# IRIDITE® 14-2

# Chromate Coating for Aluminum

## DESCRIPTION

**Iridite 14-2** is a chemical process that produces a protective chromate conversion film on aluminum and aluminum alloys. Application is by dip, brush, swab, or spray, producing coatings ranging from clear to dark yellow. The darker coatings providing the greatest corrosion protection. The coating can be used as a final finish or can be dyed various colors. It can also serve as a base for paints and high performance top coats, lacquers, or as a base for rubber bonding.

The operating range of Iridite 14-2 is extremely flexible. Suitable adjustments of the Iridite 14-2 concentration can accommodate wide variations in immersion time, the corrosion protection (film thickness) desired, and the alloy to be treated.

## FEATURES

1. Coating has minimum effect on electrical characteristics of aluminum for high or low frequency work when used at lower concentrations
2. Coating protects abraded anodized surfaces and also provides electrical contact to those surfaces
3. Coated aluminum surface can be welded by shielded arc method or by spot welding
4. Bath activators are self-regulating, providing maximum uniformity of results and ease of control
5. Qualified under Specification MIL-DTL-81706B, Class 1A, Form II, Method A, B, C; and under Class 3, Form II, Method C. The clear Iridite 14-2 finish also qualifies under Class 3, Form II, Method C of the same specification. (Specification MIL-DTL-81706B qualifies products for use in conforming to Specification MIL-C-5541E)

## TYPICAL PROCESS CYCLE

1. Clean (as recommended)
2. Warm or cold running rinse
3. Iridite 14-2
4. Cold running rinse
5. Hot water rinse *
6. Dry

* Optional: See Rinsing & Drying Procedures on Pages 4 to 6.

## EQUIPMENT

**Tank:** Use 304 stainless steel, or use mild steel lined with polyethylene or Koroseal, or equal.

**Heating:** Use 316 stainless steel for heating coils.

**Agitation:** Agitation is not required in the bath other than to free entrapped air bubbles. However, moderate agitation, either mechanical or with clean air, improves coating uniformity and accelerates coating reaction slightly.

**Ventilation:** Adequate local ventilation is required.

## SOLUTION MAKE-UP

1. Fill tank ¾ full with water.
2. Heat water to about 120°F (49°C). **Do not exceed 120°F (49°C).**
3. Add required quantity of Iridite 14-2 compound, while stirring. **Iridite 14-2 concentration should not exceed 4 oz/gal (30 g/L).**
4. Heat (or cool) working solution to required operating temperature.

## OPERATING CONDITIONS

### Cleaning

Prepare metal as recommended in the Cleaning Cycles section of this document.

### Operating Conditions

**Iridite 14-2:** ¾ - 2 ¼ oz/gal (5.6 - 17 g/L)

**Solution temp:** 60°-100°F (16°-38°C)

**Immersion time:** 30 sec. - 6 min

| Concentration | pH Range |
|---|---|
| 5.6 g/L (¾ oz/gal) conc. | 1.6-1.9 |
| 9.4g/L (1¼ oz/gal) conc. | 1.3-1.6 |
| 17 g/L (2¼ oz/gal) conc. | 1.1-1.4 |

### Yellow Coating

Generally, a yellow coating for maximum protection is obtained using an Iridite 14-2 concentration of 1¼ oz/gal (9.4 g/L) and a 3- to 6-minute immersion time. Higher concentrations and/or temperatures reduce immersion time necessary to produce a comparable film thickness.

Coating color varies to some extent with the alloy treated. For example, coatings on "soft" alloys, such as 3003 and 5052, tend to be dark in color. Coatings on 6061, 7075, and die cast alloys tend to be light in color. The immersion time selected should take this variation into consideration. Excessive immersion times cause a loose powdery coating. Best results on high-silicon cast alloys are obtained using an Iridite 14-2 concentration of 5.6 g/L (¾ oz/gal) and a 3- to 5-minute immersion time.

### Clear Coating

A protective clear finish is obtained by first forming the normal yellow coating, using an Iridite 14-2 concentration of 1¼ oz/gal (9.4g/L) and a 30-second to 3-minute immersion time. The work is then cold water rinsed, followed immediately by prolonged immersion in a final hot water rinse, which bleaches out the yellow color. At a rinse temperature of 200°F (93°C) one minute immersion is sufficient. As the temperature is lowered, immersion time must be increased. Do not use an immersion time in excess of that necessary to remove the yellow color since this reduces the protective value of the film.

### Cleaning

If cleaner is to be applied by spray, your MacDermid representative will recommend a suitable low-foaming cleaner. Otherwise, prepare metal as recommended in Cleaning Cycles, page 6-9.

### Operating Conditions

**Iridite 14-2:** 1-2 oz/gal (7.5-15 g/L)

**Solution temp:** 60°-120°F (16°-49°C)

**Spray time:** 15 sec. - 3 min.

**pH range:** 1.3-1.6

**Spray pressure:** 5-50 psi (34.5-345 kPa)

**Note:** Spray nozzles and pressure may vary to suit application. All nozzles and headers must be made of acid resisting material.

### Operating Data for Brush and Swab Application

**Note:** The Iridite 14-2 Brush-On Kit can be used for touch-up work on small parts. The kit contains all the necessary chemicals to clean and Iridite coat about 1000 ft 2 (93 m2) of aluminum surface. Detailed instructions are in the Iridite 14-2 Brush-On Kit technical bulletin.

### Cleaning Methods

**Degreasing:** Degrease heavily soiled work with a solvent wash, then acid clean. For lightly soiled or fingerprinted work, acid cleaning alone should be sufficient.

**Acid Cleaning:** Apply the following solution with brush or swab until water breaks disappear and surface is completely wet. Rinse thoroughly before applying Iridite 14-2.

**Isoprep 188:** 6-8 oz/gal (45-60 g/L)

**ARP 2 detergent:** 1¼ fl oz/gal (10 mL/L)

**Solution temp:** 70°-90°F (21°-32°C)

**Mechanical Cleaning:** Sanded, ground, wire brushed, or freshly cut surfaces may be treated with Iridite 14-2 without cleaning provided treatment is accomplished immediately.

### Operating Conditions

**Iridite 14-2:** 1¼-4 oz/gal (9.4-30 g/L)

**Solution temp:** 60°-100°F (16°-38°C)

| Concentration | pH range: |
|---|---|
| 1¼ oz/gal (9.4 g/L) conc. | 1.3-1.6 |
| 2¼ oz/gal (17 g/L) conc. | 1.1-1.4 |
| 4 oz/gal (30 g/L) conc. | 0.9-1.1 |

### Iridite 14-2 Application

Iridite 14-2 solution can be applied by swab, brush or flowcoat. A single application is the equivalent of 5 to 10 seconds treatment by immersion. Usually, the film produced by a single application is light in color. Repeated applications of fresh solution increase film thickness to where a golden yellow to brown color appears, and also increase the protective value of the coating. Faster results can be obtained using a concentration of 30g/L (4 oz/gal) producing a yellow coating in 15 to 30 seconds.

ARP 2 detergent can be added to the solution at the rate of 1 gal/100 gal (1 L/100 L) of working solution if the surface is difficult to coat.

# SOLUTION CONTROL & MAINTENANCE

### Control By pH and Titration

pH is the most critical factor in solution control. An increase in pH causes a lightening in film color, while a decrease in pH causes a darkening in color. In the extreme cases, too high a pH gives no coating at all; while too low a pH gives a loose and powdery coating.

For most accurate control, use both the hexavalent chromium determination (described in Analytical Control, page 5) and pH measurement. The result is more economical operation and the ultimate in product uniformity. By this procedure, Iridite 14-2 compound is added to the bath to adjust concentration. When this addition does not bring pH within the operating range, further pH adjustment is made with nitric acid (42º Bé). A nitric acid (42º Bé) addition of 13 fl oz per 100 gallons (100 mL/100L) of working solution lowers the pH about 0.1 unit.

Too low a pH can be corrected by small additions of caustic soda. The addition of 1 lb/100 gals (60g of caustic soda per 100 liters) of working solution raises pH by about 0.1 units.

Since Iridite 14-2 solution ages during use, the coating obtained becomes gradually lighter in color even though constant operating conditions are maintained. If this occurs, restore solution to normal operation by gradually increasing the Iridite 14-2 concentration within the range given and lowering the pH limit 0.1 below the range specified.

### Control By pH Only

By this method, pH alone is measured. A dual maintenance addition of Iridite 14-2 and nitric acid (42º Bé) at the following rate will lower pH approximately 0.07 unit.

**Caution:** Add the components separately to the bath. DO NOT mix the nitric acid with the Iridite 14-2 powder.

| | per 100 gal | per 100 L |
|---|---|---|
| Iridite 14-2 | 1 lb | 120 g |
| Nitric acid (42º Bé) | 3.1 fl oz | 24 mL |

Repeat this dual addition, if necessary, until pH is within operating range. If the coatings are too light, even though pH is within the optimum range, make further additions in the above preparations to lower the pH to 0.1 below the range specified.

### Control By Color of Finish

Where analytical equipment is not available, a very simple method can be used to determine if the solution is in satisfactory working order. Clean a sample panel and process it in a fresh Iridite 14-2 bath, using a 2-minute immersion time. Use this panel as a color standard.

As the coatings produced by the regular working solution become lighter due to bath depletion, make maintenance additions as described in Control by pH Only, Page 4. Repeat the dual addition, if necessary, until a test panel has approximately the same appearance as the color standard.

**Caution:** When using solution control methods other than titration analysis, add Iridite 14-2 and nitric acid in the stated proportions. Excessive quantities of acid can cause poor results.

### ARP® 70 Spot Test

ARP 70 spot test can be used to determine the presence of a clear or colored Iridite film on the aluminum surface, and to some extent the film's protective value. Refer to ARP 70 technical bulletin.

### Bath Life

Iridite 14-2 has excellent bath life. If, after prolonged use, the bath has a green discoloration, and if adjustment by regular maintenance additions is difficult, dumping may be necessary. Use the following test as a guide only when it appears that the endpoint of the bath has been reached.

1. Pipette 25mL cooled sample of Iridite 14-2 solution into a beaker or Erlenmeyer flask. Add 25 mL of distilled water.
2. Add several drops of phenolphthalein indicator.
3. Titrate with 1.0N or 2.0 N sodium hydroxide to a pink or orange endpoint. The greenish precipitate that forms varies in amount according to bath age. Add 3 drops of excess sodium hydroxide.
4. Pour contents of flask into a 100 mL graduated cylinder. Fill to 100 mL mark with distilled water and mix thoroughly.
5. Allow to stand 24 hours. Read volume of settled precipitate.

With a fresh bath, precipitate amount is virtually zero, increasing as bath is worked. Dumping point is indicated when volume of precipitate reaches 40 to 55 mL.

# ANALYTICAL PROCEDURES

### Iridite 14-2 Analysis

**Reagents:**

0.1N sodium thiosulfate ($Na_2S_2O_3$)

standard against potassium dichromate ($K_2Cr_2O_7$)

Potassium iodide solution (100 g KI/L)

Concentrates sulfuric acid ($H_2SO_4$)

Starch indicator solution or Thyodene indicator

**Procedure:**

1. Pipette 10 mL cooled sample of working solution into 400 mL beaker. Dilute to 250 mL with distilled water.
2. Add 10 mL of potassium iodide solution and 5 mL of concentrated sulfuric acid. Stir.
3. Titrate with 0.1N sodium thiosulfate solution to a light yellow color.
4. Add 1 to 2 mL of starch solution or 0.1 gram of Thyodene indicator.
5. Continue adding thiosulfate solution drop wise with constant stirring until dark blue color fades to a clear solution.

**Calculation:**

Iridite 14-2 oz/gal = m/L sodium thiosulfate x N* x 0.81

(Iridite 14-2 g/L = m/L sodium thiosulfate x N* x 6.08)

* N is exact normality of sodium thiosulfate

**pH Determination:**

1. Measure pH with electrometric pH meter, preferably after addition of Iridite 14-2.
2. If necessary, adjust pH with concentrated nitric acid (42º Be') in accordance with following calculation:

   fluid oz nitric acid required = 1.3 x pH drop required x tank volume (in gal)

   (mL nitric acid required = 10 x pH drop required x tank volume (in liters))

**Example:**

Measured pH = 1.7

Desired pH = 1.5

For a 200-gallon tank

Required nitric acid = 1.3 x (1.7 - 1.5) x 200 = 52 fl oz

# GENERAL CLEANING INFORMATION

A uniformly clean surface is of prime importance in securing satisfactory adhesion and complete coverage by subsequent surface treatment of aluminum and aluminum alloys. Failure to follow this rule results in costly rejections of finished products and in even more costly failures in service.

Surface contamination of metals is divided into two general classes: (1) Organic contamination such as oils, grease and forming and polishing lubricants; (2) Inorganic contamination as typified by metal and abrasive particles loosely held in the grease films, and by oxides bonded to the metal.

Generally, chemically clean surfaces are produced on metals by three methods:

1. **Solvent Cleaning** - Solvent vapor degreasing, solvent washing or solvent emulsion cleaning is used to remove loose particles and to reduce organic contamination to a uniformly low level.
2. **Alkaline Cleaning** - This cleaning method is used to remove the last traces of organic contamination. The effectiveness of this operation is indicated by the presence of an unbroken film of water on the work after rinsing.
3. **Acid Cleaning (Deoxidizing)** - This cleaning operation removes metal oxides and, under ideal conditions, leaves the surface chemically clean and receptive to further processing.

# CLEANING CYCLES

The following cleaning cycles are for typical applications and may have to be modified or combined for your particular requirements. Major considerations are the form and type of aluminum alloy, the amount and kind of surface contamination, the required appearance of the finished surface and the equipment available. As an example, to insure a uniform surface appearance on parts having uneven distribution of soil and/or oxides, the recommended procedure is to use Cleaning Cycle III followed by Cleaning Cycle I. Your MacDermid representative can help you in the selection of a specific cleaning procedure.

**Cleaning Cycle I (A or B)**

Use on aluminum wrought alloys, extrusions and all aluminum alloys containing less than 1% silicon.

**IA. Hot Etch Cleaning**

1. Vapor degrease, if necessary.
2. Use Isoprep 35 etch-type alkaline cleaner.

   **Isoprep 35:** 2-8 oz/gal (15-60 g/L)

   **Solution temp:** 160°-200°F (71°-93°C)

   **Immersion time:** 15-60 seconds
3. Rinse.

4. Acid clean with Isoprep 188 (chromated).

   **Isoprep 188:** 8-16 oz/gal (60-120 g/L)

   **Solution temp:** 70°-100°F (21°-38°C)

   **Immersion time:** 30 sec. - 5 min

or

4a. Acid clean with Isoprep 184 (nonchromated).

   **Isoprep 184:** 22-25% by vol.

   **Solution temp:** 70°-110°F (21°-43°C)

   **Immersion time:** 1-5 minutes

5. Rinse.

6. Use IRIDITE 14-2 per instructions.

**Note:** When using an etch-type cleaning cycle on work which has been heat treated, a more even etch by the alkali cleaner may be obtained if the work is pre-cleaned for a few minutes in the acid cleaner. This action removes heat treating oxides.

### IB Cold Cleaning

1. Use Isoprep 188 acid chromate-type deoxidizer and ARP 2 detergent.

   **Isoprep 188:** 6-8 oz/gal (45-60 g/L)

   **ARP 2:** 1¼ fl oz/gal (10 mL/L)

   **Solution temp:** 70°-90°F (21°-32°C)

   **Immersion time:** 3-5 minutes

1a. Acid clean with Isoprep 184 (nonchromated) and ARP 2 detergent.

   **Isoprep 184:** 22-25% by vol.

   **ARP 2:** 1¼ fl oz/gal (10 mL/L)

   **Solution temp:** 70°-110°F (21° - 43°C)

   **Immersion time:** 1-5 minutes

2. Rinse.

3. Use Iridite 14-2 per instructions

### Cleaning Cycle II (A or B)

Use on aluminum castings (sand, die and permanent mold) and all aluminum alloys containing more than 1% silicon.

### IIA. Hot etch cleaning

1. Vapor degrease, if necessary.

2. Use Isoprep 35 etch-type alkaline cleaner.

   **Isoprep 35:** 2-8 oz/gal (15-60 g/L)

   **Solution temp:** 160°-200°F (71°-93°C)

   **Immersion time:** 15-60 seconds

3. Rinse.

4. Acid pickle for smut removal. Use nitric acid (42º Be') to which is added Metex Etch Salts in concentrations ranging from 4 oz to 2 lb/gallon (30 to 240 g/L) of working solution. For correct proportions of nitric acid and Metex Etch Salts refer to the Metex Etch Salts technical data sheet

**Immersion Time:**

   **4 oz/gal (30 g/L):** 30 sec. - 2 min.

   **8 oz/gal (60 g/L):** 15 sec. - 1 min.

   **1 lb/gal (120 g/L):** 5-20 seconds

   **2 lb/gal (240 g/L):** 2-5 seconds

   **Solution temp:** Room temp.

NOTE: For minimum fuming use 4 oz/gal (30 g/L) concentration

5. Rinse

6. Use Iridite 14-2 per instruction.

### IIB. Cold Cleaning

1. Isoprep 188 acid chromate-type deoxidizer and ARP 2 detergent.

**Isoprep 188:** 6-8 oz/gal (45-60 g/L)

**ARP 2:** 1¼ fl oz/gal (10 mL/L)

**Solution temp:** 70°-90°F (21°-32°C)

**Immersion time:** 3-5 minutes

or

1a. Acid clean with Isoprep 184 (nonchromated) and ARP 2 detergent.

**Isoprep 184:** 22-25% by vol.

**ARP 2:** 1¼ fl oz/gal. (10 mL/L)

**Solution temp:** 70°-110°F (21° - 43°C)

**Immerse time:** 1-5 minutes

2. Rinse.
3. Use Iridite 14-2 per instructions.

### Cleaning Cycle III (A or B)

Use on polished aluminum surfaces and all other applications where etching is undesirable. Use on all aluminum alloys.

### IIIA. Hot Non-etch Cleaning

1. Vapor degrease, if necessary.
2. Use Isoprep 44 non-etch type alkaline cleaner.

**Isoprep 44:** 8-10 oz/gal (60-75 g/L)

**Solution temp:** 140°-180° F (60°-82°C)

**Immersion time:** 3-10 minutes

3. Rinse.
4. Acid clean with Isoprep 188 (chromated).

**Isoprep 188:** 8-16 oz/gal (60-120 g/L)

**Solution temp:** 70°-100°F (21°-38°C)

**Immersion time:** 30 sec. - 5 min.

or

4a. Acid clean with Isoprep 184 (nonchromated).

**Isoprep 184:** 22-25% by vol.

**Solution temp:** 70°-110°F (21°-43°C)

**Immersion time:** 1-5 minutes

5. Rinse.
6. Use Iridite 14-2 per instructions.

### IIIB. Cold Cleaning

1. Use Isoprep 188 acid chromate-type deoxidizer and ARP 2 detergent.

**Isoprep 188:** 6-8 oz/gal (45-60 g/L)

**ARP 2:** 10 mL/L (1¼ fl oz/gal)

**Solution temp:** 21°-32°C (70°-90°F)

**Immersion time:** 3-5 minutes

or

1a. Acid clean with Isoprep 184 (nonchromated) and ARP 2 detergent.

**Isoprep 184:** 22-25% by vol.

**ARP 2:** 10 mL/L (1¼ fl oz/gal)

**Solution temp:** 21°-43°C (70°-110°F)

**Immersion time:** 1-5 minutes

2. Rinse.
3. Use Iridite 14-2 per instructions.

## RINSING & DRYING PROCEDURES

### Rinsing Before Iridite Treatment

Drag-in of acid or alkali is detrimental to the Iridite 14-2 bath. Consequently, rinsing between the cleaning and Iridite operations must be particularly thorough. A clean running rinse or a spray rinse is desirable.

### Rinsing After Iridite Treatment

The rinse after Iridite treatment should be a running rinse to flush off clinging Iridite solution.

### Final Hot Rinse

A final hot rinse to facilitate drying is recommended. Keep rinse temperature below 160°F (71°C) and use an in-and-out dip, except where a clear coating is desired. Prolonged hot rinse causes color removal and some reduction in corrosion protection.

### Drying

Drying may be accomplished by air blast, centrifuge or warm circulating air. Avoid temperatures in excess of 160°F (71°C) since they tend to lower the corrosion protective value of the finish.

### Coating Hardening

Freshly formed coatings, particularly heavier coatings are soft and subject to abrasion. "Setting," or hardening, begins immediately after drying. Prior to standard corrosion resistance tests, allow coatings to age at least 24 hours for consistent results.

## STRIPPING IRIDITE FILMS FOR REPROCESSING

### Etch Procedure

1. If etching is permissible, put work to be stripped through a hot etch cleaning cycle. Use cleaning cycle IA for low-silicon alloys, and cleaning cycle IIA for high-silicon alloys.
2. Repeat entire cycle, until coating is completely removed and aluminum surface is uniformly etched.

### Non-etch Procedure

1. If etching is not permissible, put work through non-etch alkaline cleaner (Step 2 of Cleaning Cycle IIIA). Then rinse thoroughly.
2. Use stripping solution of nitric acid (42º Bé) and ARP 28.

   **Nitric acid (42º Bé):** 2 parts by vol.

   **Water:** 1 part by vol.

   **ARP 28:** 7½ grams/gal (2 g/L) of solution

Immerse work at room temperature until gassing begins (10 seconds to 2 minutes) and then rinse thoroughly. After stripping, reprocess work using the regular cleaning cycle.

## SAFETY & WARNING:

MacDermid, Inc. recommends that the company/operator read and review the MacDermid Material Safety Data Sheets for the appropriate health and safety warnings before use. Material Safety Data Sheets are available from MacDermid Incorporated.

## WASTE TREATMENT

**Prior to using any recommendations or suggestions by MacDermid, Inc. for waste treatment, the user is required to know the appropriate local/state/federal regulations for on-site or off-site treatment which may require permits. If there is any conflict regarding our recommendations, local/state/federal regulations take precedent.**

## Other Information

These instructions provided by:

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