

AUTONIC LX, 830

**Low-Phosphorous, 2-4% P,
High-Hardness, Functional Deposit,
ASTM B733 Type III**

PROCESS: AUTONIC LX process provides a functional, non-brightened, low-phosphorus (1-3 %P) electroless nickel deposit. The process designed for high production processing in engineering applications. The AUTONIC LX process represents extensive research and development in electroless nickel technology, combining industry requirements and unique advanced chemistry.

FEATURES:

AUTONIC LX is a low-phosphorus producing electroless nickel process incorporating a unique mixture of carboxylic acids and advance organo-metallic stabilizers to produce an exceptionally low phosphorus, hard, wear resistant deposit. The plating rate for the AUTONIC LX is 0.6 to 0.9 mil/hour.

AUTONIC LX 1 Mil Deposits have been tested in Neutral Salt Spray in accordance to ASTM B117 for over 240 hours with no red rust or substrate corrosion.¹

AUTONIC LX Deposit provides increased as plated hardness and improved wear resistance to metal parts in a wide range of environments. Typical hardness values are 640-820 Knoop at 100 g load (KHN100) in the as plated condition and 895-985 (KHN100) in the heat-treated condition of Mil-C-26074D, Class 2. As plated Hardness values have been greater than 68 Rc.

AUTONIC LX process is designed for high production operations with simplicity and ease of operations. Replenishment of the process involves the use of two chemicals, AUTONIC LXPC and AUTONIC LNS, Liquid Nickel Sulfate. The products are liquid and can be added to the process while plating. These additions will maintain all the constituents and pH of the process providing for 10 plus metal turnovers of processing.

AUTONIC LX process is stable and is capable of passing a 120 second palladium stability test. Typical electroless nickel solutions will only pass 5 to 10 seconds.

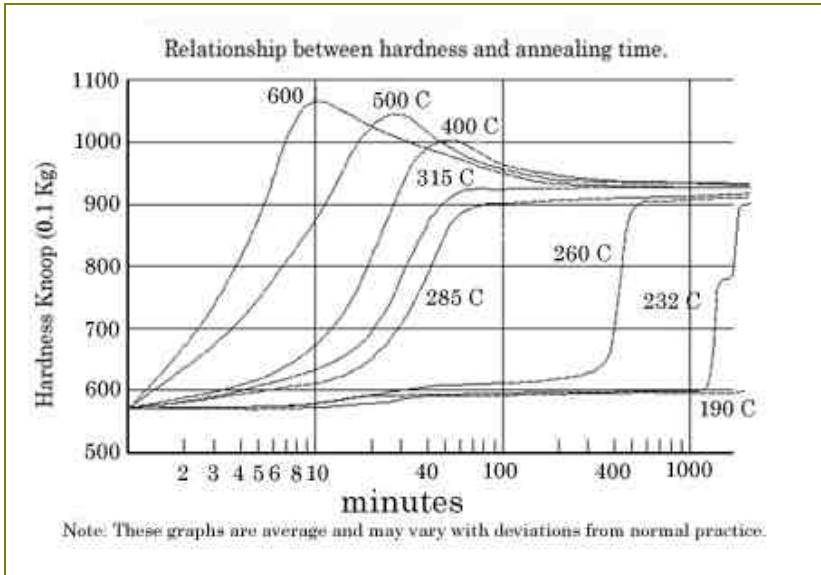
AUTONIC LX processes have been formulated for ease in waste treatment providing a process that can be plated down to less than 1 ppm.



Photo: 1Zirconia foam plated with AUTONIC LX

¹ Corrosion protection of steel substrates is very dependent on the pretreatment and nature of the substrate surface.

DEPOSIT PROPERTIES AUTONIC LX DEPOSIT



Electroless Nickel Deposits can be classified into four types. The LX deposit is low in phosphorus and has a significantly higher as plated hardness. This is caused by the formation of larger grains of nickel (111) in the as plated state. Upon heat treatment the precipitation products remain large and then recrystallize after 400 C for one hour becoming softer. The LE, LX, and LZ coatings are harder and provide nearly similar corrosion protection in the as plated condition to other AUTONIC processes due to the inherent low porosity of electroless nickel.

PHYSICAL

Bond Strength to Steel	90,000 PSI - 620 MPa
Bond Strength to Aluminum	45,000 PSI - 310 MPa
Elongation	0.1 to 0.2 %
Tensile Strength	30 - 60 KSI
Internal Stress	2.5-4 KSI Compressive as plated
Coefficient of Expansion	1.2 to 1.4 X 10 ⁻⁵
Melting Point	881° (C)
Electrical Resistivity	25 - 55 X 10 ⁻⁶ ohm-cm

COMPOSITION

Nickel	Balance
Phosphorus	2% to 4.5%
Trace	0.15 or less

HARDNESS

600 - 760 KHN_{100g} As Plated
 895 - 985 KHN_{100g} Heat treated 700° (F) for 1 hour

STRUCTURE

In the as plated condition the deposit is amorphous. Upon heating to 220° (C) the deposit will start to crystallize and NiP₃ will form. The amount and orientation of the nickel will control the physical properties of the deposit.

CORROSION RESISTANCE

The AUTONIC LX deposit has good corrosion resistant in many industrial environments. For maximum protection use the HX deposit.

Porosity

Ferroxyl on steel panels with 1 mil Passes with no blue spots
 ASTM B117 Neutral Salt on steel panels with 1 mil Passes 24 hours.

WEAR RESISTANCE

AUTONIC LX deposits are hard and resistant to abrasion and adhesive wear applications. Typical wear rates for the coating are 4 to 10 mg/1000 cycles. Taber Abrader for the as plated condition and 2 - 6 gm/1000 cycles for the precipitate hardened deposits.

OPERATING THE AUTONIC LX PROCESS

The AUTONIC LX Process is designed for ease of operations and process control. To operate the process the plater must be able to check the nickel concentration and pH and make adjustments to the process as required.

The plating process is operated in a specially designed process tank. This tank heats the solution to 90° C and filters it through a 5 micron bag at 10 to 20 times the volume of the tank each hour.

To maintain an efficient operation, the solution should be heated with a low-density heat source and parts should be loaded when the operating temperature is reached. When all the parts are processed for the day the heat should be reduced to below 50° C with the filter operating and air agitation off.

The AUTONIC Series processes use AUTONIC LNS, carbon treated and submicron filtered Liquid Nickel Sulfate to insure optimum process performance.

While the process is operating, the parts will consume nickel ions and reducing agent, thereby requiring their replacement to maintain the plating reaction. The amount of nickel consumed is generally measured in metal turnovers where 1 cycle is equal to a 100% replacement of the nickel metal in the original solution. The amount of reducing agent used is dependent on the amount of nickel consumed and will be replaced when the addition of AUTONIC LXPC is made.

TABLX 1, AUTONIC LX MAKE-UP FORMULA

Products	1 liter	Tank Volume gallons					
		100	150	200	250	300	500
AUTONIC LXPA	100 ml/l	10	15	20	25	30	50
AUTONIC LNS (5#/gal)	50 ml/l	5	7.5	10	12.5	15	25

PROCEDURES FOR MAKING UP A NEW AUTONIC LX SOLUTION

1. Fill approximately 2/3 of the final working volume of cold deionized water into a clean plating tank.
2. Add the AUTONIC LXPA to the plating tank.
3. Fill the tank to 95% percent volume with Deionized water.
4. Add the AUTONIC LNS and mix.
5. Record the new solution in a process log.
6. Start using your New AUTONIC Solution

TABLE 2, SUMMARY of OPERATING CONDITIONS

				Control Point	
Nickel Metal	6.6 g/l	6.6 g/l	4.5 g/l	5.8 g/l	.5 - 4 hr.
Hypophosphite	14 g/l	18 g/l	10 g/l	14 g/l	4 - 8 hr.
pH(Electrometric	5.1	5.4	4.9	5.1	.5 - 2 hr.
Temperature (C,)	91	95	89	91	.5 - 2 hr.

PROCESS CONDITIONS and OPERATIONS

The AUTONIC LX process is simple to operate. A list of operating conditions can be found in TABLE 2. The major control is provided by checking for nickel using an EDTA Titration and from the results computing an addition of AUTONIC replenisher concentrates. These additions will maintain the chemistry, adding all the necessary chemicals to sustain the reaction. This procedure is required every time the solution uses 10% to 20% of the available nickel metal.

The Temperature and pH are also important in sustaining the reaction and therefore should also be controlled. The temperature causes the reaction to proceed and ultimately controls the thickness of the plating. While the pH effects the alloy and plating rate and will also effect the thickness of the plating.

In TABLE 2 the Upper Control Limit (UCL), Lower Control Limit (LCL), Control Point and recommended frequency of analysis are given. By adhering to these control points you will be able to produce consistent quality and high performance at the lowest possible cost.

TABLE 3, ADDITION SCHEDULE for AUTONIC LX Process

Volume of Tank Gallons									
Concentration Ni	6.6	6.2	5.8	5.4	5.0	4.6	4.2	3.8	g/l
Percentage	100	93	88	81	75	69	63	57	%
EDTA Na ₂ mls	10	9.3	8.8	8.1	7.5	6.9	6.3	5.7	
100 gal									
AUTONIC LXPC	0	0.7	1.2	1.9	2.5	3.1	3.1	3.1	gal
AUTONIC LNS	0	0.3	0.6	0.8	1.2	1.5	1.5	1.5	gal
250 gal									
AUTONIC LXPC	0	1.8	3.0	4.8	6.3	7.8	7.8	7.8	gal
AUTONIC LNS ²	0	0.9	1.5	2.4	3.1	3.8	3.8	3.8	gal

² AUTONIC LNS is concentrated liquid nickel sulfate that has been purified to contain less than 1 ppm of heavy metals while the nickel sulfate concentration is 5 lbs/gal.

GETTING THE MOST OUT OF YOUR AUTONIC LX PROCESS

1. The solution operates most efficiently when it is plating with a load of between 30 to 90 square inches per gallon with mechanical agitation. Reducing the loading, operating with a larger volume, will improve operations generally.
2. Possible contaminants from the shop or parts should be controlled as much as possible. These contaminants can be in the form of organics, metals, or solid materials. They can be airborne, on the part, or waterborne. A clean shop with processes that are maintained correctly will help insure excellent operations and maximum performance of the deposit with minimum costs of operations. Cleanliness is important especially in facilities that contain a variety of processes and other soluble metals.
3. The AUTONIC Process will produce the most consistent deposits when it is operated in the 80% to 90% activity range. To operate in this range it is advisable to have the person who is plating, titrate and make the additions.
4. The AUTONIC Process is designed to be operated with continuous filtration through a 1 to 5 micron bag. It is advisable for the pump filter system be sized to move 20 times the volume of the solution in one hour. This high filtration will remove any unwanted particles which may have be in the process and insure that as the solution ages and at boiling the pump will still be providing in excess of 10 turnovers per hour.
5. While it is possible to plate to over 10 MTOs with this solution it is recommended that when the process reaches about 450% or 4.5 MTOs you should consider plating the solution down to 50%, destructing the solution and making up a new solution. With this type of approach you will be able to operate at the most economical point, using nearly 95% of all the nickel while still maintaining excellent deposit properties. Iron and zinc commonly build up in the solution and along with orthophosphite add stress and reduced corrosion protection to the deposit.

DAILY CARE

1. Cover the tank when you are not loading or unloading the tank.
2. Strip the tank with 20% to 30% nitric acid at the end of the production run if any significant nickel has plated onto the sides or bottom. This will help eliminate roughness and the significant loss of chemicals. After stripping the tank and piping you should always rinse and neutralize the system of nitric with a dilute solution of ammonium hydroxide. If nitric acid is present in the solution a dull or streak deposit may develop.
3. Turn off the heat when the solution is not going to be used for several hours. Prolonged heating with air agitation and no work in the tank will cause a slight oxidation of the reducing agents and subsequently reduce the efficiency of the process.
4. Always check the pH when you test for nickel. The results should be noted in a log and any correction required should be made using dilute sulfuric acid or ammonium hydroxide.

GENERAL EQUIPMENT INFORMATION

Filtration - Continuous filtration 20 times the volume per hour through 1 to 5 micron polypropylene filter bag that is elevated above the solution is recommended. This produces a pressure differential to cause filtration and removes the high concentration of heat from the filter area.

With the bag elevated, any plateout or activity in the solution can be detected and corrective action taken before a problem is evident. While plating cast iron, magnesium or zinc diecast parts the bag may become dark evidencing spitout and plateout. With proper filtration and an observant operator the bag can be changed before the solution has a problem.

Tank and Materials of Construction - All tanks, piping, racks and carriers that come in contact with the solution should be made of PVDF, Polypropylene, 316LC Stainless Steel, or Kynar. The electroless nickel solution and stripping solutions are corrosive and care should be taken to prevent contact with electrical and mechanical systems.

Agitation - Mechanical agitation is recommended when the process is operating. A minimal loss of about 5% per day of reducing agent will occur when using air agitation. This loss can be minimized by not operating the air agitation and heaters when the tank is free of work. Prolonged heating and air will accelerate the oxidation of sodium hypophosphite.

Ventilation - The vapor from AUTONIC LE plating process is inherently corrosive due to the high concentration of salts in the material. All ventilation equipment should be constructed with polypropylene, PVC or fiberglass to insure good equipment life and a healthy area for the platers.

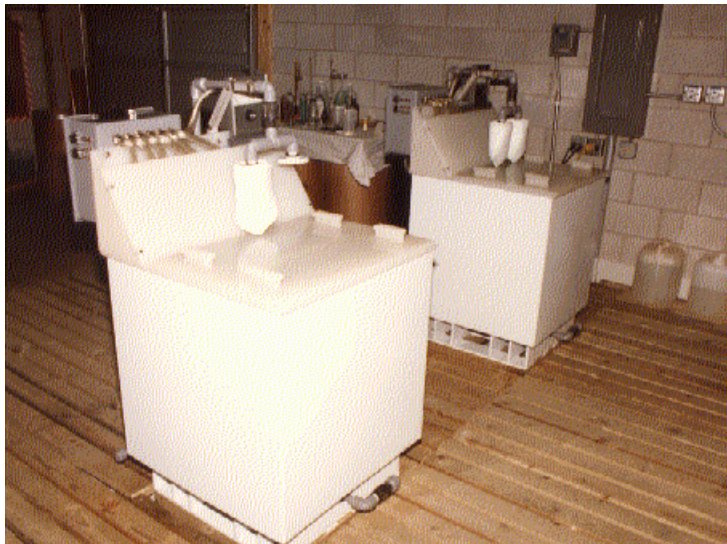


Figure 1 Twin tank EN system

CAPABILITY INDEXES & FAX Service

Producing Quality plating requires a team effort by many people. Having the products made to high standards means that every step of the details are addressed.

One means of establishing this attention to detail is the use of Capability Indexes. This technique establishes the amount of performance variation that is occurring in the manufacturing process. By tracking this variation and controlling it the process of manufacturing always yields quality products.

For users of AUTONIC that rely on statistical process control internally and for purchasers of the coating we will provide capability indexes on a monthly basis.

HANDLING

AUTONIC LXPA, LXPC are neutral pH products and are quite safe under almost all conditions. The solutions should not be taken internally and if contact with skin has occurred should be washed with copious amounts of. Wash with copious amounts of water while scrubbing well with soap and warm water. (see MSDS)

STORAGE

AUTONIC LX products are concentrated and will freeze. The temperature should remain above 38o (F). Products should be shipped in heated trailers during the winter months.

MSDS, Material Safety Data Sheets

MSDS Sheets are available upon request from our facilities in Long Beach, California. Call or write (562) 437-0541 and specify mail or FAX for return.

ORDERS

Orders are accepted by phone (800) 266-0541, by mail and by FAX (562) 437-8632. Specify trucking company and delivery date required.

TERMS

AUTONIC Products are sold FOB, Long Beach at NET 30days unless otherwise specified at the time of shipment. Annual contracts and purchase agreements are available to provide secure prices and delivery of materials. Consult Stapleton Technologies for further details.

NON-WARRANTY

The information contained in this Data Sheet is believed by Stapleton Technologies to be accurate, true and complete. Since, however final methods for use of this product are in the hands of the customer and beyond our control, we cannot guarantee that the customer will obtain the results described in this Data Sheet, nor can we assume any responsibility for the use of this product by the customer in any process which may infringe the patents of third parties.