COVENTYA

Technical Data Sheet

ENOVA H15

Stable, Moderate Speed, High Phosphorus
Electroless Nickel System

LJP	JML/BJD	E	09.09.21 update 10.03.15	MS-12 Ni update bjd
Creation	**Approval**	**Index**	**Date** *(YY.MM.DD)*	**Observations**

1. Process and Deposit Description

General Description	The **ENOVA H15** process is specifically formulated to produce a high corrosion resistant, semi-bright high phosphorus nickel deposit at a moderate rate of deposition. The **ENOVA H15** process yields a deposit with superior functional properties in terms of ductility, internal stress, solderability and corrosion performance. It is recommended for applications requiring minimum deposit porosity for severe corrosive environments. The **ENOVA H15** EN concentrates are manufactured under Statistical Process Control to ensure quality and consistency. The **ENOVA H15** process offers the following benefits: •Excellent Corrosion Resistance •Long Solution Life •Non Staining Deposit •Good Ductility, Compressively Stressed •Excellent Bath Stability •1:1 Replenishment option •Consistent Rate of Deposition •Self pH Regulating Option
Deposit Properties	**TYPICAL RESULTS** Phosphorus Content (wt.%): 10.8- 12 Melting Point: (F) 1620° (C) 880° Hardness (HK/R_CH):(As Plated) 450/45 (HT @750 F, 1hr.) 990/69 Magnetic Properties (Coercivity): Non- Magnetic Nitric Acid Test: Pass
Qualifications	**ENOVA H15** deposits can meet specification requirements of ASTM B733 and AMS 2404D, AMS-26074 (formerly Mil-C-26074), ISO 4527 & RoHS Directive 2002/95/EC.

2. Solution Make-Up

Volumes	**ENOVA AM HP** 6.0% by volume **ENOVA H15 B** 15.0% by volume Deionized Water To operating volume
Procedure	1.) Add deionized water to a properly cleaned and passivated EN tank (fill to 1/2 tank capacity) 2.) Add required amounts of **ENOVA AM HP** and **ENOVA H15 B** 3.) Fill to working volume with deionized water. 4.) Mix thoroughly with solution and/or air agitation and heat to190°F (88°C) 5.) Analyze nickel content and adjust to 6 g/l (0.8 oz/gal) if necessary. 6.) Check pH and adjust*, if necessary, to 4.8.

3. Equipment

Tanks	Tank construction can be polypropylene or stainless steel. If using stainless steel tanks, anodic protection is recommended to help minimize plating on the tank walls. Tanks with a v-bottom from which the solution is filtered are also recommended.
Heaters	Steam heaters are recommended, although electric heaters may be used. Steam heater construction can be stainless steel, titanium, or Teflon. Internal to tank or external. Electric heaters should be de-rated, and can be quartz, stainless, titanium, or Teflon. Heaters should be capable of maintaining recommended operating temperatures. Please consult with your heater manufacturer for proper selection.
Filtration	It is recommended that a minimum of one micron filter size be employed. Filter pump should be capable of pumping 10 times that bath volume through the filter per hour. Example: If the bath is 100 gallons (379 liters), then the filter pump should be capable of pumping a minimum of 1000 gallons (3785 liters) per hour through the filter. Consult your filter pump manufacturer for proper pump materials that will withstand the recommended operating temperatures of electroless nickel baths.

4. Operation Parameters

	RANGE	**OPTIMUM**
Temperature	185-205°F (85-96°C)	190°F (88°C)
pH	4.40-5.0	4.80
Ni Metal Concentration	0.64-0.84 oz/gal (4.8-6.3g/l)	0.80 oz/gal (6.0 g/l)
Na Hypophosphite Concentration	3.2-4.2 oz/gal (24.0-31.5 g/l)	4.0 oz/gal (30.0 g/l)
Bath Loading	0.20-1.00 (sq.ft/gal.) 0.5-2.5 (sq dm/liter)	0.40 (sq.ft/gal.) 1.0 (sq dm/liter)
NOTES	* pH can be adjusted up with a 50% solution of ammonium hydroxide or potassium carbonate. Sulfuric acid, 10% by volume, can be used to lower pH.	

5. Analytical Procedures

	All analytical procedures necessary for the proper operation of this product are available from your local COVENTYA representative upon request. These include, but are not limited to: Nickel, Sodium Hypophosphite, and Sodium Orthophosphite.

6. Solution Maintenance

Bath Replenishment

To ensure proper operation of the **ENOVA H15** EN system, the solution chemistry must be maintained between 85% and 105% of initial activity. This is accomplished by measuring and monitoring the nickel concentration via a standard EDTA titration. An analysis procedure for nickel and hypophosphite is available from COVENTYA Inc. upon request.

Upon determination of the nickel metal concentration, additions of both **ENOVA AM HP** and **ENOVA H15 CM** or **ENOVA H15 CMP** are made based on the following calculation and/or replenishment guide.

Replenishment Table

[100 gallon Tank]
379 liters

For 1:1 replenishment

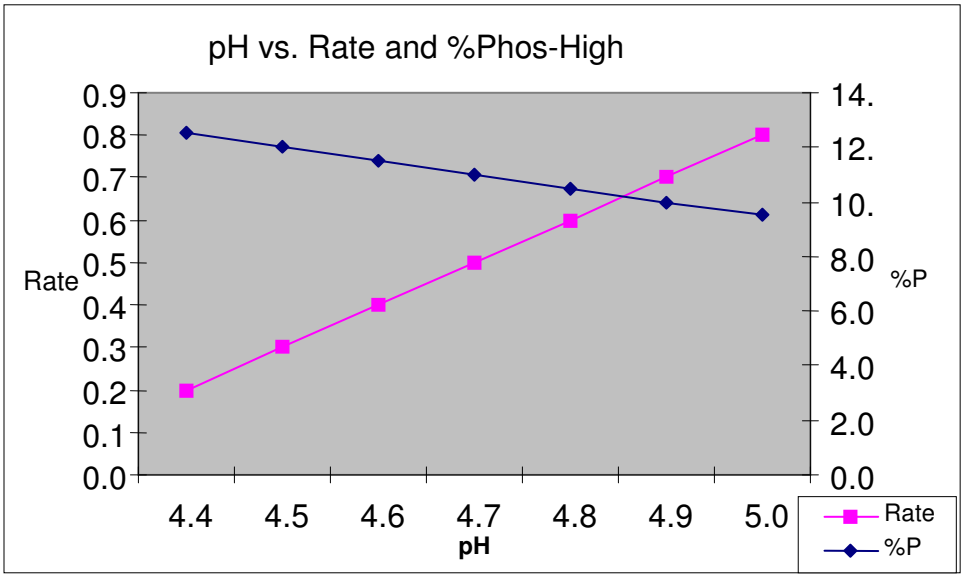
% Activity*	Nickel Conc. oz/gal & (g/l)	ENOVA AM HP 6% v/v or 60 ml/L per MTO	ENOVA H15 CM or ENOVA H15 CMP(1) 6% v/v or 60 ml/L per MTO
100	.80 (6.0)	0	0
95	.76 (5.7)	1.2 qts (1.1 liters)	1.2 qts (1.1 liters)
90	.70 (5.3)	2.4 qts (2.3 liters)	2.4 qts (2.3 liters)
85	.68 (5.1)	3.6 qts (3.4 liters)	3.6 qts (3.4 liters)
80	.64 (4.8)	4.8 qts (4.5 liters)	4.8 qts (4.8 liters)
75	.60 (4.5)	4.8 qts (4.5 liters)	4.8 qts (4.8 liters)

(1) self pH regulating system

(2) It is not recommended to make an add greater than 20% at any one time. If solution is severely depleted please make several small adds while plating and slowly increase solution activity to operating range. Large additions (>20%) at one time may lead to an over stabilized condition. This may result in skip plating, edge pullback and/or complete cessation of plating.

Temperature

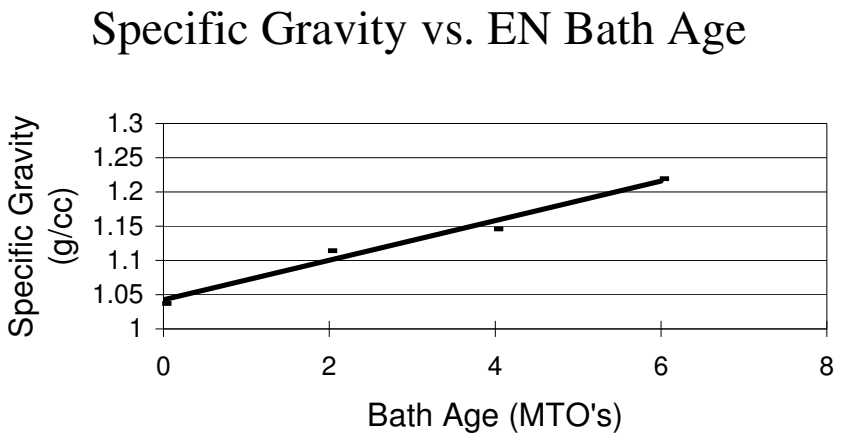
The recommended operating temperature is 190 deg.F. (88 deg C.) with a range of 185-205 deg.F. (85-96 deg.C) Bath temperatures below the lower control limit will yield slow plating rates and quite possibly lead to poor adhesion on various substrates due to poor initiation. Operating at temperatures beyond the upper control limit may result in accelerated tank plateout and/or bath decomposition. Maintaining the solution at operating temperatures for extended periods of time without work throughput may result in excessive consumption of the reducing agent, sodium hypophosphite.

pH	Due to the evolution of hydrogen gas generated during the plating process, the solution pH will decrease and will require additions of 50% ammonium hydroxide or potassium carbonate to maintain the pH between 4.4-5.0. The profound effect pH has on both the solution plating rate and the subsequent deposits phosphorus content is illustrated graphically: 
Loading	The recommended workload to solution volume should be maintained between .2-1.0 sq.ft./gal. (0.5-2.5 sq dm/liter). Overloading may result in slower plating rates, dull deposits and may lead to bath instability. Low bath loading will decrease the efficiency of the reduction reaction, consuming more sodium hypophosphite than necessary. Low loading may also result in skip plating, edge pullback and/or complete surface passivation. If bath operation at workloads less than the lower control limit is unavoidable the following may help: 1.) Operate Bath at the upper limit for pH and Temp. 2.) Maintain Bath activity (Ni metal conc.) at 80%. 3.) Reduce or eliminate solution and/or air agitation.

Bath Age Determination

Unlike conventional electroplating baths, electroless nickel solutions have a finite life. An industry standard for monitoring EN bath age is the metal turnover (cycles and regenerations are synonymous terms). A metal turnover occurs when you replenish the initial amount of nickel metal used to make-up the bath. For example, if 6 gallons (23 liters) of **ENOVA AM HP** is required to make-up a bath, one metal turnover occurs when 6 gallons (23 liters) of **ENOVA AM HP** have been replenished. For this reason, all additions made to the bath should be recorded. There are some instances where recorded adds are not possible (automatic controller) or do not reflect the true age of an EN bath (high drag-out or bail-out).If this is the case there are two other practical methods used to determine bath age:

Sodium orthophosphite analysis. A typical EN bath will generate 1.2 g/L of orthophosphate for each 1 gram of sodium hypo consumed to deposit nickel. For a typical 30 g/L hypo bath, a theoretical 36 g/L of sodium orthophosphate will be generated however typical operating conditions including solution loss or drag out will reduce the amount of orthophosphate per MTO which is related to the increase with solution specific gravity. This analysis is available upon request. Specific Gravity will increase linearly with bath age and can be monitored graphically:



Effects of Contaminants

Contaminants can be introduced into an EN bath in a number of ways and can have a profound effect on bath and deposit performance. The following guide lists possible contaminants, methods of introduction and possible remedies:

CONTAMINANT	CRITICAL LEVEL	INTRODUCED	EFFECT	REMEDY
Cadmium	3 ppm	used equip.	1, 2, 4	plate-out
Chromium(+3)	3 ppm	used equip.	3, 6	dump
Chromium(+6)	0.2 ppm	used equip.	4	dump
Copper	30 ppm	Cu substrates	1, 5, 6	plate-out
Lead	3 ppm	substrates, maskants	1, 2, 4, 6	plate-out
Nitrates	50 ppm	stripping	3, 6	lower pH, heat, agitate

Effects:

1 - Dark Deposit 2 - Skip plating/edge pullback 3 - Cloudy/streaked deposits
4 - No deposition 5 - Copper immersion/poor adhesion 6 - Slow plating rate

7. Troubleshooting

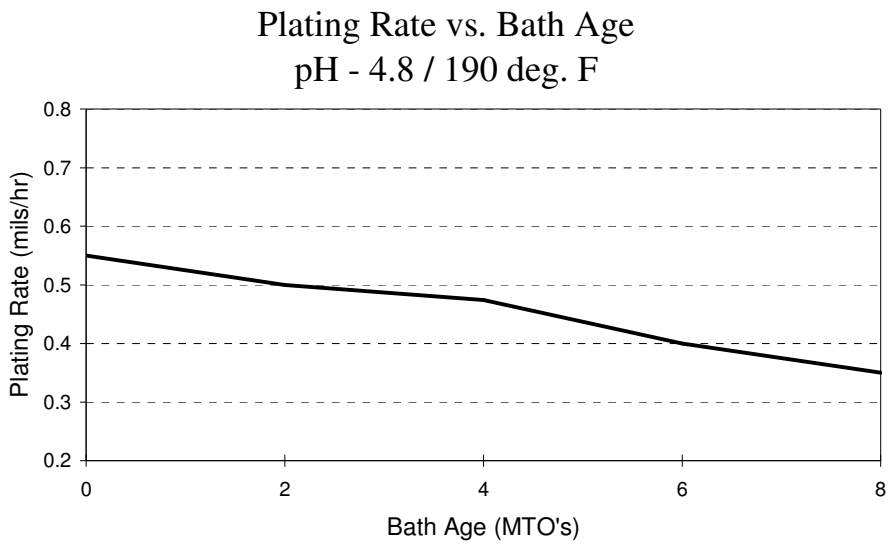
	An extensive Electroless Nickel Troubleshooting Guide is available upon request from your local COVENTYA representative. The technical team at COVENTYA will also gladly assist you with any questions that may arise. They may be contacted at the number or website at the bottom of this Technical Data Sheet or through your local COVENTYA representative.

8. Plating Sequences

	Recommended plating sequences for a wide variety of base materials are available upon request from your local COVENTYA representative.

9. Performance

Plating Rate



Solution life, Metal Turnovers

	Typical Value
Steel:	8-10
Aluminum:	
pH adjusted w/ Ammonium Hydroxide	5-7
pH adjusted w/ Potassium Carbonate	7-9
With Alkaline EN Strike	8-10

Coverage

Mil Square Feet/Gallon of Operating Bath	
5 Metal Turnovers*	7.04
8 Metal Turnovers	11.02
10 Metal Turnovers	13.68

	*One Turnover occurs when the original concentration of 0.8 oz/gal (6 g/l) nickel metal has been replenished.

10. Water Care and Waste Management

	ENOVA H15 plating solutions contain nickel metal, which must be removed in accordance with federal, state and local regulations. COVENTYA Inc. provides complete Water Management Services for Metal Finishing and Metal Processing operations through COVENTYA Water Care. Questions regarding specific process applications as well as facility overall wastewater concerns should be directed to Mark Andrus at M.Andrus@Coventya.com

11. Safety and Health

	Contact your local COVENTYA representative to obtain the pertinent Material Safety Data sheets for these products.

12. Warranty

Disclaimer of Responsibility	The data set forth in this bulletin is believed by COVENTYA, Inc. to be true, accurate, and complete, but is not guaranteed. Our sole warranty is as stated in our Standard Terms and Conditions of Sale. We cannot warrant that our customers will achieve the same results from any process, chemical or product described in this bulletin because we do not have control over the conditions of use; nor can we assume any responsibility for our customer's use of any of our products in a manner which infringes the patents of third parties.				
Product Specification		**ENOVA AM HP**	**ENOVA H15-B**	**ENOVA H15-CM**	**ENOVA H15-CMP**
	Color	Green	Clear	Clear	Clear
	pH	3.5	5.3	6.0	10.5
	SG	1.340	1.180	1.325	1.260
IMDS Number	76774736				