (70 - 100) mL/L and **DIPSOL IZ-264T** @ (35 - 45) mL/L, with pH=(4.0 - 4.4), with mild agitation.
16	Air Time	Hold Part in Air for (25 ± 5) seconds to complete Chromate Conversion reaction
17	Rinse*	Water Rinse for minimum of 90 seconds
18 (c)	Rinse (c)	Apply Hot Water Rinse for 10 seconds at (160 - 190) ºF
19	Drying	Apply Forced Air Drying (Hot or cold)
20	Demask/ Unrack	Demask/Unrack if not performed before
21 (d)	Inspect (d)	Measure thickness and Nickel Co-deposition
22 (e)	Bake (e)	Bake for 23 hours or as required per spec @ 375°±25°F Within 4 hours of completion of plating

*Rinse time can vary depending on operation and OEM requirements.

1.8.2 Application of DIPSOL IZ-C17+ LHE Zinc-Nickel to ***LOW Strength SteelParts*** and other substrates with DIPSOL IZ-264 Trivalent Chromate Conversion Coating System

Step	Process	Description
1	Soak Alkaline Clean	**Dipsol 523-SC** (90 mL/L, 140°F, 10 minutes) Dipsol LC-34 and Dashi 39 *(Asian Market)*
2	Rinse*	Water Rinse for 180 seconds at room temperature
3	Acid Pickle	Hydrochloric Acid (300 mL/L - 75°F - 5 minutes)
4	Rinse*	Water Rinse for 180 seconds at room temperature
5	Electro cleaner	**Dipsol 331-EC** (100 mL/L) **Dipsol 331-ECX** (20 mL/L) 140°F - 5 minutes 10ASF (Barrel)/40ASF (Rack) Dipsol NC-20 and NC-20A *(Asian Market)*
6	Rinse	Water Rinse for 180 seconds, 75°F
7	Acid Activate	Hydrochloric Acid (100 mL/L - 75°F - 60 seconds)
8	Rinse*	Water Rinse for 120 seconds. Proceed to Plating Tank
9 (a)	Plating	**Barrel Process**: Apply ZnNi Plating, at a range of (0.6 -1.25 A/dm^2) (5.6 -11.6 ASF) Solution Operating temperature is between 68 and 78 °F
		Rack Process: Apply Zn-Ni Plating, at a range of (3 - 6 A/dm^2) (28 to 56 ASF) – up to 25 minutes plating to produce 0.3 - 0.6 mils (8 to 15 microns) of Zn-Ni coating deposit. Solution Operating temperature is between 68 and 78 °F
10	Rinse*	Water Rinse for 180 seconds, thoroughly, 75°F
11	Rinse*	Water Rinse for 180 seconds, thoroughly, 75°F
12	Rinse	Water Rinse for minimum of 30 seconds, thoroughly, 75°F
13	Acid Activate	Immerse in 0.1% HCL (15 seconds, 75°F)
14	Rinse	Water Rinse for 120 seconds; 75°F
15	Trivalent Chromate Conversion Coating	Apply **DIPSOL IZ-264** system for (30 to 120 seconds) at operating temperature of (61 – 89.6)°F. **DIPSOL IZ-264** @ (70 - 100) mL/L and **DIPSOL IZ-264T** @ (35 - 45) mL/L, with pH=(4.0 - 4.4), with mild agitation.
16	Air Holding Time	Hold Part or barrel in Air for (25 ± 5) seconds to complete Chromate Conversion reaction, 75°F
17	Rinse*	Water Rinse for 120 seconds; 75°F
18 (c)	Rinse (c)	Apply Hot Water Rinse for 10 seconds at (160 - 190) °F
19	Drying	Apply Forced Air Drying (Hot or cold)
20 (d)	Inspect (d)	Measure thickness and Nickel Co-deposition
21 (e)	Bake (e)	Bake for (4 - 24) hours @ 375°±25°F or as required per spec Within 4 hours of completion of plating.

The above process cycle is only a general recommendation for low strength steel substrates. Surface conditions can vary and prompt modification to this cycle. When processing aluminum bronze, stainless alloys or aluminum, please consult your pretreatment suppliers recommendations.

*Also, by specification, cycle times and conditions can vary depending on operation and OEM requirements.

NOTES: Rinse prior to conversion coating must be sufficient and thorough to remove all plating solution from plated surface otherwise stains will appear after conversion coating.

a. By specification, a zinc-nickel strike can be applied to the high and low strength steel parts and fasteners at double the desired current density for up to 60 seconds, then

reduce the current back to the desired current density for the rest of the required plating time to achieve the thickness.

b. Demask is optional at this stage, however, if done, then parts need to be wet at all times to prevent any bleed out on the plated parts.
c. This hot rinse final stage helps in drying the parts faster. It is optional and not required.
d. If XRF is used to measure thickness and composition, it needs to be calibrated on a daily basis and recorded. Calibrated micrometer is also acceptable for thickness measurements.
e. Calibrated oven is required at all times.

1.9 SOLUTION MAINTENANCE & CONTROL

1.9.1 PERIODIC DILUTION

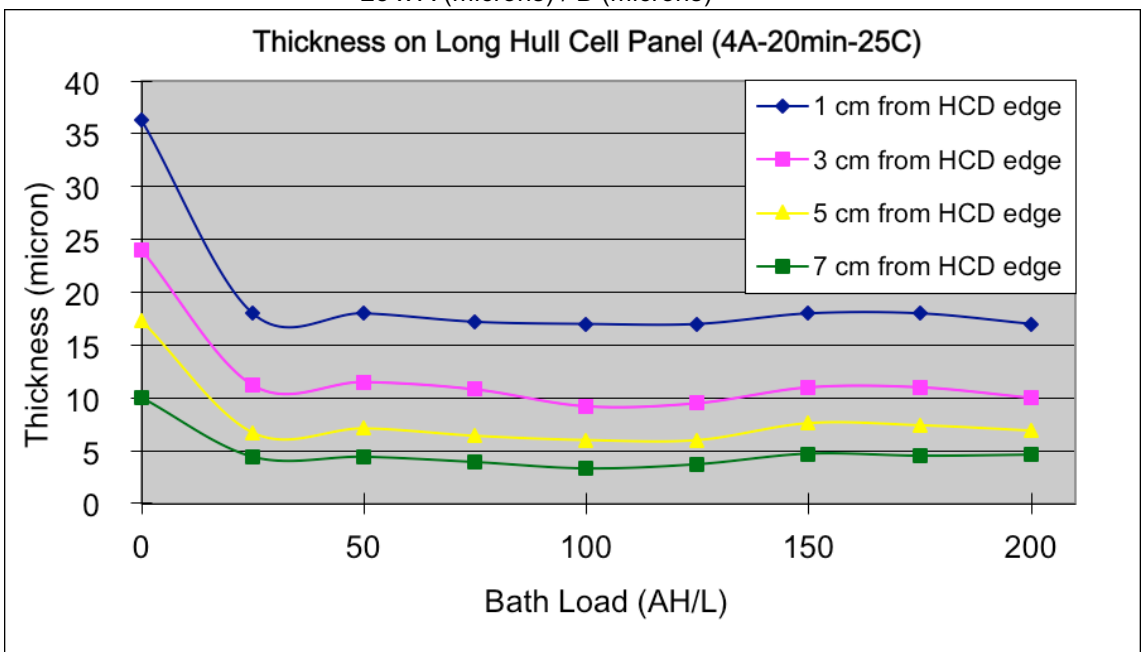
Plating Solution may need to be diluted periodically.
Dilute 20% when the bath reaches 50 AH/L, and 20% dilution is required every 25 AH/L thereafter. Regular carbon treatment and carbonate removal. Organic contaminants are removed using traditional carbon treatment methods.

1.9.2 PLATING SPEED & PLATING TIME

The plating speed of the solution slows down over time due to the presence of carbonates and contaminants. The plating time might require adjustments to accommodate for this by “Coupon Dummy Plating”.

1- Plate 4”x 6”x 0.040” alloy Steel 4130 (**AMS 6350**) panel with brand new plating solution (when the bath is made) at the production line for 25 minutes.
2- Measure the thickness at the center of the panel. Record the thickness (A) and retain the panel as “standard”.
3- Plate a 4”x 6”x 0.040” alloy Steel 4130 (**AMS 6350**) panel at the production line for 25 minutes at the current conditions.
4- Measure the thickness at the center of the panel (B).

Required Plating Time (min) currently needed
= 25 x A (microns) / B (microns)



1.9.3 REPLENISHMENT for LHE DIPSOL IZ-C17+ System

Depending on the drag out, the replenishment rates might require some adjustment. Following, are the chemicals that need to be replenished for rack and barrel applications respectively:

DIPSOL IZ-C17+Ni

To replenish nickel metal for rack: 800 - 1300 mL/1000 amp hours
To replenish nickel metal for barrel (fasteners): 1300 - 1600 mL/1000 amp hours

DIPSOL NZ-777

DIPSOL NZ-777 zincate solution is added periodically to maintain zinc concentration at 7 to 9 g/L. The addition of **DIPSOL NZ-777** to the plating bath should be based on the amount of Zinc needed in the plating bath. **DIPSOL NZ-777** should not be used to adjust for caustic if the Zinc content in the plating bath is within the range, rather, Liquid or powder caustic can be used.

100 grams	**DIPSOL NZ-777** supplies	10 grams zinc metal 34 grams caustic
	- OR -	
1 gallon	**DIPSOL NZ-777** supplies	590.5 grams (20.83ounces) zinc metal 2,006.1 grams (70.76 ounces) caustic
	- OR -	
1 liter	**DIPSOL NZ-777** supplies	155.9 grams (5.50 ounces) zinc metal 530.1 grams (18.70 ounces) caustic

DIPSOL NZ-777 ADDITION

	Increase	
Per 100 Gallon Tank	Zinc	Caustic
1 gal (3.785 liters)	1.56 g/L (0.21 opg)	5.30 g/L (0.71 opg)
5 gal (18.925 liters)	7.80 g/L (1.04 opg)	26.5 g/L (3.54 opg)

DIPSOL IZ-C17+B

To replenish stabilizer, for improving leveling in rack applications 70 - 90 mL/1000 amp hours and for barrel (fasteners) applications 260 - 280 mL/1000 amp hours

DIPSOL F-0529

To replenish conditioner for both applications, 8 mL/1000 amp hours

1.9.4 Replenishment for DIPSOL IZ-264 system

When the addition of **Dipsol IZ-264T** is made, it requires three times the amount of the **Dipsol IZ-264**. The ratio is **2:1 = Dipsol IZ-264 : Dipsol IZ-264T**. This ratio is a guideline, and can vary depending on the operation.

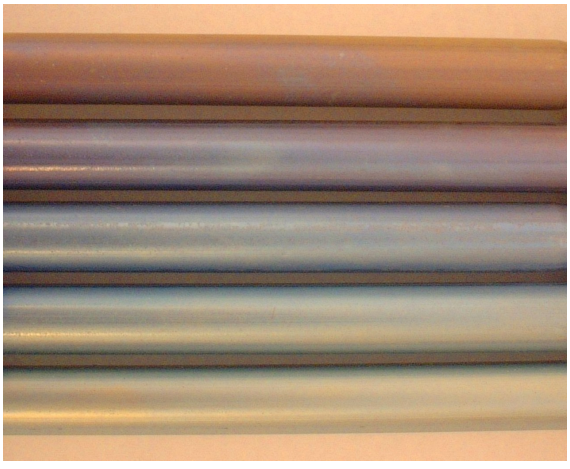
The pH of the solution goes up during treatment. Maintain the optimum pH by adding 67% Nitric Acid. If the pH of the solution goes down, 10% NaOH can be used to adjust to desire pH. **Dipsol IZ-264** and **IZ-264T** do not affect pH enough to assist in bath pH maintenance.

Cr concentration must be maintained at 2.1 g/L (0.279 oz/gal). **DIPSOL IZ-264T** contains 52 g/L of Cr metal. After-make-up, 5% of Cr will begin to precipitate out of solution. Due to this, the solution must be filtered prior to Cr analysis.

Co concentration must be maintained at 3.2g/L (0.427oz/gal). **Dipsol IZ-264** contains 40g/L of Co metal.

The recommended limit of dissolved Zn in solution is 5g/L (0.66 oz/gal). Bath renewal may not be necessary as long as Fe and Cu impurities are below recommended limits (Fe <100ppm, Cu <5ppm).

1.9.5 APPEARANCE



Brown- Yellow

Reddish Purple

Blue

Light Blue

Blue - Yellow

Thinner Chromate Film

Thicker Chromate Film

1.10 IMPURITIES

For LHE Zinc Nickel, DIPSOL IZ-C17+ plating solution:

Impurity	Range	Phenomenon	Countermeasure
Cr^{6+}	< 5 ppm	1. Dull at LCD area 2. Brown deposit at HCD area	1. Drag-Out 2. Sodium Hydrosulfite ($Na_2S_2O_4$) cannot be used.
Pb^{2+}	< 0.5 ppm	1. Black deposit or skip plating at LCD area 2. Poor covering 3. Low Ni co-deposition 4. High plating speed	1. Drag-Out 2. Dummy Plating[*1] Sodium Sulfide (NaS) cannot be used.
Cu^{2+}	< 4ppm	1. Turns black during chromate 2. Low Plating speed	1. Dummy Plating[*1] 2. Drag-Out
Fe^{2+}	<100 ppm	1. Poor adhesion 2. Low plating speed	1. Drag-Out
Cd	< 5 ppm	1. Low Plating Speed 2. Bright Appearance	1. Dummy Plating[*1] 2. Drag Out
Organic		1. Cloudy appearance 2. Pitting 3. Rough surface 4. Poor bending property	1. Activated Carbon Treatment[*2] 2.Drag-Out

NOTE: Zn dust treatment is not effective because Zn powder dissolves in the plating solution before it can remove impurities.

1*: Dummy plating: Cathode Current 0.2 – 0.6 A/dm^2 (1.8 - 5.5 ASF)
(Make sure that the Anode Current Density has to be over **8 A/dm^2**)

2*: Carbon treatment: 500 gm/ Filter 1 m^2 or 0.3 – 0.6 g/L for 2 – 4 hours
Carbon treatment has negligible effect on the removal or reduction of **DIPSOL IZ-C17+B** and **DIPSOL F-0529** components. Organic decomposition is carbon sensitive and can be removed.

For DIPSOL IZ-264:

Hexavalent Chromium impurities disrupts the trivalent chromate film and will not allow a uniform film thickness to develop.

Limitation of metal impurities Zn: 5 g/L, Fe: 100 ppm, Cu: 5 ppm.

1.11 SOLUTION ANALYSIS

1.11.1 ZINC-NICKEL PLATING BATH ANALYSIS

1.11.1.1 ZINC AND CAUSTIC SODA

1. Pipette a 5 mL sample of plating solution into a 500 mL Erlenmeyer flask.
2. Add about 100 mL of DI water.
3. Dip a glass electrode of pH meter into the flask.
4. Titrate with 1 N (HCL) Hydrochloric Acid standard solution until the solution pH ranges from (11.45 – 11.55).
5. Read this endpoint as V_1 mL of 1 N Hydrochloric Acid
6. Add 1 N HCL again until the solution pH decreases to the range of 5 to 6
7. Pull out the pH glass electrode and wash with DI water.
8. Add 15-20 mL of pH 5 buffer solution and 3 mL. of 5% w/w Sodium Cyanide
9. Add 1 to 3 drops of 0.1% w/w XO (xylenol-orange) indicator Solution should have an orange-reddish color
10. Titrate with 0.1 M EDTA standard solution until a yellow color endpoint occurs. Read this endpoint as V_2 mL of 0.1 M EDTA standard solution.

Calculation:
NaOH (g/l) = V_1 mL x 8 x 1 N HCL
Zn (g/l) = V_2 mL x 1.308 x 0.1 M EDTA

1.11.1.2 Zinc Analysis using Atomic Absorption Process

1. Pipette 2 mL of sample plating solution into 100 mL volumetric flask.
2. Add 50 mL of DI water, then add 5 mL of concentrated HCL (or HNO_3) and fill the balance to 100 mL line with DI water. This flask is 50X-diluted solution.
3. Pipette 1 mL of the 50X-diluted solution into another 100 mL volumetric flask.
4. Add 5 mL of concentrated HCL (or HNO_3) and fill to line with DI water. This flask is 5,000X-diluted solution.
5. Analyze this solution with Atomic Absorption spectrophotometer with a Zinc standard (1, and 2 ppm).

Calculation:

Calculation:
Zn (g/l) = Concentration Reading (ppm) x 5

SODIUM CARBONATE

1. Pipette exactly 5 mL of plating solution into a 250 mL beaker.
2. Add 100 mL of deionized water to the beaker
3. Add 10 mL of 10% barium chloride ($BaCl_2$) to the beaker and let is rest.
4. Add 1 -2 mL of $BaCl_2$ and inspect for more precipitation. If more precipitation persists, add an additional 5 mL of $BaCl_2$.
5. Add a magnetic stir bar and mix at 70 (± 3) ˚C for 5 min.
6. Allow solution to cool to 30˚C or less.
7. Filter (gravity filtration) the solution using 44 Whatman filter paper and rinse with warm deionized water.
8. Once completely filtered, place the filter paper into a separate, clean beaker.
9. Add 20 mL of 0.5N hydrochloric acid (HCl) to the beaker.
10. Mix the new solution for 5 min, heating it to 30 (± 3) ˚C.
11. Add 100 mL of 70± 5 ˚C deionized water and macerate the filter paper using a glass stir rod.
12. Add 2-3 drops of Methyl Orange indicator.
13. Titrate using 1 N NaOH until the solution color changes from pink to orange. Record volume as V_1 mL.

Calculation:
Sodium Carbonate (g/L) = 10.6 x [10 – V_1 mL]

1.11.2 NICKEL

1.11.2.1 By Atomic Absorption Spectrophotometer:

1. Prepare a 100 mL volumetric flask.
2. Pipette 2 mL sample of plating solution into the 100 mL volumetric flask.
3. Add DI water to volume line and mix well.
4. Pipette 5 mL of the above solution into another 100 mL volumetric flask.
5. Add about 5 mL of concentrated hydrochloric acid into the flask.
   5 mL of concentrated nitric acid can also be used instead of hydrochloric acid.
6. Add DI water to volume line and mix well. (Total of 1000 times Dilution, (50x20)).
7. Analyze this solution by atomic absorption spectrophotometer compared with 1 and 2 ppm of nickel standard solution. Some chemists might use different Ni standards, dilution parameters, machine settings, etc, based on equipment used in their lab.

Calculation:
Ni (g/l) = Concentration Reading (ppm) x 1

1.11.2.2 (UV/VIS) Spectrophotometer Analysis of DIPSOL IZ-C17+B

Procedure

1. Power on spectrophotometer and set up:
   Wavelength measurement: 679 nm
   Reference: DI Water
   Lamp: D2 lamp
   Cell: Quartz cell

2. Prepare analysis sample:

   a. Pipette exactly 2 mL of the plating solution into a 100 mL volumetric flask
   b. Add approximately 20 mL of DI water
   c. Add exactly 12 mL of *0.1M $CuSO_4$ (*25 gm $CuSO_4$ $5H_2O$ in 1 L volumetric flask)
   d. Add DI water to the level
   e. Shake for 1 minute
   f. Leave the solution for 15 minutes then filter (gravity filtration) with Whatman 44 filter paper

3. Measure absorption:
   a. Scan from 700 nm to 600 nm
   b. Read the absorption at 679 nm

Calculation:
DIPSOL IZ-C17+B (g/l) = 104 x Absorption – 5.0

NOTE: After the analysis, wash the volumetric flask with conc. Hydrochloric Acid. The precipitation remains on the glassware wall even if it appears clean.

The **DIPSOL IZ-C17+B** results are within 5% of HPLC/ ICP accuracy.

1.11.3 TRIVALENT CHROMATE BATH ANALYSIS

1.11.3.1 DIPSOL IZ-264T System

There are two ways to measure the Cr^{3+} in the solution. Either Atomic Absorption Spectrophotometer or through wet analysis.

Wet chemistry analysis:

1. Filter (gravity filtration) the operating solution with Whatman 41 filter.
2. Pipette a 10 mL sample of the operating solution into an 500ml Erlenmeyer flask.
3. Add 50 mL DI water.
4. Add 4mL of 10% w/w Sodium Hydroxide solution.
5. Add 5 mL 35% H_2O_2 (Hydrogen Peroxide solution)*1 slowly.
6. Mix until gassing stops.
7. Add another 5 mL 35% H_2O_2 (Hydrogen Peroxide solution) slowly.
8. Boil the solution for 20 – 30 minutes (add back water if necessary) to complete the reaction and hydrogen peroxide.
9. Allow the solution to cool and dilute to approximately 100 mL with DI water.
10. Acidify solution with 10 mL concentrated Sulfuric Acid and let the solution cool down to 30°C or less.
11. Add 10 mL of 10% w/w Potassium Iodide solution.
12. Titrate the brown solution with 0.1N Sodium Thiosulfate solution until the solution becomes straw color.
13. Add 1 mL of 1% w/w starch solution and continue the titration with the Thiosulfate solution until the solution becomes clear. Record the mL of Titrate.

Calculation:
g/L of Cr^{3+} = mL of 0.1N Thiosulfate X 0.173

*1: Poor quality of Hydrogen Peroxide solution causes inaccurate analysis result. Hydrogen Peroxide needs to be retained in a cool dark place, and make sure that it is not expired.

1.11.3.2 Chromium and Cobalt Analysis with ICP, ICP-MS, or AA Method

1. Filter the operating solution.
2. Prepare a 100 mL volumetric flask.
3. Pipette 1 mL sample of operating solution into the 100 mL volumetric flask.
4. Add about 5 mL of concentrated hydrochloric acid into the flask 5 mL of concentrated nitric acid can also be used instead of hydrochloric acid.
5. Add DI water to volume line and mix well.
6. Pipette 5 mL of the above solution into another 100 mL volumetric flask.
7. Add about 5 mL of concentrated hydrochloric acid into the flask 5 mL of concentrated nitric acid can also be used instead of hydrochloric acid.
8. Add DI water to volume line and mix well. (Total of 2000 times Dilution, (100x20)).
9. Analyze this solution by atomic absorption spectrophotometer compared with 1 and 2 ppm of chrome and cobalt standard solution. Some chemists might use different Cr standards, based on equipment used in their lab.

Calculation:
Cr (g/l) = Concentration Reading (ppm) x 2
Co (g/l) = Concentration Reading (ppm) x 2

1.11.4 CHEMICAL LIST FOR ANALYSIS

Caustic Soda
1 N or (0.5 N) hydrochloric acid (HCL)

Zinc
Buffer solution (pH = 5): Dissolve 150 grams anhydrous sodium acetate and 30 grams of acetic acid in water to 1 liter
5% Sodium Cyanide
1 N or (0.5 N) hydrochloric acid (HCL)
XO indicator: Xylenol orange 0.1% aqueous solution
0.1 M EDTA

Sodium Carbonate
10% $BaCl_2$ solution
0.5N hydrochloric acid (HCl)
Methyl Orange indicator
1 N NaOH

Chrome
10% Sodium Hydroxide
35% H_2O_2 (Hydrogen Peroxide)
concentrated Sulfuric Acid
10% Potassium Iodide
0.1 N Sodium Thiosulfate

1.12 WASTE TREATMENT

1.12.1 Process 1

For stand-alone **DIPSOL IZ-C17+** wasted water solution treatment without the presence of other plating systems, or rinses.

1. Dilute 500 times plating Solution (pH about 12)
2. Add Cu, Fe, Cr, Co.
3. Add 0, 5, 10, 25, and 50 mL/L of Sodium Hypochlorite.
4. Mix well
5. Adjust pH to 9 by NaOH or H_2SO_4.
6. Add Precipitating agent.
7. Filtration.
8. Check by AA

		Zn (mg/L)	Ni (mg/L)	Cu (mg/L)	Fe (mg/L)	Cr (mg/L)	Co (mg/L)
Before Treatment		16	6.4	15	100	5	11.4
After Treatment	0mL/L	2.6	5.5	12.0	0.1	0.3	7.0
	5mL/L	0.2	4.4	11.1	0.1	0.3	4.8
	10mL/L	0.1	2.8	7.7	0.1	0.5	2.3
	25mL/L	0	0.9	0.5	0	3.6	5.3
	50m/L	0	0.9	0.2	0	3.8	3.0

1.12.2 Process 2

For combined **DIPSOL IZ-C17+** system and Trivalent Cr wasted water solution treatment along with other plating systems in the plant.

1. Dilute 100 times plating Solution (pH about 12)
2. Add Cu, Fe, Cr, Co.
3. Add 20 mL/L of Sodium Hypochlorite.
4. Add 3 mL/L of 25% Aluminum Chloride Polymer
5. Mix well
6. Adjust pH to 9 by NaOH or H_2SO_4.
7. Add 1 g/L, 5 g/L of Na_2S
8. Adjust pH to 9 by H_2SO_4
9. Add Precipitating agent.
10. Filtration.
11. Check by AA

		Zn (mg/L)	Ni (mg/L)	Cu (mg/L)	Fe (mg/L)	Cr (mg/L)	Co (mg/L)
Before Treatment		16	6.4	15	100	5	11.4
After Treatment	1 g/L	0	1.2	0	0	0	1.0
	5 g/L	0	0.7	0	0	0	0.6

1.12.3 Process 3

For stand alone **DIPSOL IZ-264** wasted water solution treatment without the presence of other plating systems or rinses.

1. Waste water into acid waste.
2. Adjust waste water pH to between 3 and 5.
3. Add 0.2 g/L of $FeCl_2$ $4H_2O$ (40 ppm as Fe) *1. $FeSO_4$ may also be used.
4. Add 0.2 g/L of $Ca(OH)_2$.
5. Mix for 5min.
6. Adjust pH to between 9 and 10 by adding NaOH.
7. Add flocculants.
8. Allow particulates to settle for 10 min.
9. Filtration out particulates.

*1: Need to add same amount (mol/L) Fe as Cr in the wastewater. If the wastewater already contains enough Fe, $FeCl_2$ addition is not necessary.

1.13 TROUBLE SHOOTING GUIDE

1.13.1 DIPSOL IZ-C17+

APPEARANCE OF PLATED DEPOSIT		
Nature of Defect	**Possible Cause**	**Method of Correction**
Lack of brightness in HCD area or burning	1. Low nickel metal	1. Add **DIPSOL IZ-C17+Ni**. Check the replenishing rate of **DIPSOL IZ-C17+Ni**.
	2. High zinc metal	2. Check and adjust the Zn/Ni ratio.
	3. High caustic soda	3. Check the replenishing rate of caustic soda. Stop addition of caustic soda.
	4. Improper current distribution	4. Need to clean hooks and contacts. Place anode properly.
	5. Low anode current density	5. Reduce anode surface area (> 8 A/dm^2).
	6. High bath temperature	6. Adjust the temperature.
Lack of brightness in LCD areas	1. Low nickel metal	1. Add **DIPSOL IZ-C17+Ni**. Check the replenishing rate of **DIPSOL IZ-C17+Ni**.
	2. High zinc metal	2. Check and adjust the Zn/Ni ratio.
	3. Low **DIPSOL IZ-C17+B**	**3.** Add **DIPSOL IZ-C17+B** Check the replenishing rate of **DIPSOL IZ-C17+B.**
	4. Impurities	4. Refer to impurities section for details.
	5. Poor pre-treatment	5. Re-check pre-treatment process.
	6. Low bath temperature	6. Adjust the bath temperature.
Pitting, Streaks Or Haziness in MCD-LCD area	1. Impurities	1. Refer to the impurities section.
	2. Poor pretreatment	2. Re-check pretreatment process.
Roughness	1. Improper filtration	1. Check filter.
	2. Poor pretreatment	2. Re-check pretreatment process.
	3. Magnetized base material	3. Examine for proper pretreatment. Process may need demagnetized treatment for parts.

APPEARANCE OF PLATED DEPOSIT		
Nature of Defect	**Possible Cause**	**Method of Correction**
Poor Thickness Distribution	1. High metals	1. Stop the addition of **DIPSOL IZ-C17+Ni**. If too high, adjust by dilution.
	2. Low caustic soda	2. Check the replenishment rate of caustic soda. Add caustic soda.
	3. High solution temperature	3. Cool down to 76°F (25°C). Investigate the source of temperature rise and take counter-measures.
	4. Metallic contamination (lead, tin)	4. Refer to the impurities section for details.
Poor covering	1. High metals	1. Stop the addition of **DIPSOL IZ-C17+Ni**. If too high, adjust by dilution.
	2. Low caustic soda	2. Check the replenishing rate of caustic soda. Add caustic soda.
	3. Low **DIPSOL IZ-C17+B**	3. Add **DIPSOL IZ-C17+B** (Check by Hull Cell test.)
	4. High solution temperature	4. Cool down to 76°F (25°C). Investigate the source of temperature-rise and take counter-measures.
	5. Low electric current	5. Check rectifier setting and adjust, if necessary.
Slow Plating Rate	1. Low metals	1. Adjust with **DIPSOL NZ-777** for zinc and/or **DIPSOL IZ-C17+Ni** for nickel. (NZ-777 contains 10% wt. of zinc and 34% wt. of caustic soda.)
	2. Low Caustic Soda	2. Check the replenishing rate of caustic soda. Add caustic soda.
	3. High **DIPSOL IZ-C17+B**	3. Check the replenishing rate of **DIPSOL IZ-C17+B**. Stop addition of **DIPSOL IZ-C17+B**.
	4. High Carbonate	4. Remove Carbonate by freezing plating solution.
	5. Low solution temperature	5. Heat the solution to 76°F (25°C).
	6. Metallic contamination (tin, copper, chrome, lead)	6. Refer to the impurities section.

APPEARANCE OF PLATED DEPOSIT		
Nature of Defect	**Possible Cause**	**Method of Correction**
Poor bending property	1. High nickel metal	1. Check the replenishing rate of **DIPSOL IZ-C17+Ni**. Stop addition of **IZ-C17+Ni**.
	2. Low zinc metal	**2.** Add **DIPSOL NZ 777** (**DIPSOL NZ-777** contains 10%wt. of zinc and 34% wt. of caustic soda).
	3. Low caustic soda	3. Check the replenishing rate of caustic soda. Add caustic soda.
	4. Low **DIPSOL IZ-C17+B**	4. Check the replenishing rate of **DIPSOL IZ-C17+B**. Add **DIPSOL IZ-C17+B**.
	5. Impurities (Metals or Organics)	5. Zn powder treatment, Activated carbon treatment. Find source of contamination.
	6. Low solution temperature	6. Heat the solution to 76°F (25°C).
	7. High Thickness	7. Adjust plating time. Fix the thickness distribution.
	8. Bipolar	8. Need to clean hooks and contacts. Place anode properly.
Rack mark	1. Poor conductivity of hook	1. Completely strip the plating from the hooks.
	2. High plating voltage operation	2. Reduce the voltage.
Low Ni co-deposition	1. High Zinc metal	1. Dilution.
	2. Low Nickel metal	2. Add **DIPSOL IZ-C17+Ni** and check the replenishment rate.
	3. Low **DIPSOL IZ-C17+B**	3. Add **DIPSOL IZ-C17+B** and check the replenishment rate.
High Ni Co-deposition	1. Low Zinc metal	1. Add **NZ-777** (**NZ-777** contains 10% wt. of zinc and 34% wt. of caustic soda).
	2. High Nickel metal	2. Stop the addition of **IZ-C17+Ni** and check the replenishment rate. If too high, adjust by dilution.
	3. High sodium carbonate	3. Remove carbonate by freezing plating solution.

1.13.2 DIPSOL IZ-264 (Trivalent Chromate)

Phenomenon	Possible Cause	Countermeasure
Brown-Yellow Or Purple Appearance	1. Low Cr	1. Raise Cr by **DIPSOL IZ-264T**
	2. Low Temperature	2. Adjust temperature
	3. Strong Agitation	3. Very mild agitation is required
	4. Short Immersion Time	4. Lengthen Immersion Time
	5. Impurities (Zn, Fe, Cu)	5. Take out dropped parts. Renew the solution
Blue-Yellow Or Light Blue Appearance	1. High Temperature	1. Adjust temperature
	2. Long Immersion Time	2. Shorten Immersion Time
Uneven appearance (White Stain)	1. Insufficient Rinse	1. Keep rinse water clean. Use activation (1mL/L HCL) before chromate
Water Stain Mark	1. Insufficient Rinse	1. Raise water flow rate
	2. Insufficient Drying	2. Drying at 80°C for 10 – 20min is recommended.

1.14 SPECIAL HANDLING INSTRUCTIONS

The use, handling, and storage of this product may involve certain hazards. Please refer to the Safety Data Sheets on **DIPSOL IZ-C17+MS**, **DIPSOL IZ-C17+Ni**, **DIPSOL IZ-C17+B**, **DIPSOL NZ-777** and **DIPSOL F-0529** for additional hazard information.