



SUBJECT CYANIDE COPPER PLATING
Process Specification

SUPERSEDED DATE 8/3/49

This specification covers the conventional cyanide copper plating process known as DuPont "Coppralyte", Potassium Formulation, Plating Process (formerly Potassium High-Speed Copper RH-661). Rack and barrel plating are included herein.

(See S. N. 34-36-60B for cyanide copper strike process specifications.)

1. EQUIPMENT

- a. Tank - Koroseal lined steel or Pyrex glass.
- b. Heater - Stainless steel steam coil, hot plate, or steel immersion heater.
- c. Temperature controls - Automatic.
- d. Agitator - Cathode and/or solution.
- e. Filter - Continuous.
- f. Exhaust - Exhaust required.
- g. Power supply - D-C from rectifier or generator.
- h. Contacts - Copper anode and cathode bars; case hardened steel anode Barrel when required.
- i. Electrical instruments - Ammeter, voltmeter, and rheostat.

2. MATERIALS

- C601 Coppralyte Plating Salts, Potassium Formulation.
- C164 Copper Anodes.
- C611 Coppralyte Addition Agent 774 (anti-pitter).
- P64 Potassium Hydroxide, Technical.
- P60 Potassium Cyanide, Technical.
- C167 Cuprous Cyanide.
- - Barium Hydroxide, Technical.
- W60 Deionized Water (or W7E Distilled Water).
- - Sulfur.
- - Lime, Unslacked.
- - Nylon Anode Bags.



CYANIDE SAFETY PRECAUTIONS: See 33-2-13A.
POTASSIUM HYDROXIDE SAFETY PRECAUTIONS: See 33-2-8A.

3. PREPARATION OF SOLUTION

- a. Composition:
 - Plating salts - - - - - 24 oz./gal.
 - Potassium hydroxide - - - - - 5.6 oz./gal.
 - Addition agent - - - - - 8 cc./gal.

b. Procedure:

- (1) Fill the tank two-thirds full with deionized or distilled water and dissolve the required amount of potassium hydroxide. The temperature of the water should not exceed 51°C.(125°F.) before adding the potassium hydroxide.
- (2) Dissolve the required amount of plating salts.
- (3) Add water to bring the solution up to the operating volume and heat to the specified temperature.
- (4) Stir the solution and filter.
- (5) Add the required amount of addition agent previously diluted with an equal volume of water.
- (6) Sample and balance solution before operating.

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4. SOLUTION OPERATION & CONTROL
a. Limits:

	Preferred per gal.	Limits per gal.
Copper as metal	5.6 oz.	4.9-8.0 oz.
Free potassium cyanide §	0.5 oz.	0.3-0.75 oz.
Potassium hydroxide	5.6 oz.	4.0-7.0 oz.
Addition agent	8 cc.	6-10 cc.
Carbonate	- -	3-13 oz.
§ For barrel plating: 1.8 oz/gal preferred; 1.5-2.0 oz/gal. limits		

Temperature: 80-85° C. (176-185°F.)

Current density: 10-60 amp./sq.ft.

D-C Tank potential: 3-6 volts

Time: The following table gives the time required in minutes for deposits at various current densities (100% current efficiency).

Deposit Thickness in Inches	Weight Oz./Sq.Ft.	Time in Minutes				
		Amp./Sq.Ft.				
		10	20	30	40	60
0.0001	0.074	5.3	2.6	1.8	1.3	0.9
0.0002	0.148	10.6	5.3	3.5	2.6	1.8
0.0003	0.222	15.8	7.8	5.3	3.9	2.7
0.0004	0.296	21.1	10.6	7.0	5.3	3.5
0.0005	0.370	26.4	13.2	8.8	6.6	4.4
0.0006	0.444	31.7	15.8	10.6	7.9	5.3
0.0007	0.518	36.9	18.5	12.3	9.2	6.2
0.0008	0.592	42.2	21.1	14.1	10.6	7.0
0.0009	0.666	47.5	23.8	15.8	11.9	7.9
0.0010	0.740	52.8	26.4	17.6	13.2	8.8
0.0015	1.110	79.2	39.6	26.4	19.8	13.2
0.0020	1.480	105.6	52.8	35.2	26.4	17.6

This table is calculated on the requirement of 528 ampere minutes to deposit 0.001" copper on 1 sq. ft of area.
(Ref.-DuPont copper plating bulletin)

Barrel plating efficiency may be somewhat less than 100%.

- (1) Sampling: Submit a 100-200 cc. sample of plating solution each week to C & P Laboratory, making sure that solution is well agitated and up to operating temperature before taking the sample. See S.N. 34-36-1 for standard sampling procedure.

b. Purification:	Contaminant	Purification Method
	Insoluble matter	Filtration
	Carbonates	Precipitation with barium hydroxide
	Heavy metals	Dummy plating
	Organic matter	Activated carbon

Refer to S.N. 34-36-1A for carbonate precipitation procedure.

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4. SOLUTION OPERATION & CONTROL (Cont.)

c. Notes:

(1) The plating solution should be balanced as follows:

<u>Defect</u>	<u>Remedy</u>
Low Copper	Add plating salts
Low cyanide	Add potassium cyanide
Low hydroxide	Add potassium hydroxide
High cyanide	Add copper cyanide
High cyanide & low copper	Add copper cyanide
High copper	Replace some of the copper anodes with insoluble anodes

The Hallcell Test shall be made where there is any question about the brightner content.

- (2) The solution should not be air agitated.
- (3) The minimum spacing between work and anode should be 4 inches.
- (4) The solution should never be operated with less than a 2 to 1 anode to cathode ratio.
- (5) The anodes and cathodes (parts) must be completely immersed in the solution at all times.
- (6) After removing the parts from the plating solution they shall be thoroughly rinsed to remove all cyanide. (The details on types and number of rinses, and drying, are specified in the plating schedules either below or in S.N. 34-1-1P.)
- (7) Extreme care must be exercised to prevent the introduction of dirt or lint in the solution which may catch on the parts. The anodes should extend from one extremity of the jig or barrel to the other and should be as deep as the parts in the solution.
- (8) Make cathode contact before lowering part into plating solution unless part has previously received a copper strike.
- (9) All electrical contact areas should be kept clean.
- (10) Parts should not be allowed to dry between strike and plating.
- (11) Barrel Plating: Excessive plating should not be allowed to build up on outside of barrel.

5. DISPOSAL OF SOLUTIONS

- a. Determine the amount of cyanide present.
- b. Dilute with water.
- c. For every pound of cyanide add 0.72 lb. of sulfur and 0.26 lb. of unslacked lime to the solution.
- d. Heat to 90°C. for 2 hours stirring constantly during heating.
- e. Allow to stand overnight.
- f. Check for completion of reaction by inserting a bright copper wire. Destruction of cyanide is evidenced by wire turning dark.
- g. For disposal of the residue from the sulfur and lime treatment contact Buildings & Grounds Section.

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6. SAFETY PRECAUTIONS

This plating solution is a CYANIDE solution and should be handled with extreme care - see S.N. 33-2-13A.

Under no circumstances should acid be introduced into the solution - cyanides in contact with acids develop deadly hydrocyanic acid gas which is colorless and nearly odorless (burnt-almond smell can be detected by some persons).

SCHEDULE NO. 1

Preship plating complete tube.
Initially for Type 5786

Caution: Terminal wires must not enter cleaning or plating solutions. Immerse so that all metal parts are in solution, with terminal wires above solution.

1. Immerse 2 mins. in hot 50% HCl.
2. Rinse 30 secs. in running tap water.
3. Dip 2 secs. in acetone.
4. Dry in air.
5. Buff metal parts with stainless steel wire wheel operating at low speed. Diameter of wire wheel 4 inches. Buff until loose scale and oxides have been removed.
Caution: Keep ends of wire brush away from glass as much as possible. Do not use excessive pressure on the wheel. Keep glass parts of tube away from metal parts of buffer.
6. During and after buffing, wear clean cloth gloves to prevent finger prints.
7. Wire metal parts for electrical contact. Use 0.030" Ni wire. Twist wire around metal cap on end opposite lead wires. Thread wire through radiator. Allow enough excess wire for suspending the tube in the plating solution.
8. Immerse 5 secs. in 5% KCN solution.
9. Copper strike 2A/part, 30 secs.
10. Copper plate 3A/part (20A/SF) 15 mins. for 0.0005".
11. Rinse in warm water, 30 seconds.
12. Dip 2-3 seconds in chromic acid solution (34-34-62, IB)
13. Rinse thoroughly in tap water.
14. Rinse thoroughly in deionized water.
15. Dip 5-10 seconds in clean, dry acetone.
16. Dry.
17. Remove contact wire.

DANGER

HYDROCHLORIC ACID SAFETY PRECAUTIONS: See 33-2-7C



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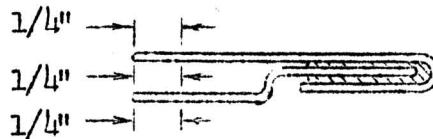
SCHEDULE NO. 2 (Initially for FM6965 cathode top seal assembly of 5831)

- a. Material: Kovar.
- b. Plating Surface: 0.2 sq. ft.

CAUTION: Handle the assemblies with extreme care. The glass seals are very fragile.

c. Procedure:

1. Wash complete assembly with acetone (A55) to remove castor oil remaining from leak testing.
2. Pickle in hot 50% solution of hydrochloric acid (A15), 51-66°C. (125-150°F.), 2 minutes.
3. If scale is not removed, repeat step 2.
4. Rinse in running water, 30 seconds.
5. Dip in acetone (A55).
6. Dry.
7. Buff exposed surfaces with wire wheel taking extreme care to avoid heating assembly.
8. Mask with Microstop lacquer (L631A) 1/4" from top edges as follows:



9. Dry for 30 minutes.
10. Rack.
11. Preheat assembly in warm water, 38°C. (100°F.), 1 minute.
12. Electroclean, anodic, 6 v., 93°C. (200°F.), 1 minute. See 34-34-74.
13. Rinse in running warm water with agitation, 38-66°C. (100-150°F.), 30 seconds.
14. Dip in hot 50% solution of hydrochloric acid (A15), 51-66°C. (125-150°F.), 5 seconds.
15. Rinse in running water with agitation, 30 seconds.
16. Dip in 5% solution of potassium cyanide (P60), 1 - 2 seconds.
17. Rinse in running water with agitation, 30 seconds.
18. Copper strike, 4 amp./assembly, 60-71°C. (140-160°F.), 30 seconds.
19. Copper plate to thickness of 0.0010", cathode agitation, 4 amp./assly. (20 amp./sq. ft.), 79-85°C. (175-185°F.), 26 minutes.
20. Rinse in running warm water with agitation, 38-66°C. (100-150°F.), 30 seconds.
21. Dip in chromic acid solution (Sch. ID, 34-34-62), 1 - 2 seconds.
22. Rinse in running water with agitation, 30 seconds.

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 DANGER

BLACOSOLV SAFETY PRECAUTIONS: See 33-2-11C.

HYDROCHLORIC & NITRIC ACID SAFETY PRECAUTIONS: See 33-2-7C.

POTASSIUM CYANIDE SAFETY PRECAUTIONS: See 33-2-13A.

SCHEDULE NO. 2

c. Procedure: (cont'd)

23. Remove masking lacquer by soaking in acetone (A55).
24. Rinse in clean acetone (A55) to remove all traces of lacquer.
25. Dry.
26. Inspect masked area for presence of copper. If any copper is present remove as follows:
 - (a) Fill a flat-bottomed, dry beaker with 1/4" depth of red fuming nitric acid and place beaker on a level table.
 - (b) Place assembly, unplated area down, into acid and allow to remain for 30 seconds. Rinse in water and inspect for removal of copper. If copper spots are not completely removed, dry assembly thoroughly and repeat.

**SCHEDULE NO. 3 (Initially for MP6003 beam former mounting flange and MP6013 anode main flange of 5831)

a. Material: Vega Tool Steel (1% chromium)

b. Plating Surface: 0.8 sq. ft.

c. Procedure:

1. Degrease in hot Blacosolv.
2. Rack on about 1/8" dia. copper or nickel wire through non-threaded hole.
3. Electroclean, anodic, 4-6 v., 82-93°C. (180-200°F.), 1 minute, S. N. 34-34-74.
4. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
5. Dip in hot 50% solution of hydrochloric acid (A15), 51-66°C. (125-150°F.), 5 seconds.
6. Rinse in running water with agitation, 30 seconds.
7. Nickel strike, 64 amp./part, room temperature, 1 minute.
8. Rinse in running water with agitation, 30 seconds.
9. Dip in 5% solution of potassium cyanide (P60), 1-2 seconds.
10. Rinse in running water with agitation, 30 seconds.
11. Copper strike, make contact with flexible lead before immersing, 24 amp./part, 60-71°C. (140-160°F.), 30 seconds.
12. Copper plate to thickness of 0.0015", cathode agitation, 24 amp./part (30 amp./sq. ft.), 79-85°C. (175-185°F.), 26 minutes.
13. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
14. Continue without interruption of the cycle with silver plating schedule, S.N. 34-36-66, Sch. 1.



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BLACOSOLV SAFETY PRECAUTIONS: See 33-2-11C.
HYDROCHLORIC ACID SAFETY PRECAUTIONS: See 33-2-7C.
POTASSIUM CYANIDE SAFETY PRECAUTIONS: See 33-2-13A.
CHROMIC ACID SAFETY PRECAUTIONS: See 33-2-7B.

SCHEDULE NO. 4 (Initially for MP6012 grid flange facing of 5831)

- a. Material: Vega Tool Steel (1% chromium).
- b. Plating Surface: 0.4 sq. ft.
- c. Procedure: Same as Schedule No. 3 above except for currents. Use following currents -

Nickel strike	32 amp./part
Copper strike	12 amp./part
Copper plate	12 amp./part

Continue without interruption of the cycle with silver plating schedule, S. N. 34-36-66, Sch. 2.

SCHEDULE NO. 5 (Initially for MP6004 cathode water seal top ring of 5831)

- a. Material: 18-8 Stainless Steel.
- b. Plating Surface: 0.4 sq. ft.
- c. Procedure:
 1. Degrease in hot Blacosolv.
 2. Rack on about 1/8" dia. copper or nickel wire through non-threaded hole.
 3. Electroclean, anodic, 4-6v., 82-93°C. (180-200°F.), 1 minute, S. N. 34-34-74.
 4. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
 5. Dip in 50% solution of hydrochloric acid (A15), 51-66°C. (125-150°F.), 5 seconds.
 6. Rinse in running water with agitation, 30 seconds.
 7. Nickel strike, 32 amp./part, room temperature, 1 minute.
 8. Rinse in running water with agitation, 30 seconds.
 9. Dip in 5% solution of potassium cyanide (P60), 1-2 seconds.
 10. Rinse in running water with agitation, 30 seconds.
 11. Copper strike, make contact with flexible lead before immersing, 12 amp./part, 60-71°C. (140-160°F.), 30 seconds.
 12. Copper plate to thickness of 0.001", cathode agitation, 12 amp./part (30 amp./sq. ft.), 79-85°C. (175-185°F.), 17 minutes.
 13. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
 14. Dip in chromic acid solution (S.N. 34-34-62, Sch. ID), 1-2 seconds.
 15. Rinse in running water with agitation, 30 seconds.
 16. Rinse in deionized water.
 17. Dip in acetone (A55) with agitation, 5-10 seconds.
 18. Dry.
 19. Deliver to Inspection.



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HYDROCHLORIC ACID SAFETY PRECAUTIONS: See 33-2-7C.
 POTASSIUM CYANIDE SAFETY PRECAUTIONS: See 33-2-13A.
 CHROMIC ACID SAFETY PRECAUTIONS: See 33-2-7B.

SCHEDULE NO. 6 (Initially for MP6006 cathode return condenser threaded tubing of 5831)

- a. Material: 18-8 Stainless Steel.
- b. Plating Surface: 0.07 sq. ft.
- c. Procedure: Same as Schedule No. 5 except for following conditions:
 Rack on small parts rack or 0.050" dia. nickel wire.
 Nickel strike, 5.5 amp./part.
 Copper strike, 2 amp./part.
 *Copper plate, 0.00025", 2 amp./part, 5 minutes.

SCHEDULE NO. 7 (Initially for MP6008 cathode water seal ring of 5831)

- a. Material: 18-8 Stainless Steel.
- b. Plating Surface: 0.2 sq. ft.
- c. Procedure: Same as Schedule No. 5 except for currents. Use following currents -

Nickel strike	16 amp./part
Copper strike	6 amp./part
Copper plate	6 amp./part

SCHEDULE NO. 8 (Initially for MP6011 envelope master ring of 5831)

- a. Material: Nickel Plating on Carpenter 883 Tool Steel.
- b. Plating Surface: 0.5 sq. ft.
- c. Procedure:
 The following is the second part of a continuous schedule which starts with nickel plating, S.N. 34-36-64, Sch. 3. Continue without interruption of the cycle from the nickel plating schedule to this schedule.
 1. Dip in hot 50% solution of hydrochloric acid (A15), 51-66°C. (125°-150°F.), 5 seconds.
 2. Rinse in running water with agitation, 30 seconds.
 3. Dip in 5% solution of potassium cyanide (P60), 1-2 seconds.
 4. Rinse in running water with agitation, 30 seconds.
 5. Copper strike, make contact with flexible lead before immersing, 15 amp./part, 60-71°C. (140-160°F.), 30 seconds.
 6. Copper plate to thickness of 0.00075", cathode agitation, 15 amp./part (30 amp./sq. ft.), 79-85°C. (175-185°F.), 13 minutes.
 7. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
 8. Dip in chromic acid solution (S. N. 34-34-62, Sch. ID), 1-2 seconds.

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BLACOSOLV SAFETY PRECAUTIONS: See 33-2-11C.
 HYDROCHLORIC ACID SAFETY PRECAUTIONS: See 33-2-7C.
 POTASSIUM CYANIDE SAFETY PRECAUTIONS: See 33-2-13A.
 CHROMIC ACID SAFETY PRECAUTIONS: See 33-2-7B.

SCHEDULE NO. 8 (Cont.)

c. Procedure: (Cont.)

9. Rinse in running water with agitation, 30 seconds.
10. Rinse in deionized water.
11. Dip in acetone (A55) with agitation, 5-10 seconds.
12. Dry.
13. Deliver to Inspection.

SCHEDULE NO. 9 (Initially for MP6014 anode top flange of 5831)

a. Material: Low Carbon Steel.

b. Plating Surface: 0.3 sq. ft.

c. Procedure:

1. Degrease in hot Blacosolv.
2. Rack on about 1/8" dia. copper or nickel wire through non-threaded hole.
3. Electroclean, anodic, 4-6 v., 82-93°C. (180-200°F.), 1 minute, S. N. 34-34-74.
4. Rinse in warm running water with agitation, 38-66°C (100-150°F.), 30 seconds.
5. Dip in hot 50% solution of hydrochloric acid (A15), 51-66°C. (125-150°F.), 5 seconds.
6. Rinse in running water with agitation, 30 seconds.
7. Dip in 5% solution of potassium cyanide (P60), 1-2 seconds.
8. Rinse in running water with agitation, 30 seconds.
9. Copper strike, make contact with flexible lead before immersing, 9 amp./part, 60-71°C. (140-160°F.), 30 seconds.
10. Copper plate to thickness of 0.0015", cathode agitation, 9 amp./part (30 amp./sq. ft.), 79-85°C. (175-185°F.), 26 minutes.
11. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
12. Dip in chromic acid solution (S.N. 34-34-62, Sch. ID), 1-2 seconds.
13. Rinse in running water with agitation, 30 seconds.
14. Rinse in deionized water.
15. Rinse in acetone (A55) with agitation, 5-10 seconds.
16. Dry.
17. Deliver to Inspection.



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HYDROCHLORIC ACID SAFETY PRECAUTIONS: See 33-2-7C.
POTASSIUM CYANIDE SAFETY PRECAUTIONS: See 33-2-13A.
CHROMIC ACID SAFETY PRECAUTIONS: See 33-2-7B.

SCHEDULE NO. 10 (Initially for R6745 grid pantograph lamination of 5831)

a. Material: 18-4-1 High Speed Steel.

b. Procedure:

1. Parts should be sandblasted and have 1/4" hole drilled near one end.
2. Rack through hole on copper wire. Pinch part firmly with wire.
3. Electroclean, anodic, 4-6 v., 82-93°C. (180-200°F.), 1 minute, S.N. 34-34-74.
4. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
5. Dip in hot 50% solution of hydrochloric acid (A15), 51-66°C. (125-150°F.), 5 seconds.
6. Rinse in running water with agitation, 30 seconds.
7. Dip in 5% solution of potassium cyanide (P60), 5-10 seconds.
8. Rinse in running water with agitation, 30 seconds.
9. Copper strike, make contact before immersing part, 0.73 amp./sq.in., 60-71°C. (140-160°F.), 30 seconds.
10. Copper plate to thickness of 0.003", fasten to cathode bar with clip, cathode agitation, 0.73 amp./sq.in. (30 amp./sq. ft.), 79-85°C. (175-185°F.), 52 minutes.
11. Rinse in warm running water with agitation, 38-66°C. (100-150°F.), 30 seconds.
12. Dip in chromic acid solution (S.N. 34-34-62, Sch. ID), 1-2 seconds.
13. Rinse in running water with agitation, 30 seconds.
14. Rinse in deionized water.
15. Rinse in acetone (A55) with agitation, 5-10 seconds.
16. Dry.
17. Deliver to Inspection.
18. Magne-gage and record reading.