1087

High Speed, High Phosphorus Electroless Nickel

Product Codes: 1087-M (3061), 1087-R (3062), 1087-N (3063)

1. PERFORMANCE

OVERVIEW

Acculabs 1087 is a highly stable, simple-to-operate electroless nickel process that deposits a smooth, bright, high-phosphorus coating on a variety of substrates. The deposit contains 10-12% by weight phosphorus, providing excellent corrosion resistance across a broad range of applications. The Acculabs 1087 process is tolerant of many typical impurities, is designed for a high rate of deposition and long service life, and is well suited for production facilities where maximum economy of operation is required. Properly applied deposits of Acculabs 1087 meet specifications MIL-C-26074, AMS 2404, AMS 2405, and ASTM B-733.

FEATURES & BENEFITS

SPECIFICATION COMPLIANCE	Meets MIL-C-26074, AMS 2404, AMS 2405, and ASTM B-733 -- supports qualification and approval requirements for aerospace, defense, and precision-engineering applications without additional process development.
HIGH PHOSPHORUS DEPOSIT (10-12%)	The 10-12 wt% phosphorus content delivers superior corrosion resistance compared to mid- or low-phosphorus EN, and produces a non-magnetic deposit as-plated -- enabling use in applications where magnetic response must be avoided.
HIGH DEPOSITION RATE	Optimum plating rate of 12-18 micron/hr (up to 23 micron/hr) reduces cycle times and improves throughput relative to lower-rate EN processes -- supporting production operations where economy of time is critical.

EXCELLENT HARDNESS AND WEAR RESISTANCE	As-plated hardness of 500-600 HK100 increases to 850-950 HK100 after heat treatment at 750 degrees F (400 degrees C) for 1 hour -- enabling replacement of hard chrome in selected wear and friction applications.
STABLE, LONG-LIFE BATH	Tolerant of many typical process impurities; titratable nickel and hypophosphite concentrations are maintained by the 1087-N/1087-R replenishment system -- minimizing bath change-out frequency and maximizing productive bath life.
ECONOMICAL CONCENTRATED COMPONENTS	Three-component system (1087-M, 1087-N, 1087-R) used at low make-up volumes (7-15% v/v); concentrated formula reduces freight, storage, and chemical cost per unit of production output.

DEPOSIT PROPERTIES

Property	Typical Value
Density	7.8 g/cm3
Phosphorus Content	10-12%
Melting Point	890 degrees C (1630 degrees F)
Hardness -- As Plated	500-600 HK100
Hardness -- Heat Treated (750 degrees F / 400 degrees C, 1 hr)	850-950 HK100
Ductility	1.0% Elongation
Wear Resistance -- As Plated	20-25 TWI
Wear Resistance -- Heat Treated (750 degrees F, 1 hr)	10-15 TWI
Magnetic Tendency (as plated)	Non-magnetic
Electrical Resistivity	75-100 micro ohm/cm
Corrosion Resistance	Passes nitric acid test

2. PROCESS SETUP & OPERATIONS

PROCESS COMPONENTS

Component	Product Code	Function	Make-Up Addition	Replenishment
1087-M	3061	Reducer and complexor	15% v/v	Up to 5% v/v per MTO for complexor loss (high-dragout lines)
1087-N	3063	Nickel-bearing component	7% v/v	7% v/v per metal turnover (MTO)
1087-R	3062	Reducer and stabilizer	--	7% v/v per metal turnover (MTO)

EQUIPMENT REQUIREMENTS

Component	Specification
Plating Tank	Natural high-density polypropylene or anodically protected 316 stainless steel
Heating	Steam or hot water via externally mounted heat exchanger; or internally mounted stainless steel derated or PTFE-coated immersion heaters
Agitation	Circulation pump, cathode agitator rod, or clean mild air from an air blower
Filtration	Continuous through a 1-micron filter at 10 tank volumes per hour; bag or cartridge filters

MAKE-UP COMPONENTS

Tank Volume	1087-N	1087-M	DI Water
100 gallons	7 gallons	15 gallons	Balance to working volume
100 liters	7 liters	15 liters	Balance to working volume

MAKE-UP PROCEDURE

1. Clean and passivate the plating tank using a 30-50% nitric acid solution for 4-8 hours. Rinse the tank thoroughly after passivating. The tank must be completely free of all traces of nitric acid -- use nitrate test strips to confirm.
2. Fill the clean plating tank to approximately half of its working volume with deionized water.
3. Add the required amount of Acculabs 1087-M and mix well.
4. Add the required amount of Acculabs 1087-N and mix well.
5. Fill the tank to its final operating level with deionized water and mix thoroughly.
6. Measure the solution pH and adjust to the working range as needed. Use dilute sulfuric acid (10% by volume) to lower pH, or dilute ammonium hydroxide (50% by volume) to raise pH.
7. Heat to operating temperature. The bath is now ready for operation.

BATH OPERATION & CONTROL

Parameter	Range	Optimum
Nickel Concentration (g/L)	5.4-6.0	6.0
Nickel Concentration (oz/gal)	0.72-0.80	0.80
Nickel Activity	90-100%	100%
Hypophosphite Concentration (g/L)	33-42	37.5
Hypophosphite Concentration (oz/gal)	4.4-5.6	5.0
Hypophosphite Activity	85-115%	100%

Parameter	Range	Optimum
Temperature	185-195 degrees F (85-91 degrees C)	190 degrees F (88 degrees C)
pH	4.4-5.2	4.6-5.0
Replenishment Ratio	1 part 1087-N to 1 part 1087-R (7% v/v per MTO)	--
Plating Rate (micron/hr)	10-23	12-18
Plating Rate (mil/hr)	0.4-0.9	0.5-0.7
Bath Loading (dm2/L)	0.25-2.5	1.2
Bath Loading (ft2/gal)	0.1-1.0	0.5

Maintain the nickel and sodium hypophosphite concentrations at 90-100% activity to achieve consistent deposit quality and plating rate. Replenishment additions may be made while parts are plating; however, for best results additions should be made away from parts, in 5-10% activity increments. Many smaller additions are preferred over fewer large additions. Measure pH after replenishment additions have been completed and the solution stirred well. Adjust pH upward with dilute ammonium hydroxide (50% by volume) or downward with dilute sulfuric acid (10% by volume) as needed.

REPLENISHMENT GUIDE

mL EDTA (0.0575M)	Nickel Activity (%)	Nickel (g/L)	1087-N (mL/gal)	1087-N (gal/100 gal)	1087-R (mL/gal)	1087-R (gal/100 gal)
8.9	100	6.0	0	0	0	0
8.5	95	5.7	13	0.35	13	0.35
8.0	90	5.4	27	0.70	27	0.70
7.6	85	5.1	40	1.05	40	1.05
7.1	80	4.8	53	1.40	53	1.40

NOTE: It is extremely important to follow the above replenishment recommendations to maintain continuous successful operation. Nickel concentration is determined using the EDTA titration procedure in the Analytical Methods section.

NOTE: If hypophosphite concentration is low due to under-loading or extended idle periods while the solution is hot, restore concentration by one of the following: (1) Slightly increase the 1087-R addition ratio until hypo returns to range -- a starting ratio of 1 part 1087-N to 1.2 parts 1087-R is a good starting point. (2) Add 1087-M at a maximum of 5% by volume per addition; each 1% v/v addition of 1087-M increases hypophosphite concentration approximately 2.2 g/L.

GENERAL OPERATING NOTES

All plating equipment must be resistant to nickel build-up on surfaces in direct contact with the solution, resistant to nitric acid, and capable of continuous operation at temperatures up to 200 degrees F. Tanks fabricated from natural high-density polypropylene or 316 stainless steel with anodic protection are recommended. Proper pretreatment is critical to successful electroless nickel application -- surfaces must be thoroughly clean and free of oxides before plating. Electroless nickel solutions are sensitive to contamination: do not share plating equipment or pretreatment solutions with other finishing processes. Use deionized water exclusively for bath make-up and volume adjustments. After each passivation cycle, rinse the plating tank and all accessory equipment thoroughly to remove all traces of nitric acid. On lines with high dragout or frequent tank transfers, add 1087-M at 0.25-0.5% v/v per metal turnover to compensate for complexor loss.

ANALYTICAL METHODS

NICKEL CONCENTRATION (EDTA / MUREXIDE TITRATION)

1. Pipette a 5 mL cooled sample of the Acculabs 1087 bath into a 250 mL Erlenmeyer flask.
2. Add approximately 100 mL of deionized water and 10 mL of ammonium hydroxide.
3. Add a small amount (pinch) of murexide indicator to produce a yellow/brown color.
4. Titrate with 0.0575M EDTA to a purple endpoint.
5. Calculate: (mL of EDTA) x 0.674 = g/L Nickel Metal
6. Or: (mL of EDTA) x 11.25 = % Nickel Activity

SODIUM HYPOPHOSPHITE (IODOMETRIC TITRATION)

1. Pipette a 5 mL cooled sample of the Acculabs 1087 bath into an Erlenmeyer flask.
2. Add 25 mL of 6N hydrochloric acid.
3. Pipette exactly 50 mL of 0.1N iodine using a 50 mL pipette. Do NOT use a graduated cylinder -- graduated cylinders are not accurate enough to give a reliable result.

4. Stopper the flask and set in the dark for 45 minutes.
5. After 45 minutes, remove the flask from the dark and immediately titrate with 0.1N sodium thiosulfate to a colorless endpoint.
6. Calculate: g/L sodium hypophosphite monohydrate = (mL 0.1N iodine -- mL 0.1N sodium thiosulfate) x 1.06
7. Or: oz/gal sodium hypophosphite monohydrate = (mL 0.1N iodine -- mL 0.1N sodium thiosulfate) x 0.141

3. HANDLING & COMPLIANCE

WASTE TREATMENT

Spent Acculabs 1087 solutions are acidic and contain nickel salts. These solutions must not be discharged directly into a sewage system without proper treatment in accordance with applicable local, state, and federal regulations. The complexing agents present in electroless nickel solutions make conventional waste treatment more difficult when mixed with wastes from other finishing processes -- treat spent 1087 baths separately from other finishing waste streams. Contact your Acculabs representative for specific waste management options. Prior to implementing any waste treatment approach, confirm compliance with all applicable local, state, and federal regulations, which take precedence over any Acculabs recommendations.

SAFETY & HANDLING

When handling Acculabs 1087 liquid concentrates and working solutions, wear rubber gloves, safety glasses, and a chemical-resistant apron at all times. Wash thoroughly after handling. Provide adequate ventilation in the area around the plating tank during operation. In case of eye or skin contact, immediately flush with large amounts of water for at least 15 minutes. Read and review the Safety Data Sheet (SDS) for each component (1087-M, 1087-N, 1087-R) before use and ensure all applicable health, environmental, and safety regulations and standards (OSHA, NIOSH, ACGIH, NFPA) are met.

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Refer to the applicable Safety Data Sheet (SDS) for detailed information regarding safe handling, storage, and emergency measures prior to use.