

NYLON POWDER COATING :

Nylon powder coating is done in order to achieve high quality corrosion protection with excellent mechanical properties, high heat resistance, good chemical resistance and aging resistance. DelTech offers **Nylon 12** (Polyamide 12) coated discs for valve size from 2" to 24". DelTech uses VESTOSINT[®] 1111 Gray nylon coating powder from Degussa AG High performance polymers.

Some of the properties of the **Nylon 12** powder are:

- High Wear Resistance
- High mechanical strength and elasticity, even at low temperature
- Low coefficient of sliding friction in dry motion contact with metals and other polymer materials
- Sound and vibration absorption
- Lowest water absorption of any commercially available polyamide
- Good resistance to water that is boiling or contains detergents
- Very good resistance to fats, oils, fuels, hydraulic fluids, saline solutions & many other organic solvents
- Excellent stress cracking resistance
- Good electric strength and insulation

PROCESS :

Fluidized-bed coating process is used for coating the components. This process is an economical method of coating pre-heated, preferably metallic articles with nylon powder. Coating thickness of approximately 300 to 500 μ m (0.01181 to 0.01969 inches) is achievable.

The coating process contains three main steps:

1. Pretreatment of the components to be coated.
The components to be coated are pretreated in order to remove any traces of grease and oil to increase corrosion resistance. This involves phosphatizing (Refer to TDS no 50/52 - 116 for Phosphatizing) of the components, i.e. all the components are dipped in the phosphate solution for the specified time.
2. Heating the components in forced-air oven with good temperature control & distribution.
The heating of the carefully pretreated metal parts is carried out in the hot, forced-air oven, which is operated with fuel oil, gas or electric power and ensures a constant temperature over the entire interior space. The furnace operates at a temperature of between 230 and 450^oC.
3. Coating the components in the fluidized-bed coating tank.
The pretreated metal parts heated to above the melting range of the powder are immediately dipped into the coating bath in order to avoid heat losses and are moved back and forth in the tank. Since the airflow causes the powder particles to move up and down, the articles should be immersed so that the surface to be coated is to be parallel to this direction surface.

After a dipping time, which is usually between 2 and 10 seconds and during which an appropriate amount of powder is sintered on, the adhering particles melt to form a smooth, homogenous and pore free coating with a uniform thickness.

When the article is removed from the fluidized-bed coating tank, the excess powder flows off from all vertical surfaces. The remaining powder is removed by shaking, vibration or blowing off. If glossy coatings are required, the coated part is dipped into the water bath after the powder has completely melted.



Properties of the Nylon 12 Powder :

Property	Test Method	Unit	Value
Melting Temperature	ISO 3146	°C	176
Density at 23°C	ISO 1183	g/cm ³	1.016
Shore Hardness D	ISO 868		75
Ball Indentation Hardness H30	ISO 2039 – 1	N/mm ²	90
Water Absorption			
100 °C, Immersion	ISO 62	%	1.93
23 °C, 96% R. H.	ISO 62	%	1.33
23°C, 50% R.H.	ISO 62	%	0.52
Thermal Linear Expansion	ISO 11359	10 ⁻⁴ K ⁻¹	1.09
Thermal Conductivity	DIN 52612	W m ⁻¹ K ⁻¹	0.23 – 0.29
Specific Heat	DIN 53765	J g ⁻¹ K ⁻¹	2.35
Abrasion	DIN 53754 (Taber)	mg/100 turns	14

*NOTE : For imperial units refer to conversion Charts.

Chemical Resistance Guide :

(For explanation of symbols refer to next page)

Compound	Concentration %	20° C	40° C	60° C	90° C
Acetaldehyde		A	B	B	---
Acetic acid	10	B	N	N	N
Acetone	100	A	A	B	N
Acetylene		A	A	A	---
Ammonia, aq	Conc.	A	A	---	---
Amyl acetate		A	A	A	B
Aniline	Pure.	B	N	N	N
Asphalt		A	A	A	
Barium salts	Conc.	A	A	A	A
Battery acid		A	A	B	
Beer		A			
Benzene		A	A	B	
Bromine		N	N		
Butane		A	A	A	
Chlorine		N	N	N	N
Chromic acid	10	N	N	N	N
Coffee		A	A	A	A
Crude Petroleum		A	A	A	
Edible oils (animal or vegetable)		A	A	A	A
Ethyl acetate		A	A	A	
Ethyl alcohol	100	A	A	A	A
Fluorine		N	N	N	N





Compound	Concentration %	20° C	40° C	60° C	90° C
Formaldehyde		A	B	N	
Formic acid		N	N	N	N
Fuel oils		A	A	A	A
Glycerine	100	A	A	B	N
Glycol		A	A	A	N
Hexane		A	A	A	
Hydrochloric acid	1	A	B	N	N
Hydrochloric acid	10	A	B	N	N
Hydrogen peroxide	30	A	B		
Kerosene		A	A	A	
Lactic acid		A	A	A	B
Magnesium Chloride	50	A	A	A	A
Methanol	Pure	A	B	N	
Methyl Chloride		A	N		
Milk		A	A	A	A
Nitric acid	All Conc.	N	N	N	N
Petrol		A	A	A	
Picric Acid		B	N	N	N
Potassium Permanganate	5	N	N		
Potassium Sulfate		A	A	A	A
Rum	40	A	A	A	A
Sea water		A	A	A	A
Soda Water		A	A	A	A
Sodium Carbonate		A	A	B	N
Silicone oils		A	A	A	A
Sodium chloride	Saturated	A	A	A	A
Sugar solutions	All Conc.	A	A	A	A
Sulphur		A	A		
Sulphuric acid	1	A	B	B	N
Sulphuric acid	10	A	B	N	N
Toluene		A	A	B	B
Trichloroethylene		A	B		
Water		A	A	A	A
Wine		A			

Key To Symbols:

- A – Recommended for usage.
- B – May sometimes be used depending on the conditions of applications.
- N – Not recommended for usage.
- Blank – Insufficient Data.

NOTE : This ' Chemical Resistance Guide' has been developed from information supplied by raw material manufacturers and technical publications. It is provided as a basis for selection of suitable valve materials for general and specific applications. None of this information is to be interpreted as a guarantee or warranty that the materials will be suitable in a particular application.





ELECTROLESS NICKEL PLATING :

Electroless Nickel Plating (ENP) is a deposit of nickel phosphorus alloy applied onto catalytic or catalyzed, metallic or non-metallic substrates, by chemical reduction, without application of electric current. This deposited alloy contains between 2% and 13%, by weight, of phosphorus. The percentage of phosphorus in the deposit determines different physical and mechanical characteristics.

PROCESS :

The chemical process producing ENP deposit is an oxide-reduction reaction in which the nickel ions are reduced to metal nickel by hypophosphite.

Plating thickness achieved is 15 to 20µ.

TYPES OF ENP :

(ENP deposits are fundamentally subdivided into three categories.)

Item	Type of ENP	% P	Hardness	Application	Appearance
1	Low Phosphorus ENP	2 – 4	As plated 600-700 HV & after H.T. upto 1150 HV.	Particularly suitable for alkaline environments.	Matte.
2	Medium Phosphorus ENP	7 – 9	As plated 450-550 HV & after H.T. upto 1050 HV.	Particularly suitable for applications in not very corrosive environments.	Semibright/ Bright.
3	High Phosphorus ENP	≥ 10.5	As plated 480-580 HV & after H.T. upto 1050 HV.	For under severe operating conditions.	Semibright/ Satin (matte).

ENP coating may be used in the presence of hydrogen sulfide (H₂S) or sulphur compounds but the maximum operating temperature shall be restricted to 80⁰C.

DelTech offers high phosphorus ENP on the components to achieve uniform surface finish for long lasting effect including good corrosion resistance properties.

HIGH PHOSPHORUS ENP :

It is a high phosphorus (10.5 - 12%) electroless nickel plating process, particularly suitable for industrial applications where corrosion resistance properties are above all requested. It is a particularly ductile deposit with generally compressive internal stresses, non-porous even when the thickness is relatively low.

Base materials : 1) Cast iron. 2) Ductile iron. 3) Carbon steel.

PHYSICAL CHARACTERISTICS :

- 1) Deposit phosphorus content (% by weight). ≥ 10.5
- 2) Hardness (in HV) as deposited. = 480 - 580
- 3) Hardness (in HV). ≥ 475 - 600
- 4) Melting point (°C). = 880 - 960
- 5) Magnetic properties. = Non-magnetic.
- 6) Electrical resistivity (Micro-Ohm/cm). = 50 - 100
- 7) Ductility (%). = 1.5 - 1.6
- 8) Elongation (%). = 1.5 - 1.6
- 9) Thermal expansion coefficient (micron/m°C). = 13 - 15
- 10) Thermal conductivity (cal/cm/sec°C). = 0.0105 - 0.0135





PHYSICAL PROPERTIES :

- The specific weight varies from 8.5 g/cu.cm. for deposits containing 2% phosphorus, to 7.85 g/cu.cm. For deposits containing 12% phosphorus.
- The electrical resistivity varies from 20 micro-Ohm/cm. For 2% phosphorus platings to 90 micro-Ohm/cm. For 10.5% phosphorus coatings.
- ENP deposits reflect exactly the finish of the substrate surface. An appearance from bright to semi-matt can be obtained depending upon bath composition.

COMMON RANGES OF THICKNESS (Microns) FOR ENP.			
<u>SERVICE CONDITION</u>	MILD	MODERATE	SEVERE
A) Corrosion resistance 1) Smooth Surface 2) Rough Surface	7.5 - 20* 12.5 - 25	12.5 - 37.5 25 - 50	25 - 75 50 - 75
B) Abrasion C) Abrasion/Corrosion	12.5 - 25** 12.5 - 25**	25 - 50** 25 - 50	50 - 75** 50 - 75
D) Wear, Galling resistance	5.0 - 17.5**	5.0 - 17.5**	5.0 - 17.5**
E) Abrasion 1) Smooth Surface 2) Rough Surface	2.5 - 12.5 7.5 - 25.0	--- ---	--- ---
* Some corrosion resistance in mild atmospheric conditions can be achieved at 2.5 - 7.5 microns on smooth surfaces. ** Heat treatment for added deposit hardness may be beneficial in some cases.			

REFERENCE STANDARDS:

1. ASTM B 656 – 84.
2. ASTM B 733 – 84.
3. ASTM B 320.





NICKEL PLATING :

Nickel deposits are usually sulfur-free and matte in appearance. These deposits are specified to improve corrosion and wear resistance, to salvage or build up worn or undersized parts, to modify the magnetic properties, etc.

Basic Process :

The process requires the passages of direct current between two electrodes that are immersed in a conductive, aqueous solution of nickel salts. The flow of direct current causes one of the electrodes (the anode) to dissolve and the other electrode (the cathode) to become covered with nickel. The nickel in solution is present in the form of divalent positively charged ions (Ni^{++}). When current flows, the positive ions react with two electrons ($2e^-$) and are converted to metallic nickel (Ni^0) at the cathode surface. The reverse occurs at the anode, where metallic nickel is dissolved to form divalent positively charged ions, which enter the solution. The nickel ions discharged at the cathode are replenished by those formed at the anode.

Types of Nickel Plating :

Bright Nickel Plating :

Single layer bright nickel coatings are suitable for use in a mildly corrosive service using a nickel thickness of 10 to 20 μm . Several substances, organic and inorganic, are used at appropriate concentrations to achieve brightness, leveling and the control of internal stress.

Multilayer Nickel Plating :

For severe and very severe conditions of exposure, especially where longtime resistance to corrosion is required, multilayer nickel plating is recommended. The coating thickness of 35-40 μm can be achieved. The multilayer nickel plating can be double or triple layer coating.

Nickel Plus Chromium Plating :

The remarkable corrosion resistance of modern nickel plus chromium plating depends on the use of multilayer nickel in combination with microdiscontinuous chromium. The improved performance is due to the fact that the combinations of layers of nickel have different electrochemical reactivities. Generally, the coating thickness of chromium layer is 0.3 μm . The thickness of bottom layers (nickel) depends on the service conditions.

Nickel Plating on Butterfly Valve Discs :

Type of Nickel Plating: Nickel Plus Chromium Plating.

Coating Thickness = 20 – 25 μm (Single Layer Nickel Plating) + 0.3-1.0 μm (Chromium)

Vickers Hardness, 100 gms load = 130 – 200.

Salt Spray Test (As per ASTM B117) = 72 hrs.

Phosphatizing :

Phosphatizing is a chemical conversion applied to iron and steel castings and wrought steel in order to increase the surface lubricity and to provide temporary resistance to mild corrosion. It also reduces friction, galling, wear and high temperature oxidation.

Basic Process :

The materials to be phosphatized are initially cleaned from rust, grease, etc., and then put into a hot bath of phosphate solution. The manganese and nickel ions in the phosphate solution exchange with iron ions in the surface of the metal. Thus the steel or iron surface is chemically converted into an insoluble phosphate crystal. Phosphatizing process creates surfaces blackish in color, non-metallic, non-reactive, oily and smooth in texture, which will not rub off or change dimensions.

Phosphatizing process consists of the following steps,

- A) Degreasing – Dipping all the components for 10 – 15 min in the alkaline degreasing compound.
- B) Water Rinsing – Dipping all the components in water to remove the loosened oil and grease from surface.
- C) Derusting – Dipping all the components in derusting compound for 5-7 min or for longer time depending upon the extent of rust. The solution may be heated to 50⁰C to 60⁰C for quick action.
- D) Water Rinsing – Dipping all the components in water to loosen and remove the rust and acidic residues from the surfaces. It would be desirable to give 1-2 vertical movements for good rinsing.
- E) Phosphatizing – Dipping all the components for 5-7 min in the tank with bath conc. of 4% and Temp of 35 – 45⁰C.
- F) Passivation – Dipping all the components in the passivate solution for 4-5 min at room temperature to enhance the corrosion resistance.

Types of Phosphate Coatings :

Three principal types of phosphate coatings are in general use :

- A) Zinc phosphating.
- B) Iron phosphating.
- C) Manganese phosphating.

Applications :

- Base for the paints.
- Base for oil or other rust-preventive material.
- Lubricity and resistance to wear, galling or scoring of parts.
- A surface that facilitates cold forming.
- Temporary or short-time resistance to mild corrosion.
- A base for adhesives in plastic-metal laminations or rubber-to-metal applications.

SCOPE: Aroxy Coating Process For Discs.

PRINCIPLE: Aroxy is a surface nitriding process with epoxy coating on top. It is a case hardening process that involves the diffusion of nitrogen into the surface of the job at a temperature of about 550°C ~ 570°C and diffusion time from 90 to 120 min.

The treatment produces a duplex surface layer, (compact and porous areas) consisting of a ε – nitrides and Fe, C, N compounds, depth of which is independent on the composition of substrate. The process produces a surface having exceptional resistance to wear, seizure, scuffing, corrosion and fatigue.

PROCEDURE :

1. Precleaning carried out at 60°C ~ 80°C by electrically heated bath using standard degreasing alkaline solution. Further cleaning is done by 3-tank process in plain running water.
2. Preheating is done by gas fired furnace prior to surface nitriding especially for the jobs having unit weight more than 1 ~ 2 Kg. The preheating is carried out between 300°C ~ 350°C.
3. Actual Surface nitriding process is carried by using proper fixture, and for required 550°C ~ 570°C temperature for 1.5 hours.
4. Quenching is carried out in cold (room temperature) and hot water bath. The hot water tank is electrically heated (12Kw Capacity) having temperature 70°C ~ 90°C to avoid distortion if any, and removal of salt on the job surface.
5. Washing job in cold water so that 100% salt from job gets cleaned.
6. Epoxy powder coating on the jobs.

PROPERTIES :

1. **Resistance to Corrosion:** The corrosion resistance of a single phased compact surface layer which is obtained by combination of passivation and finishing treatment is significantly superior to many conventional anti – corrosion coatings (Chromium, Nickel, Zinc, etc).
2. **Resistance to Wear, Abrasion and Pitting:** These properties are achieved due to the single phase compound layer which is hard and ductile and has good frictional properties. The hardness of the compound layer varies from 600 to 800 HV, which effectively overcomes the problem of wear. Surface finish lead to a notable decrease of the coefficient of friction.
3. **Resistance to Fatigue :** Significant and important increase in fatigue strength is obtained by compressive stresses created in the nitrogen diffusion zone.
4. **No Hydrogen Embrittlement :** Surface nitriding also eliminates risk of failure due to hydrogen embrittlement – a major problem encountered with many applied coatings.

ADVANTAGES:

1. Aroxy coating process improves properties such as wear resistance, corrosion resistance to seizure.
2. The Compressive stresses produced on surface due to Aroxy coating process are more than any other method thus improving fatigue strength.
3. Aroxy coating process is a non-polluting, non-poisonous liquid bath nitriding process in which the bath consists of alkaline cyanates and carbonates stabilized by the addition of lithium compounds.

AROXY COATING ON DISC (PROPERTIES) :

1. NITRIDING HARD ZONE THICKNESS----- 12 ± 3 μ.
2. CORROSION RESISTANCE (SALT SPRAY)----- 200 Hours (min).
3. SURFACE NITRIDING HARDNESS----- 600 TO 800 HV.
4. EPOXY COATING THICKNESS ----- 40 – 50 Microns (min).

ZINC PLATING :

SCOPE : This technical data sheet covers requirements for electrodeposited zinc coatings applied to iron or steel components to protect them from corrosion except for coatings applied to components having threads of basic major diameter from 1.25 to 12.5 mm and coatings applied to sheet or wire in the unfabricated form or to close-coiled springs.

Reference Standard : IS 1573 – 1986, ASTM B 633 - 1985

FEATURES :

Zinc coating offers the following features.

Zinc protects steels cathodically, that is given by sacrificial protection in most environments and this protection is given to steel even at discontinuities in coatings. But zinc plating loses its initial brightness due to environmental conditions like dust, condensed moisture at high relative humidities, acidity, high ambient temperatures, etc, and forms bulky, white corrosion products, usually of basic zinc carbonate. One of the best methods of retarding this type of corrosion is by the application of inhibitive chromate passivation films. Passivation by chrome conversion coatings gives additional protection against corrosion.

PRECLEANING OF BASIS METAL :

Proper preparatory procedures and thorough cleaning of the basis metal should be done to ensure satisfactory adhesion and corrosion resistance performance coating. Remove all oil, grease and oxide films from basis material.

ZINC COATINGS :

CLASSIFICATION NUMBER ----- Fe / Zn 25
MINIMUM COATING THICKNESS----- 20 MICRONS
MAXIMUM COATING THICKNESS----- 30 MICRONS
SALT SPRAY TEST (ASTM B117)----- > 96 Hrs.

SUPPLEMENTARY TREATMENT :

Supplementary treatment shall be of type C – Iridescent and having following specifications.

TYPE----- C – IRIDESCENT
TYPICAL APPEARANCE ----- YELLOW IRIDESCENT
APPROXIMATE FILM DENSITY ----- 0.5 TO 1.0 g / m²
TYPICAL CHROMIUM CONTENT ----- 50 TO 100 mg / m²

HEAT TREATMENT AFTER PLATING HYDROGEN EMBRITTLEMENT RELIEF :

All electroplated parts having a tensile strength of 1200 MPa or higher shall be baked at a minimum of 190 °C for 3 hours or more within 4 hours after electroplating to provide hydrogen embrittlement relief.