ENFINITY HB

Functional, High Phosphorus Nickel.
ASTM B733 Type V

ENFINITY HB is a semi-brightened, high-phosphorus electroless nickel process designed for critical corrosion and wear applications requiring heavy build-up. The ENFINITY HB process produces a plating rate of 0.3 to 0.4 mils per hour and provides superior mechanical and physical properties.

Applications for these coatings include pipe and tubular goods, hydraulic cylinders, oil and gas environments, marine and aggressive industrial environments.

The ENFINITY HB process incorporates a revolutionary chemistry that provides for a perpetual process operation. This produces an environmentally clean system and a constant high purity chemistry that yields a superior deposit for high production processing.

FEATURES:

ENFINITY HB is a high-phosphorus electroless nickel process using advance Transition type stabilizers to produce an exceptionally poor free and corrosion resistant 11.0 to 13.5 percent phosphorus alloy. The deposit meets the requirements of ASTM B733 Type V for all Service Conditions and Classes.

ENFINITY HB Deposit provides wear and corrosion resistance to metal parts in a wide range of environments. Typical hardness values are 460-490 Knoop (KH100) in the as plated condition and 885-980 (KH100) in the heat treated condition of Mil-C-26074C, Class 2.

ENFINITY HB process is used with the assistance of the purification units. These machines are used to remove the unwanted by-products and replenish the operating solution. There are two products used in replenishing the ENFINITY HB Process. These are ENFINITY HBIR and ENFINITY Purifier.

ENFINITY HB process is operated with the PU system. This unit purifiers the operating plating solution of unwanted by-products which are always building in the electroless solution. This feature produces several significant benefits.

The PU1 and PU3 also provide the plater with an accounting of solution chemistry, machine condition and communication to Stapleton. The later is used to send requests for service and receive lab reports and equipment maintenance

Providing Quality Electroless Nickel Plating Processes since 1960

BENEFITS:

- High Phosphorus 11 - 13.5%
- Corrosion Resistance 1000+hours
- Moderate Plating Rate 0.3-0.4 mils/hr
- Un-limited Solution Life 8000 MTOs
- Equivilant Cycles 1.5-1.8 cycles
- Elimination of Hazardous Waste

ENFINITY HB DEPOSIT PROPERTIES SUMMARY

ENFINITY Process is different from all other types of electroless nickel processes. In the ENFINITY chemistry both the sodium and sulfate ions are eliminated from the chemistry. The ENFINITY process also eliminates the byproduct trace metals and Orthophosphite with a precipitation and filtration procedure. This is accomplished with a piece of equipment called a purification unit (PU). These changes provide for a process which remains free of unwanted trace elements and salts thereby improving quality by reducing deposit stress and improving adhesion and improving overall process efficiency and rinsing.

The purification unit works by removing a small amount of plating solution (REMOVAL) for each 5 to 10% of nickel metal plated from the process. This removed material is added to a heal in the process and treated and filtered, removing the unwanted by-products and trace elements. After the material (RECOVERY) has been treated it is returned to the plating process for continued use. A replenishment (REPLENISHER) is added back to the process to replace the nickel that has been consumed on the parts.

The ENFINITY EN process uses a number of products. The following list of materials are used in the process:

Table 1, SUPPLIES for ENFINITY EN

Name - Description	Unit of Measure	P Code
ENFINITY HB Makeup	GALLON/LITRE 5, 55, 275	HBIA3-CA
ENFINITY HB Replenisher	GALLON/LITRE 5, 55, 275	HBIR3-CA
ENFINITY HB Control	GALLON/LITRE 1, 5 gallons	HBIC2-CA
ENFINITY Purifier	POUNDS/KILO	INFP2-CA
ENFINITY Reducer	GALLON/LITRE (Optional)	H7933-CA

In addition to these materials the ENFINITY Facility will need to have on hand ammonium hydroxide and deionized water.

There are several benefits to this innovative chemistry. First, the ENFINITY solution remains in a near new condition for several hundred metal turnovers, MTOs, and is possible of going several thousand. Quality of deposit, deposit stress, adhesion on aluminum, rinsing, plating rate are all directly benefited. Secondly, the overall costs are lower through the elimination of waste treatment and hazardous waste management and the elimination of making up new solutions.

DEPOSIT PROPERTIES

Electroless Nickel Deposits can be classified into four types. These are based on the percent of phosphorus and structure of the deposit. ASTM B733 describes these as Types and makes the following classifications:

Table 2, Electroless Nickel Alloy Types

Alloy Type ASTM B733	Phosphorus %wt	ENFINITY	AUTONIC/MICRO
I	0-14	All	All
II	1-3		282SX. LE
III	2-4		LX,LB
IV	5-9	MX,MB	MX, MB
V	10-+	HX,HB	HX, HB

The HB and HX processes provide a 11.5% to 13% phosphorus percent alloy and are free of Ni(111) both before and after heat treatment. These coatings are more corrosion resistant to most environments and are non-magnetic.

PHYSICAL PROPERTIES ENFINITY HB

Bond Strength to Steel	90,000 PSI - 620 MPa
Bond Strength to Aluminum	45,000 PSI - 310 MPa
Elongation	0.4 to 0.8 %
Tensile Strength	60 - 90 KSI
Internal Stress	0.5 KSI Tensile as plated
Thermal Coefficient of Expansion	1.2 to 1.4 X 10^{-5} degree $^{-1}$
Melting Point	881 (C)
Electrical Resistivity	80 - 110 X 10^{-6} ohm-cm

COMPOSITION

Nickel	Balance
Phosphorus	11.5% to 13.5%
Trace	0.05 or less

HARDNESS

420 - 470 KHN100g As Plated
885 - 980 KHN100g 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. There are kinetic effects that will determine the degree of precipitation over time. Shorter times at higher temperature may resist precipitation while longer times at low temperature will enhance precipitation.

CORROSION RESISTANCE

The ENFINITY HB deposit has excellent corrosion resistant in many industrial environments.

	Electrochemical	Immersion
Water, Brine 3.5% NaCl & Sat. CO2	9.8 mpy	5 mpy
Water, Brine 3.5% NaCl & Sat H2S	0.02 mpy	nil
Water, Sea 3.5%	0.08 mpy	nil

(for a complete list of corrosion rates see "State of the Science")

Porosity Ferroxyl on steel panels with 1 mil Passes with no blue spots. ASTM B117 Neutral Salt on steel panels with 1 mil has Passed 20,000 hours.

WEAR RESISTANCE

Taber Abrader wear rates for the coating are 12 to 16 mg/1000 cycles as plated and 6 - 12 gm/1000 cycles for the precipitate hardened deposits

OPERATIONS

The ENFINITY HB 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 either enter the information into the purification unit or make manual adjustments over the side.

The ENFINITY Process is like all electroless nickel plating processes and requires a specially designed process tank. This tank heats the solution to 92 [C] and filters it through a 1 or 5 micron filter at 10 to 20 times the volume of the tank each hour.

To maintain an efficient operation, the solution should be heated with an external steam heat exchanger or low watt density electric heaters. The parts should be loaded after 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.

An hourly or more frequent analysis and addition schedule should be implemented. This analysis involves the titration for nickel metal in solution and a measurement of pH. Based on the results an addition is made to bring the process into control.

There are four ways to purify the process.

Manual methods have been used for many years requiring a vacuum filter. This technique is useful in laboratory operations.

PU1 method uses an automated vacuum filter that indexes paper through the filter chamber and dumps the orthophosphite cake into a tote, Solutions are automatically removed, cooled, reacted, filtered, and returned to the process.

PU2 method uses a semi- automated vacuum filter that is manually charged with purifier and manually unloaded. This unit removes, cools, reacts, filters and returns the treated solution back to the process.

PU3 method uses a fully automatic pressure filter which measures the nickel hypophosphite and ortho-phosphite in the process and removes, reacts, filters, and returns the solution to the process maintaining the process at a constant quality at all times.

YIELD

The ENFINITY HB process contains 6.65 g/l of nickel metal at 100%. This amount of nickel will produce about 186 mil in^2 of deposit. To determine the operating cost of the electroless nickel process divide the operating cost for one gallon by this yield factor. For this calculation the density of 11.0% electroless nickel is 7.95 g/cm^3

Table 3, ENFINITY HB MAKE-UP FORMULA

Tank Volume	1 Litre	100 Gallons
ENFINITY HB Makeup	500 ml	50 GAL
Deionized Water	500 ml	50 GAL

PROCEDURES FOR MAKING UP A NEW ENFINITY HB SOLUTION

1. Fill approximately 1/2 of the final working volume of cold deionized water into a clean plating tank.

2. Add the ENFINITY HB Makeup to the plating tank.

3. Record the new solution in the PU1 or PU3

4. Start using your New ENFINITY Solution.

Table 4, SUMMARY of OPERATING CONDITIONS

Conditions	at make-up g/l	UCL g/l	LCL	Control Point	Frequency of Analysis
Nickel Metal	6.6	6.6	3.5	5.8	.5 - 4 hr.
Hypophosphite	38	50	35	40	4 - 48 hr.
pH(Electrometric	4.6	4.8	4.1	4.6	0.5 - 2 hr.
Temperature (C)	91	95	89	91	0.5 - 2 hr.

PROCESS CONDITIONS and OPERATIONS

The ENFINITY HB process is simple to operate. A list of operating conditions can be found in table. The replenishment is determined by testing for nickel and making an addition of ENFINITY HBIR and HBIC Control. The purification units make these additions automatically after the operator enters the information or the unit test for the concentration.

The ENFINITY HB Process will produce a coating with the specified properties on all wetted surfaces. The plating rate is dependent on the pH and temperature of the process and will vary from between 0.2 - 0.4 mils/hr. In this range the alloy, porosity and corrosion protection are assured.

In the operation of the ENFINITY HB Process the pH will tend to drop slightly. This requires a small amount of ammonium hydroxide be added back. The purification unit accomplishes this automatically at the time of each replenishment. If operating manually this adds will need to be made.

The following table describes the schedule of additions to the process. It can be used to operate the process manually or used to check the operation of the purification units.

Table 5, ADDITION SCHEDULE for ENFINITY HB Process

Nickel concentration	**6.6**	**6.3**	**5.9**	**5.6**	**5.3**	**4.9**	**4.6**	**4.3**	**g/l**
	100	**95**	**90**	**85**	**80**	**75**	**70**	**65**	**%**
EDTA Na2 0.0575M	**10**	**9.5**	**9.0**	**8.5**	**8.0**	**7.5**	**7.0**	**6.5**	ml
100 Gallons									
ENFINITY HBIR	0	1.25	2.50	3.75	5.0	6.25	7.50	8.75	
ENFINITY HBIC	0	0.05	0.1	0.15	0.2	0.25	0.30	0.35	
300 Gallons									
ENFINITY HBIR	0	3.75	7.5	11.2	15.0	18.7	22.5	26.2	
ENFINITY HBIC	0	0.15	0.3	0.45	0.6	0.75	0.90	1.05	

GETTING THE MOST OUT OF YOUR ENFINITY HB 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.

2. Possible contaminates from the shop or parts should be controlled as much as possible. These contaminates 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.

3. The ENFINITY 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 ENFINITY Process is designed to be operated with continuous filtration through a 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. The ENFINITY process will operate for well over 100 MTOs before any special treatments need to be performed. After using the solution for several years a slight discoloration will occur. This requires an activated carbon filtration with a warm solution for several hours. This will remove the color and return the solution to the emerald green natural nickel color.

DAILY CARE

Cover the tank when you are not loading or unloading the tank.

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.

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.

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.

Organic contamination can be eliminated by Carbon filtering the warm or hot solution. Place a pound of washed activated carbon in a filter bag or use filter cartridges and circulate the ENFINITY HB solution. Any oil or tars will be adsorbed onto the carbon any late pitting, 2-5 mils, will be eliminated. Organic contamination can be identified by pitting on vertical surfaces and an oil film on the surface.

GENERAL INFORMATION

Filtration - Continuous filtration through 5 or better micron polypropylene filter bag which is elevated above the solution is recommended. This produces a pressure differential to cause filtration while removing the high concentration of heat from the filter area. With the bag elevated, any plate-out or activity in the solution can be detected and corrective action taken before a problem is detected on the parts.

Tank and Materials of Construction - All tanks, piping, racks and carriers which come in contact with the solution should be made of CPVC, Poly-propylene, 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 ENFINITY HB plating process are corrosive due to complexers used in the material. All ventilation equipment should be constructed with stainless steel, poly-propylene, PVC or Fiberglass to insure good equipment life and a healthy area for the operators.

PURIFICATION UNITS

Process are best accomplished by operating with a purification unit. There are three types of units. All system remove ortho-phosphite and make additions back to the operating process. Typically the process a small portion of plating solution, removing the ortho-phosphite and regenerating the process.

OPERATING with the PU1

The PU1 is controlled from a keyboard and terminal. These are located in an enclosure and are hardened to meet the harsh environments of the plating shop. The Keyboard utilizes membrane technology and can be exposed to wet conditions such as wet gloves and hands.

START-UP

The PU1 is started each day by going to a program called STARTUP. This program checks the sensors and determines the PU1 is in the proper condition for OPERATION.

From the any menu press the OPERATE function key. This will take you to the OPERATE MENU and another selection. Press the START-UP function key, F9. If the unit is in Stand-by press the START function key, F9. Depending on why the unit is in Stand-by you might have to press the RESET function key and then the START function key.

The Stand-by message will change to Ready and the PU1 can now be operated. If any problems remain they will be displayed on the Start-Up Screen.

MAKING a 5% ADDITION

From the OPERATE MENU select F10, "Addition of 5% Replenishment". This will cause the PU1 program to go to a "5% ADDITION" Screen which will display several override conditions. Using the UP ARROW key move the cursor one field up to enter the password. Each PU1 has a unique set of Passwords. Enter your password followed by the ENTER key <1>. This will cause the PU1 to start a cycle, working for about 20 minutes removing Orthophosphite and replenishing the solution in approximately 20 gallons of working solution.

POSSIBLE OPERATOR QUESTION

There are several situations that may require the operator to intervene on the automatic operations. These are described in this section.

The first is the failure of the pH probe to send a drift free signal to the computer. A dirty pH junction can cause this condition. If the pH is in the correct range press the "PH MAN A" function key and the program will continue.

If the pH is outside of the control limits established for the process setup an error message of "pH out of Range" will be displayed. This will alert the operator that the process or pH probe may have a problem. After checking the pH of the solution then check and calibrate the pH probe. When these things have been accomplished then press the "PH LMT A" and the program will continue.

If during the reacting of purifier the pH fails to increase an error message is displayed describing a timeout condition on purifier Add. After filling the dry feed hopper with purifier press the "PH ADJ A" function key and the program will start.

AUTOMATIC OPERATIONS

The PU1 will proceed automatically on the following sequence when a 5% add is requested.

1. Plating solution is removed from the tank. This material is called REMOVAL.

2. The following steps occur simultaneously

a. The removal material is cooled to 40 (F).

b. RECOVERY material from the last treatment is returned to the plating tank.

c. REPLENISHER is metered into the plating tank.

d. CONTROL is metered into the plating tank.

e. A small amount of Ammonium hydroxide is added into the plating tank.

3. After cooling the REMOVAL material is pumped to the reactor. At this point the following actions are accomplished:

a. The pH of the plating solution is checked and stored in the computer. This value is tested for stability and range.

b. The pH is then increased to 9.0 by adding PURIFIER. This will cause the Ortho-phoshite to precipitate to a Calcium phosphite.

c. After this reaction a digestion period of 6 minutes is scheduled.

4. The reacted REMOVAL material is then pumped into a vacuum filter where the liquor is filtered from the solids.

a. The liquid is now RECOVERY and goes to a tank for storage and return to the plating tank at the next 5% ADD.

b. The Solids are discharged to a drum and collected for disposal.

c. Rinse water is added to the vacuum filter and increased the volume slightly to the RECOVERY. Excess water is discharged to the drain. The amount of water needed is controlled by local regulation depending on the WET limits on the filter cake.

5. An automatic rinse of the PU1 will occur after 30 minutes of no activity. This cleans the pH probe and helps keep the system free of solids that build in the reactor.

OPERATING with a PU2

The PU2 incorporates the basic functions of the PU1 in a smaller and more manual system. The basic benefit over the PU1 is the simplicity and lower cost to manufacture. The machine operates the same with similar capacity.

The operator has three functions which he can activate. These are :

- Make 5% Addition
- Begin Treatment
- Unload Filter & Return

The buttons are interlocked to the internal computer program which directs the operator to make the add, then treat the batch on the rector and then unload the filter chamber.

ADDITION

The PU2 will proceed automatically on the following sequence when a 5% ADD is requested.

1. Plating solution is removed from the tank. This material is called REMOVAL.

2. The following steps occur simultaneously

   a. The removal material is cooled to 40 (F).

   b. RECOVERY material from the last treatment is returned to the plating tank.

   c. REPLENISHER is metered into the plating tank.

   d. CONTROL is metered into the plating tank.

   e. A small amount of Ammonium hydroxide is added into the plating tank.

3. After cooling the REMOVAL material a Ready to Treat Light comes on.

TREATMENT

The operator them performs the treatment by pressing the Treat Button and adding a pre-measured amount of Purifier into the reactor. At this point the following actions are accomplished automatically:

Note: Purifier is provided in measured packages in 2-pound increments.

1. The agitator on the reactor, the reactor pump and by-pass valve are activated. This causes the solution to circulate. As soon as the temperature starts to rise the cooling system engages.

2. The pH is then increased to 8.0 through the addition of Purifier. This will cause the Orthophosphite to precipitate to Calcium phosphite. The table below can be used to estimate the amount of Purifier required to adjust the pH to 8.0.

3. This reaction progresses for a period of 6 minutes.

4. The reacted REMOVAL material is then pumped into a vacuum filter where the liquor is filtered from the solids.

5. The liquid is now called RECOVERY and is pumped to a tank for storage and return to the plating tank at the next 5% ADD.

Note: The filter system uses a three point vacuum gage that can sense when the liquor is filtered and activate a rinse system. This feature is available on all three units and is required if the filter cake is to be non-hazardous.

To complete the operation the operator removes the filter cake from the filter chamber. This is accomplished by pressing the Unload Button on the front panel. A bell sounds and the filter chamber dumps the contents into a tote. The operator then returns the filter chamber by pressing the Return Button. This causes the bell to sound and the filter chamber return to rest position.

Table 6, Purifier Addition Schedule

Ortho g/l	70	80	90	100	110	120
10 gal	3.5 #	4 #	4.5 #	5 #	5.5 #	6 #
15 gal	5.2 #	6 #	6.6 #	7.4 #	8.2 #	8.9 #
20 gal	7.0 #	8 #	9.0 #	10 #	11 #	12 #
25 gal	8.7 #	10 #	11.1 #	12.3 #	13.6 #	14.9 #
30 gal	10.5 #	12 #	13.5 #	14.9 #	16.5 #	18 #

PROCEDURE for ANALYSIS

TITLE: Analysis for Nickel Metal

SCOPE: This method is a direct titration for nickel metal using EDTA. The procedure is quick and will works with automatic titrators using ampermetric or specrtometric probes.

APPARATUS

1. Erlenmeyer flask 250 ml
2. Automatic burette
3. Chemicals
    a. Distilled water
    b. Ammonium hydroxide
    c. 35% Trieythanolamine
    d. Murexide Indicator in sodium chloride
    e. 0.1 M EDTA Na2 Solution

PROCEDURE:

1. Add exactly 10.0 ml of plating bath into the Erlenmyer flask.
2. Add about 100 mls of distilled water to the flask.
3. Add 20 mls of Ammonium hydroxide to the flask.
4. Add 10 mls of 35% Trieythanolamine
5. Add about 0.2 g of Murexide Indicator Mix to the flask. The solution should be light straw color.
6 Titrate immediately with standard 0.1 M EDTA Na2 Solution to purple endpoint.

ANALYSIS

Nickel g/l = (MLS 0.1 M EDTA Na2) x 0.576

TITLE: Analysis for Hypophosphite

SCOPE: This is a direct titration for hypophosphite using indirect titration for iodate using thiosulfate. The method takes 10 or 30 minutes and can be automated using automatic titrators.

APPARATUS

1. Erlenmeyer flask 250 ml with stopper
2. 2 Automatic burettes, 25ml
3. 1x10 ml pipette
4. Chemicals
    a. Distilled water
    b. 0.1N Iodine
    c. 0.1N Thiosulfate
    d. 6N H2SO4 Analytical Grade
    e. Starch Indicator

PROCEDURE

1. Add exactly 2.0 mls of plating bath into the Erlenmyer flask.
2. Add approximatly 20 ml of 6N H2SO4 to the flask.
3. Add exactly 25 ml 0.1N Iodine to the flask.
4. Stopper flask and place in a dark place for exactly 30 minutes.
5. Remove from dark area and wash stopper and neck of flask into the sample contents with deionized water.
6 Titrate immediately with standard 0.1N Thiosulfate Solution to light yellow point. Add a small amount of starch indicator. Solution will go black. Continue titration until solution goes clear.

ANALYSIS:

Hypophosphite g/l = (MLS 0.1N Iodine (25) - MLS 0.1N Thiosulfate) x 2.65

TITLE: Analysis for Ortho-phosphite

SCOPE: This is a titration method for ortho-phosphite using indirect titration for iodate using thiosulfate. The method takes 30 minutes and can be automated using automatic titrators.

APPARATUS:

1. Erlenmeyer flask 250 ml with stopper
2. 2 Automatic burettes, 25ml
3. 1x10 ml pipette
4. Chemicals
    a. Distilled water
    b. 0.1N Iodine
    c. 0.1N Thiosulfate
    d. 5% by weight Sodium bicarbonate Solution
    e. 10% by volume Acetic Acid Solution
    f. Starch Indicator

PROCEDURE:

1. Add exactly 2.0 mls of plating bath into the Erlenmyer flask.
2. Add 20 ml Deionized Water to the Erlenmyer flask.
3. Add 20 ml of Sodium bicarbonate.
4. Add exactly 50 ml 0.1N Iodine to the flask.
5. Stopper flask and place in a dark place for exactly 30 minutes.
6. Remove from dark area and wash stopper and neck of flask into the sample contents with deionized water.
7. Add 20 ml 10% Acetic Acid to Erlenmyer flask.
8. Titrate immediately with standard 0.1N Thiosulfate Solution to light yellow point. Add a small amount of starch indicator. Solution will go black. Continue titration until solution goes clear.

ANALYSIS:

Ortho-phosphite = (50 - MLS 0.1N Thiosulfate) X 2.05 g/l

EXAMPLE:

Upon titrating with 0.1N Sodium thiosulfate the sample went clear at 27.6 ml.

Ortho-phosphite = (50 - 27.6) X 2.05

Ortho-phosphite = 45.9 g/l

Note: The amount of iodine may need to be increased if the ortho is greater than 80 g/l in the process. Increase the quantity to a range where the difference is within range.

0-75 g/l	50 ml
75-100 g/l	65 ml
100-150 g/l	100 ml
150-200 g/l	150 ml

FAX Service

Producing Quality plating requires a team effort by many people. Having products made to high standards means that every step people attend detail.

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 ENFINITY that rely on statistical process control we will make available our capability indexes on a monthly basis.

HANDLING

ENFINITY HB Control is a neutral pH product and is quite safe under almost all conditions. The solutions should not be taken internally and if contact with skin has occurred it should be washed with copious amounts of water. ENFINITY R Replenisher is low in pH and will cause chemical burns if prolonged contact occurs. Wash with copious amounts of water while scrubbing with soap and warm water. (see MSDS)

STORAGE

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

MSDS, Material Safety Data Sheets

MSDS Sheets are available upon request from STAPLETON. Call or write (800) 266-0541 and specify mail or FAX for return.

ORDERS

Orders are accepted by phone at (800) 266-0541, FAX (562) 437-8632, e-mail or by mail. Specify trucking company and delivery date required. Materials are shipped the same day if received by 2:00 PM PST. for California and 2:00 PM CST for Chicago, IL

TERMS

ENFINITY Products are sold FOB, Long Beach, CA warehouse at NET 30 days 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 for further details.

http://www.stapletontech.com

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Photo: 1 PU2, ENFINITY Purification System