



## Kanigen Group, your partner for electroless nickel plating

*Kanigen Group has been active in electroless nickel plating of technical parts since 1960. In addition to electroless nickel using the Kanigen® process, we also offer co-deposition layers such as electroless nickel with PTFE or black electroless nickel, but also amagnetic electroless nickel and diffusion deposits.*

### Electroless (chemical) surface treatment

Specializing in **electroless surface treatment** of technical products, Kanigen Group offers several versions of electroless nickel, using **the Kanigen® process**. This process gives the plated parts interesting new mechanical and chemical properties.

With its technical expertise, Kanigen Group sees itself primarily as a partner. Our ambition is to propose competitive and integrated solutions, not only to the system builders but also to their suppliers **in various markets**: automotive, semiconductor, industry, off-shore and defense.

Kanigen Group is an innovative company that continuously invests in its means of production in order to achieve the goals that have been set. Our 2 production sites allow us to ensure the logistic flow at all times and in all circumstances.

The strength of Kanigen Group is first of all, an experienced team of skilled technicians and a multilingual technical sales team that advises and assists customers with the necessary technical support !



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## Adapted Services

As a supplier, Kanigen Group is often part of a global process that involves multiple participants. For each of them, Kanigen Group tries to offer customized solutions meeting specific needs:

- Technical support for system builders and their suppliers during the development of a new product and / or project.
- Feasibility studies of the plating process of specific projects and products.
- The development and in-house manufacturing of specific tools to meet specific product requirements.
- Integration of peripheral processes.
- The integration of the packaging after final inspection, including labelling according to GALIA or VDA, as part of the logistic flow of system builders, including direct delivery to the assembly line of the end customer.
- Packaging according to high cleanliness standards



## Expertise and Quality

The Kanigen Group has always focused on its core business, i.e. the application of electroless nickel layers using the Kanigen® process, and the further development and industrialization of the production of its variants, in order to meet the market demand.



The Kanigen Group still makes its own chemistry according to the Kanigen® process. The recipe was adapted to meet the need for deposits with different phosphor contents (low, medium and high). Kanigen is equipped with inspection tools to guarantee a specific phosphor content according to the ISO4527 standard. It evolved over the years to become compliant with the current RoHS and ELV directives. The chemical regulation on REACH has also been integrated.

The two production units of the Kanigen Group are ISO9001:2008 certified. This certification was completed with the requirements expressed by the standard ISO/TS16949:2002.

## Sustainable and ecological entrepreneurship

Sustainable and ecological business development is part of the strategy Kanigen Group. We continuously invest in new advanced technologies respecting the environment.

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## Kanigen® process

*Kanigen® Nickel is a nickel-phosphor alloy (9-12 wt% P) obtained by a catalytic reduction in liquid phase, of a nickel-salt by an alkaline hypophosphite, with added heat but without using additional sources of electricity.*

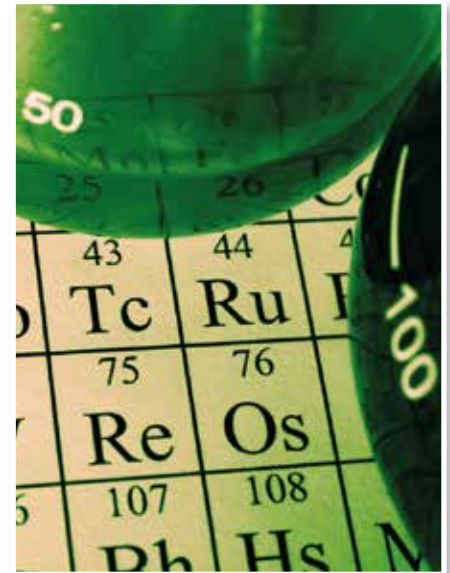
### Kanigen® process

The Kanigen® process, where Kanigen stands for KAlytic Nickel GENeration, was developed by G.A.T.X. (General American Transport Corporation) at the end of the 1950s. The first commercial electroless nickel plating process was intended to provide protection for storage drums intended for the transportation of caustic soda.

The name Kanigen® is still protected (registered) and only Kanigen Works Benelux has the right to use this trade mark in the Netherlands, Belgium, Luxemburg and France.

In contrast with electrolytic processes, the chemical Kanigen® process results in a very uniform plating that can also be applied very accurately. This process offers the plated parts interesting new mechanical and chemical properties. To meet specific needs, a phosphor content lower than 10 wt% P or higher than 10,5 wt% P can be guaranteed.

The electroless nickel process makes it possible to treat a broad spectrum of materials that are used in industry. The most common that are found at Kanigen Group are: construction steel, alloyed steel, cast iron, stainless steel, aluminium and copper alloys, silver ...





## Kanigen® electroless nickel

*Electroless nickel is an autocatalytic deposit composed of nickel (Ni) and phosphorus (P: 9% to 12% wt%). It is applied using the Kanigen ® process (electroless) by immersion in an aqueous environment offering new mechanical and chemical properties.*

### Accurate and uniform layer thickness

As a result, electroless nickel is ideal for geometrically complex precision parts, which can be plated, directly to final dimensions, without mechanical finishing, within the requested tolerances and without side effects.



Electroless  
nickel deposit



Electrolytic  
(galvanic)  
deposit



### Properties of Kanigen® electroless nickel

Due to its typical (high) phosphorus content in the deposit, Kanigen ® electroless nickel offers a range of interesting properties:

- corrosion resistance
- high hardness, wear resistance
- low friction coefficient (prevents galling)
- good adhesive deposit for soldering

Other properties : high degree of adhesion on the substrate, Röntgen amorphous structure (XRay-amorphous), in particular interesting for vacuum applications, very low degree of magnetism, ...

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## Variants

- Kanigen® electroless nickel – good corrosion resistance – hardness : 530 HV0,1
- Amagnetic electroless nickel – wt%P > 10,5
- Electroless hard nickel – hardness > 900 HV0,1 after heat treatment on 280°C – wear resistant
- Diffused electroless nickel – corrosion and wear resistance in extreme conditions: off-shore
- Electroless nickel with PTFE incorporated (NiPtef) – reduction of friction
- Mat black electroless nickel – for technical and optical applications

## Frictioncoefficient

	Not lubricated	Lubricated		Not lubricated	Lubricated
Kanigen® nickel vs steel	0,38	0,21	Kanigen® nickel vs chrome	0,45	0,30
Kanigen® nickel vs cast iron	0,16	0,08	Kanigen® nickel vs nickel	grip	0,26
Kanigen® nickel vs Kanigen® nickel	0,45	0,25	NiPtef vs Kanigen® nickel	0,10	-

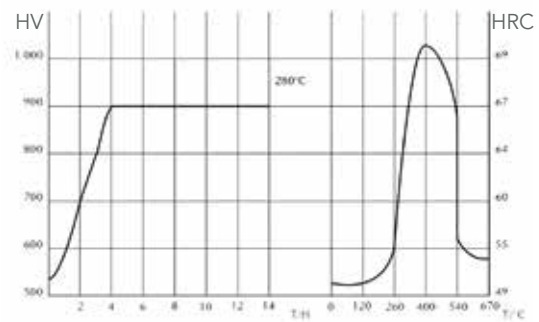
## Hardness

The hardness of a Kanigen® electroless nickel deposit :

- Without heat treatment : 530 HV0,1
- After 11 hours at 280°C : 900 to 950 HV0,1
- Maximal hardness after 1 hour at 400°C : 1050 HV0,1
- After diffusion heat treatment : 650 to 750 HV0,1

The hardness of a NiPtef deposit :

- Without heat treatment: 350 HV0,1
- After 11 hours at 280°C: 550 HV0,1



## Corrosion resistance

Resistance against corrosion according to "neutral salt spray test" ISO 9227 :

- Light service: 2µm – 10 µm 12 uur
- Mild service: 10 µm – 25 µm 192 uur
- Moderate service: 25 µm – 50 µm 480 uur
- Severe service: > 50 µm (75 µm) 960 uur

## Standards and means of production

Our electroless (autocatalytic) nickel deposits are plated according following standards as : ISO4527, ASTM B733, AFNOR A91-105 or others ... . The parts are plated in drums, mounted on racks, our on dedicated and customer specific mounting tools. We are equipped for:

- Single (prototypes) parts – small, middle and very large series.
- Very small till very large parts.

## Technical data

- Melting point 890°C
  - Dilatation coefficient 13 x 10<sup>-6</sup> cm / cm °C
  - Thermal conductivity (at 10,5 wt%P) = 0,016 cal.cm<sup>-1</sup>s<sup>-1</sup>grad<sup>-1</sup>
  - Electric resistance 50 to 60 µΩcm
  - Contact resistance 30mΩ
  - Magnetism (at 9 wt%P) 4% - (at 10,5 wt%P) 0%
  - Ductility 2,2% to 6%
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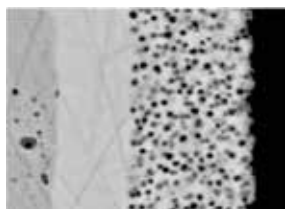


## Kanigen® electroless nickel with PTFE

*NiPtef is a co-deposition layer of Kanigen® electroless nickel as a support layer and a composite (dispersion) layer of Kanigen® electroless nickel with PTFE. This process gives the treated parts specific and functional characteristics: hard, self-lubricating and hydrophobic.*

### A composed deposit

Kanigen® electroless nickel is an electroless nickel deposit with a phosphor content of 9 -12 wt%, applied using the Kanigen® process. In the dispersion process of the NiPtef layer, PTFE particles with a diameter of 0.2 to 0.3  $\mu\text{m}$ , are incorporated homogeneously into the Kanigen® electroless nickel matrix.

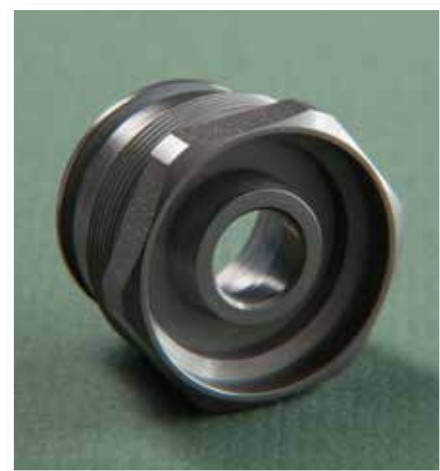


The bottom layer of Kanigen® electroless nickel, is applied for corrosion protection. The thickness of this layer is determined depending on the customer's specifications.

5  $\mu\text{m}$  : electroless nickel with PTFE (NiPtef)

Min. 2 à 3  $\mu\text{m}$  : Kanigen® electroless nickel

Substrate



### Resistance against wear

By incorporating a dry lubricant, PTFE, combined with hard a electroless nickel matrix, electroless nickel with PTFE is an excellent alternative to the problem of wear and friction between two surfaces.

The wear and friction properties of NiPtef surface layers are determined by the properties of the two materials:

- hardness by the nickel - phosphorus matrix,
- low friction coefficient and self-lubricating effect due to the PTFE particles.

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## Frictioncoefficient

	Non lubricated	Lubricated
Steel vs steel	galling	0,20
NiPtef vs steel	0,15	-
NiPtef vs Kanigen®	0,10	-
NiPtef vs NiPtef	0,05	-

## Hardness

The hardness of a NiPtef deposit is:

- Without heat treatment : 350 HV0,1\*
- After 11 hours at 280°C : 550 HV0,1\*

\*mixed hardness (Vickers and shore) measured in HV0,1 on a test plate with 50 µm deposited NiPtef.

## Anti-adhesive coating

The energy for physically separating those Nickel-PTFE layers with 20V% PTFE, is about 18.6 mN/m, meaning that surfaces coated with NiPtef have very low adhesion characteristics towards other materials.

## Other properties of electroless nickel deposits with PTFE

Polymers (like PTFE) have an elasticity modulus which is at least 2 orders of magnitude greater than that of metals, meaning that deformation under stress is mostly an elastic deformation.

PTFE is non-reactive material with a melting point of 325°C. PTFE has a very low friction-coefficient with values determined around 0,05. The low friction-coefficient of PTFE is explained by the structure of the polymer molecule, which enables polymer chains to glide over each other when subjected to a certain shear stress. This behaviour spreads the PTFE easily over the gliding surfaces, on which it will form a very thin lubricating film.

The Tabertest, which has been designed to determine the resistance of surfaces against wear by friction, has shown that the incorporation of 1% PTFE in the electroless nickel plating reduces the weight-reduction by half, compared to non-lubricated electroless nickel plating.

By the test of the crossed cylinders, the wear due to adhesion and the friction coefficient is determined. The results of these tests have shown that the composite coatings containing 20-30% of PTFE, show wear which is 3 orders of magnitude lower than an electroless nickel plating. The friction coefficient is maintained on a low level due to transition of PTFE on the opposing surface.

## Applications

- Dry lubrication
- Reduction of friction
- Reducing adhesive characteristics
- Improving wear- and durability
- Rejection of water and dirt

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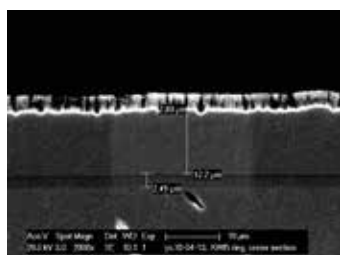


## Kanigen® black electroless nickel

*Black Electroless Nickel consists of an electroless kanigen® nickel plating, with a second electroless nickel plating layer, with specific wt% P, on top. That top layer is then passivated until a uniform mat black colour is obtained and meets specific technical and optical need.*

### Mat black electroless nickel deposit

This layer, perfectly black and mat, without iridizations, combined with a high phosphorus electroless nickel coating, allows us to serve markets in search of a visual aspect combined with specific chemical, mechanical and optic (absorption and emission) properties.



- 2 à 3 µm : black passivated deposit
- 5 à 8 µm : low phosphorus electroless nickel
- Min. 2 µm : Kanigen® electroless nickel
- Substrate



The corrosion resistance is determined by the high phosphorus electroless nickel layer, whose thickness is determined depending on the needs of the customer.

### Properties of black electroless nickel

- Colour: mat black (22 on L.A.B. scale), homogeneous and uniform, repeatable without iridizations
- Hard (8H) with limited abrasion and scratch resistance
- UV stable
- Good UV absorption and IR emission
- Good corrosion resistance

### Applications

- Military telecom connectors
- Visible parts of electro-mechanical components
- Refrigeration systems
- Direct integration into weapon systems
- Laser and optical applications
- Vacuum applications

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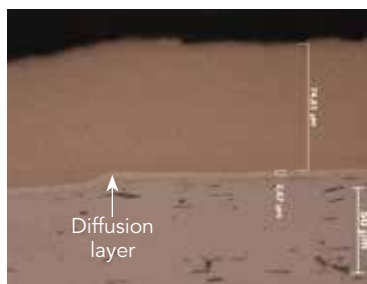




## Kanigen® diffused electroless nickel

*High phosphorous diffusion electroless nickel is an Kanigen® electroless nickel deposit which diffuses, after a specific heat treatment, into the carbon steel substrate resulting in a very high corrosion- and wear resistance in very severe conditions such as off-shore or subsea.*

### Diffusion heat treatments



After plating the part with Kanigen® electroless nickel, a heat treatment at high temperature is applied. As result of the chosen heating temperature and time, a diffusion layer between the Kanigen® electroless nickel deposit and the steel substrate appears:

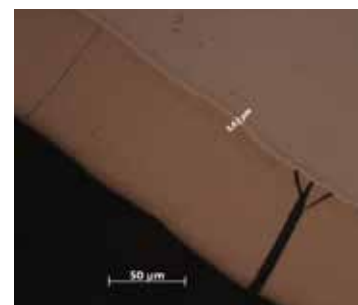
- Heat treatment at 620°C : average diffusion layer thickness of 2 to 4 μm
- Heat treatment at 650°C : average diffusion layer thickness of 3 to 5 μm



After Heat treatment in an atmospheric oven, a typical olive green colour appears. In an oven with inert gasses or under vacuum, the deposit maintains its metallic aspect.

### Properties of high phosphorous diffused electroless nickel

- High phosphor content
- Very good resistance against wear and corrosion > 1 000 hours (neutral salt spray test)
- High wear resistance in marine environment
- Electroless nickel deposit in compressive stress.
- Hardness of the deposit after heat treatment: 650 - 750 HV0,1.
- Applied layer thickness: 25 μm, 50 μm, 75 μm or more function of the specification or standard to be applied.
- After bending over a mandrel through an angle of 180° until failure of the basis occur, according to ASTM 571, no cracks appear in the diffusion layer.



### Applications

- Gasflow meters for natural gas
- On- & Offshore
- Subsea

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