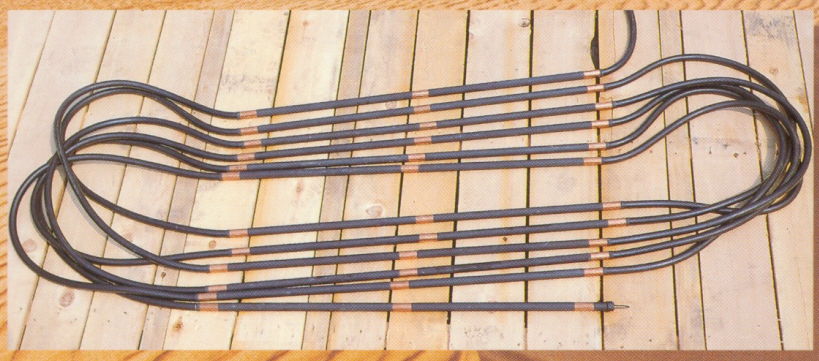
LIDA®

CATHODIC PROTECTION



DE NORA S.p.A.

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INTRODUCTION TO DE NORA S.p.A.

DE NORA S.p.A. is part of the DE NORA Group, recognized throughout the world as standing for excellence in electrochemical plants and DSA® anode manufacturing and supply. DE NORA S.p.A. markets technologies in the field of impressed current cathodic protection systems based on LIDA® anodes.

LIDA® mixed metal oxide coated titanium anodes are based on technology developed in the early 1960's for industrial production of chlorine and caustic soda. This technology was progressively extended into the important field of cathodic protection during the early 70's. LIDA® anodes are manufactured in Milano (Italy), Singapore, Sorocaba (Brazil), Goa (India), Rodenbach (Germany) at the production facilities of DE NORA Group. LIDA® is said to end users of cathodic protection systems via a world-wide distributor network.

LIDA®

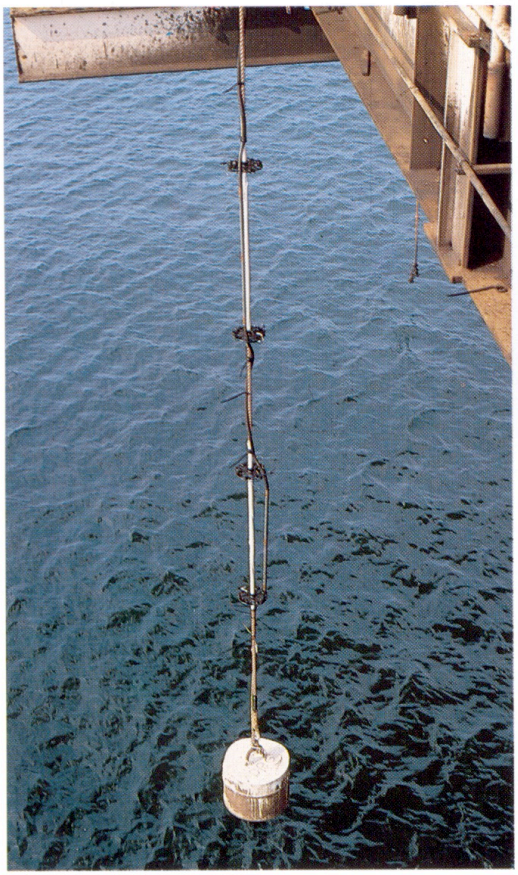
The corrosion of buried or submerged metal structures is a worldwide problem having an economic impact on everyone. It was estimated by the U.S. Department of the Interior that Corrosion costs each individual US $ 1,500 per year; 80% of this cost could be saved using currently known technology. Until now, the anodes available to the corrosion engineer offered a compromise between high weight, difficulty in handling, life and cost. LIDA® anodes have solved these problems and are the most cost-effective, easy-to-install and reliable anode choice.

LIDA® mixed metal oxide coated titanium anodes are based on electrode technology development in the early 1960's for industrial production of chlorine and caustic soda. This technology has been progressively extended into the field of cathodic protection.

The history of LIDA® anodes in the cathodic protection industry dates back to a jetty in Italy protected with 24 LIDA® rod anodes in 1971; as of this pronting all anodes are still operating and protecting the structure. In the 24 years since then, several thousand LIDA® anodes have been installed around the world with similar excellent results. There are currently over 14,000 deep, horizontal and shallow groundbed installations, with more being installed each day.

LIDA® ANODE HIGHLIGHTS

1960's	DSA® development period
1970's	DSA® completely displaces Graphite in the Chlor-Alkali Industry
1971	First commercial Cathodic Protection installation. 24 Rod Anodes installed in Sea Water for the protection of a Jetty in Italy.
1981	First commercial groundbed installation in Italy.
1984	First commercial groundbed installation in USA protecting a pipeline.
1984-1998	Over 14,000 groundbeds installed. Numerous successful Offshore and Industrial Installations, with more anodes being installed each day.



LIDA® anodes halt corrosion on offshore structures (platforms, sealines, well casings)

LIDA® anodes are installed in conventional or deep groundbeds to protect transmission and distribution lines.

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PROPERTIES OF LIDA®

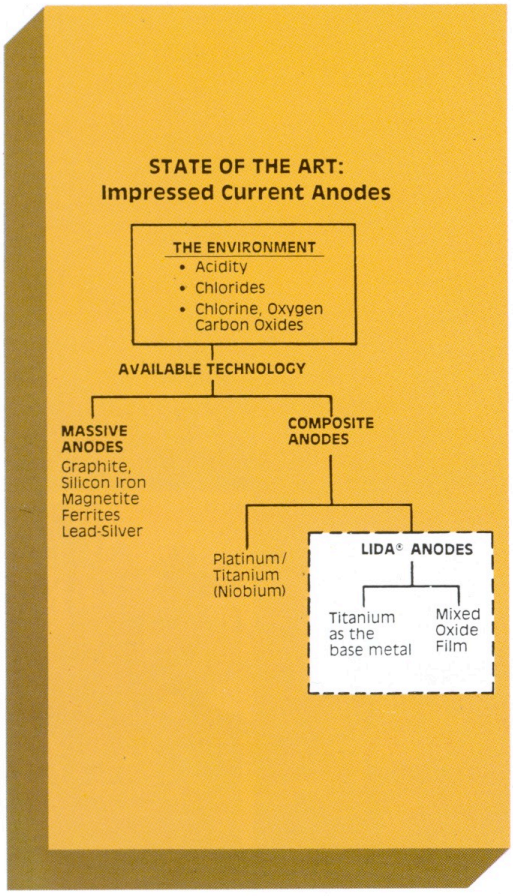
The choice of a reliable anode, with an adequate life expectancy, is a complicated matter. The cathodic protection engineer can choose between massive anodes (graphite, silicon-iron, magnetite, ferrite) and composite anodes (platinized titanium / niobium or LIDA®).

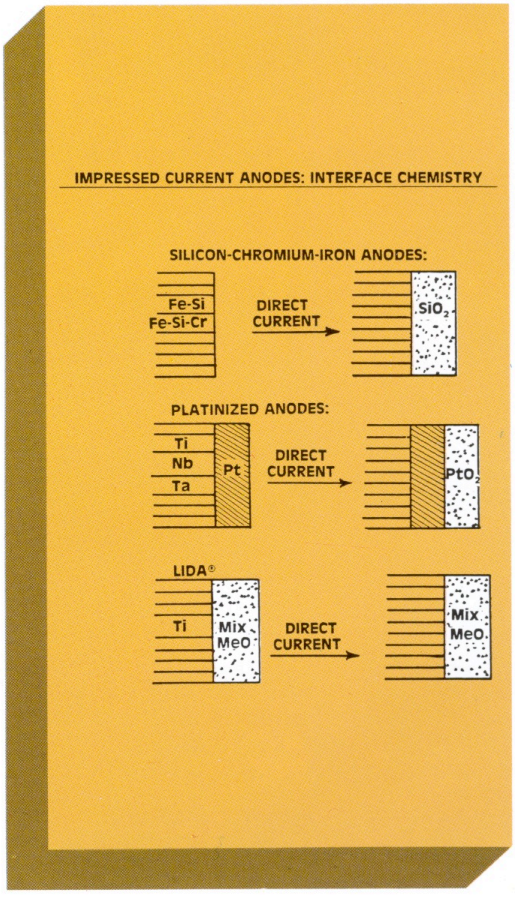
Massive anodes, especially graphite and silicon-iron alloys, are usually subject to high consumption rates, and even for a ten year life, must have a considerable mass. In addition, these anodes are very brittle, which limits ease of handling in the field. Electrical connection failures are common for end or center-connected massive anodes.

Composite anodes offer a good technical answer to these drawbacks. A ductile, corrosion resistant base metal provides for the overall toughness of the system. Titanium, or in some cases niobium, is a common choice. However, since the two materials tend to be covered by a layer of insulating oxide, their surface must be coated with a conductive film.

These electroconductive films may take on many compositions. They may be based on noble metals such as platinum, either clad or deposited. LIDA® anodes feature an electroconductive coating of mixed metal oxides, forming a solid solution with the titanium substrate and exhibiting electrical properties which allow the composite to function as an anode. The characteristics of the LIDA® mixed metal oxide coating are:

- Excellent electronic conductor (resistivity of 10^{-5} ohm cm).
- Deposited on the substrate by thermal decomposition and therefore anhydrous and insoluble in acids.
- Thermal treatment favours crystallization, which enhances the chemical stability.
- Low and uniform wear rate.





ADVANTAGES OF LIDA®

☐ MULTIPLE PRODUCTION AND ASSEMBLY LOCATIONS

DE NORA S.p.A.
Milano - Italy

DE NORA
do Brasil S.A.
Sao Paulo
Brazil

DE NORA
Pte - Ltd
Singapore

Titanor
Components Ltd
Goa - India

☐ **HIGH CURRENT OUTPUT** - Just as with any other anode current density affects the service life of LIDA® anodes. The maximum anode current density normally recommended for the design of LIDA® systems varies with the environment and temperature as per the definitions in the LIDA® specifications.

• Soil (with carbonaceous backfill)	100A/m² (9.3A/ft²)
• Fresh water	100A/m² (9.3A/ft²)

Note: temperature from 5 to 70 °C

• Sea water	600A/m² (55.7A/ft²)
• Brackish Waters	100-300 A/m² (9.3-27.9A/ft²)
• Muds	50-100 A/m² (4.6-9.3 A/ft²)

Note: temperature from 10 to 70 °C

☐ **ECONOMICAL** - In conventional groundbeds, the typical savings are 20-25% versus Silicon-Iron or Graphite anode systems on an installed cost basis. Savings are even greater for deep groundbeds. LIDA® rod anode assemblies are normally more cost effective than comparable platinum rod systems. LIDA® wire anodes are competitive on an installed cost basis versus platinized wire. LIDA® strips offer an economical alternative to silicon iron or graphite anodes when used as single anodes in shallow vertical or horizontal groundbeds, or as canistered anodes.

☐ **ACIDITY** - The characteristics of the LIDA® mixed metal oxide coating enable it to withstand severe conditions of very low pH without increasing the wear rate.

☐ **READY-TO-INSTALL** - All LIDA® anode assemblies arrive at the jobsite ready for installation. LIDA® tubular anode strings involve no field splicing or heat shrinking. These strings can even be shipped with centralizers, bottom weights and vent pipe attached. LIDA® rod assemblies are threaded and include a junction box for electrical connection. A variety of custom assemblies for specific applications (large diameter water tanks, off-shore platforms, travelling screens, locks and dams, rakers, etc.) are also available.

☐ **LONG SERVICE LIFE** - Essentially negligible consumption has been observed on the mixed oxide LIDA® coating at the recommended current densities, resulting in extended service life. LIDA® systems in sea water are designed for a nominal life of 20 years, and LIDA® systems in other environments are engineered for a 20 or 30 years nominal life. The electrocatalytic coating shows excellent stability even in very acidic environments.

☐ **DIMENSIONAL STABILITY** - LIDA® anodes are not subject to variations in shape and length during life due to the negligible consumption of the electrocatalytic coating. This provides for a constant flow of current and anode resistance during the working life.

☐ **ELECTROLYTE** - The service life of any anode is dependent upon the nature of the electrolyte in which it is immersed. The composition of the LIDA® coating has been developed by De Nora to match the relevant oxygen or chlorine evolution conditions.

Four basic types available are:

Soil	(S)
Sea Water	(SW)
Fresh and Brackish Waters	(FW)
Muds	(M)

☐ **QUALITY ASSURANCE** - Our personnel monitor the progress of every order throughout its fabrication. Base metal preparation, coating application, electrical connection, anode assembly, packaging and shipment are carefully controlled to provide the highest quality anode.

QUALITY CONTROL DOCUMENTATION IS AVAILABLE ON REQUEST.

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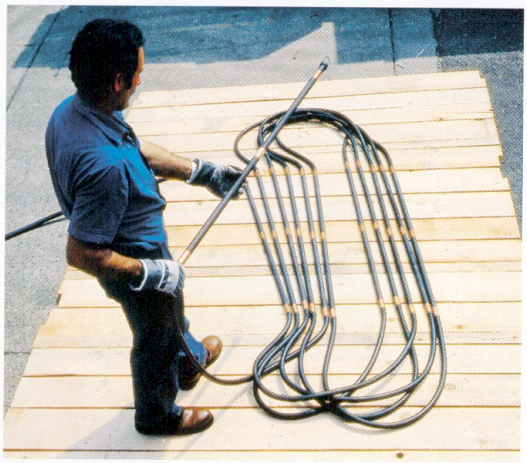
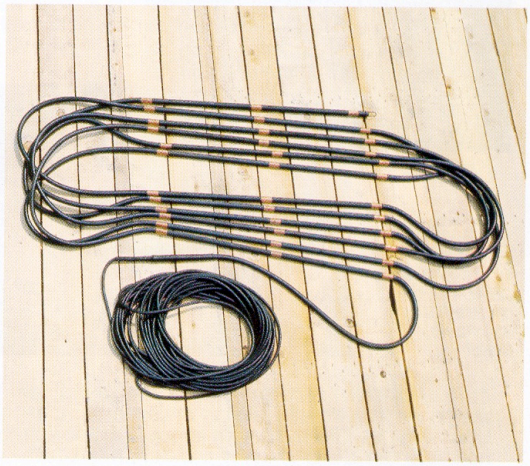
TYPES OF LIDA®

LIDA® anodes can be supplied in various shapes, according to customer technical requirements.

Because special anodes are made according to client specifications, coated special anodes are not stored in inventory, but uncoated titanium rods or plates are available for a quick production according to the requested design.

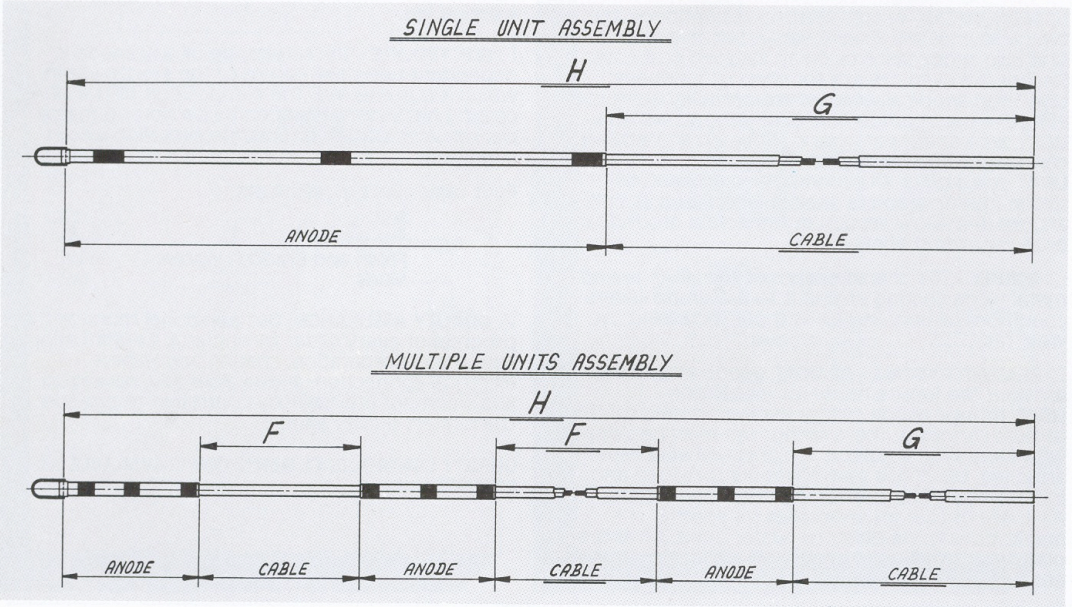
All LIDA® anodes are available with soil (ST), fresh water (FW), sea water (SW) or mud type (MT) coating.





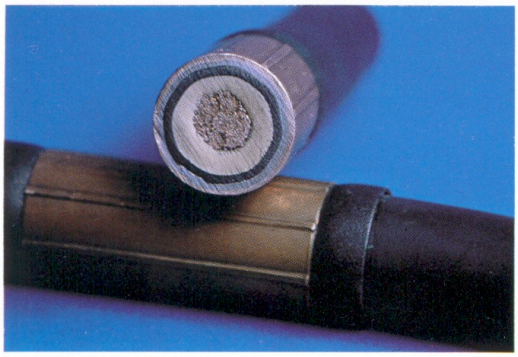
1. LIDA® TUBULAR ANODE ASSEMBLIES

LIDA® tubular anodes are assembled as single or multiple anode strings using a worldwide patented procedure (US patents 4,452,683 and 4,526,666). This system which is unique in the industry - allows De Nora to custom assemble strings of the desired length of cable and number of anodes to exactly meet the design requirements.

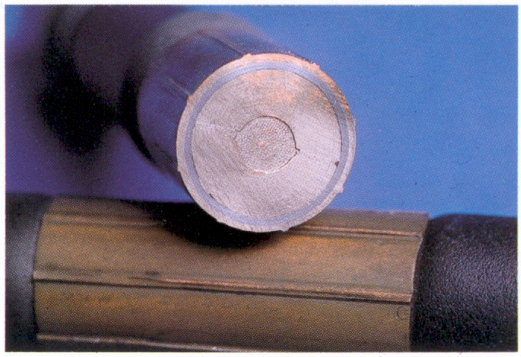


1. LIDA® TUBULAR ANODES (continued)
Patented LIDA® Cable-to-Anode Connection

Statistical data shows that a large number of system failures are due to a breakdown of the electrical connection between the cable and anode.
Traditional anodes are connected to the cable with resin based seals; these seals may develop cracks or lose adhesion to the cable or to the anode, with consequent penetration of moisture and ultimate corrosion of the electrical contact. The LIDA® patented connection - obtained in the plant by plastic deformation of the titanium tubes onto the cable - eliminates the need for resin based seals. The sealing actions results from elastic pressure developed by the rubberlike cable sheathing, allowing a long term service life.



Anode-Cable sealing at each end



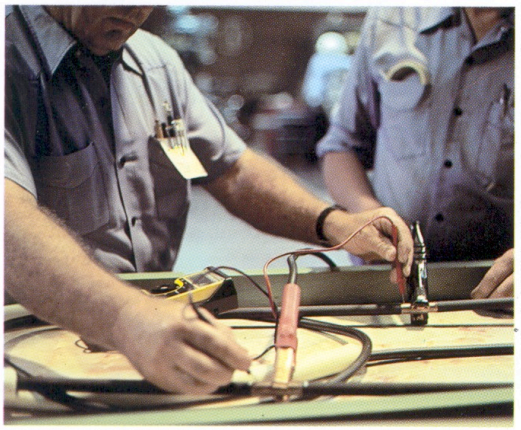
Anode-Cable electrical connection at the centre

Quality assurance

LIDA® tubular strings are shop assembled and undergo 100% quality control testing on all the components before leaving the factory, including:

- electrical and chemical tests on the cable
- helium leak test and pressure test to check each cable-anode seal
- electrochemical tests on the mixed metal oxide coating
- electrical resistance test on the cable-to-anode connection

QUALITY CONTROL CERTIFICATES CAN BE PROVIDED ON REQUEST.



Electrical continuity and resistance test

Helium leak test

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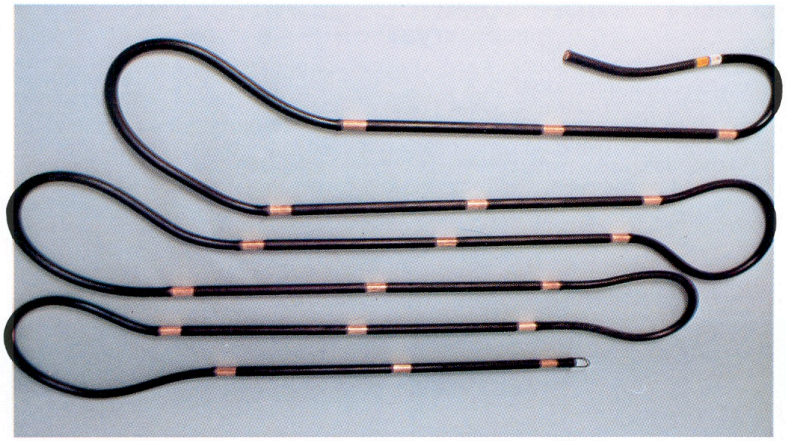
1. LIDA® TUBULAR ANODES (continued)



The following table lists the tubular anodes available and their characteristics:

DESIGNATION	DIAMETER cm/in.	LENGTH cm/in.	CURRENT OUTPUT Amps (temperature from 5 to 70°C)	CURRENT OUTPUT Amps (temperature from 0 to 5°C)
SOIL (WITH CARBONACEOUS BACKFILL) *				
S.T. 2.5/50	2.5/1.00	50/19.7	4	2
S.T. 2.5/100	2.5/1.00	100/39.4	8	4
S.T. 1.6/50	1.6/0.63	50/19.7	2.5	1.25
S.T. 1.6/100	1.6/0.63	100/39.4	5	2.5
(*)For operation in soils without carbonaceous backfill or in open holes, please contact De Nora S.p.A. for recommended current outputs.				
FRESH WATER				
FW.T. 2.5/50	2.5/1.00	50/19.7	4	2
FW.T. 2.5/100	2.5/1.00	100/39.4	8	4
FW.T. 1.6/50	1.6/0.63	50/19.7	2.5	1.25
FW.T. 1.6/100	1.6/0.63	100/39.4	5	2.5
			(temperature from 10 to 70°C)	(temperature from 0 to 10°C)
BRACKISH WATER				
FW.T. 2.5/50	2.5/1.00	50/19.7	4÷12(*)	2÷6
FW.T. 2.5/100	2.5/1.00	100/39.4	8÷24	4÷12
FW.T. 1.6/50	1.6/0.63	50/19.7	2.5÷7.5	1.25÷3.75
FW.T. 1.6/100	1.6/0.63	100/39.4	5÷15	2.5÷7.5
SEA WATER				
SW.T. 2.5/50	2.5/1.00	50/19.7	25	5
SW.T. 2.5/100	2.5/1.00	100/39.4	50	10
SW.T. 1.6/50	1.6/0.63	50/19.7	15	3
SW.T. 1.6/100	1.6/0.63	100/39.4	30	6
MUD (TYPICAL)				
M.T. 2.5/50	2.5/1.00	50/19.7	2-4(*)	1.5
M.T. 2.5/100	2.5/1.00	100/39.4	4-8	3
(*)Current outputs in brackish water depend on site conditions and chloride concentrations. Current outputs in mud depend on site conditions (sea mud or river mud, etc). Please contact De Nora S.p.A. for technical advice.				

NOTES:

1. The 1.6 cm (0.63 in.) diameter tubular anodes are assembled on LIDA® EPR/CSPE 16 sq. mm. (6 awg) cable.
2. The 2.5 cm (1 in.) diameter tubular anodes are assembled on LIDA® EPR/CSPE 50 sq. mm. (1/0 awg) cable.
3. Anodes installed in Soil or Fresh Water are operated for a nominal design life of 30 years. SW.T. Anodes, are operated in flowing sea water for a 20 years nominal design life. Anodes installed in Brackish Water or mud are operated for a 20 years nominal design life.
4. All anodes are assembled with protective PTFE plastic sleeves on the cable extending approx 10 cm from both anode ends.
5. For installations in chloride rich soils, muds or in open holes containing chloride rich waters, a protective PTFE sleeve can be provided, on request, on the total cable length.
6. For applications in environments and temperatures different from those mentioned above, please contact De Nora S.p.A. for technical advice.

Please specify number of anodes, anode types, length of cable and spacing between anodes.
Please also specify any "optional" design (configuration, combination of 50 and 100 cm anodes on same cable or uneven spacing) at the time of order placement.

2. LIDA® ROD ANODES

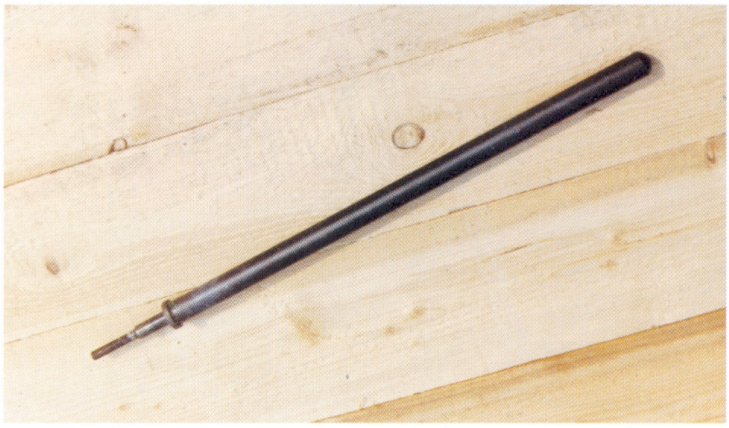
Rod anodes are used for many different applications: internal protection of industrial equipments (heat exchangers, filters, boilers and pipelines), sea water intakes, screening equipments.

Typically LIDA® rods are connected by a threaded coupling to the feeder cable, then hermetically encapsulated. The feeder cable is then passed through a conduit for mechanical protection.

Standard diameter for LIDA® RODS are: 6 - 8 - 12.7 - 16 - 20 - 24 - 25 - 30 and 32 mm.

Platinized rods are also available.

Tantalum and Niobium substrate materials are available on request.



3. LIDA® WIRE

LIDA® wire can be used in soil, fresh water or sea water.

Typical applications of LIDA® wire are: internal cathodic protection of industrial equipments: (boilers, filters), cathodic protection of tumulated tanks, localized cathodic protection of pipelines and other buried structures.

WIRE DIAMETER (mm)	Current Output (Amps/m)			Electrical resistance (Ohm/m)
	Soil (ST) with backfill	Fresh Water (FW)	Sea Water (SW)	
3	1	1	6	0.083
1.5	0.5	0.5	3	0.33

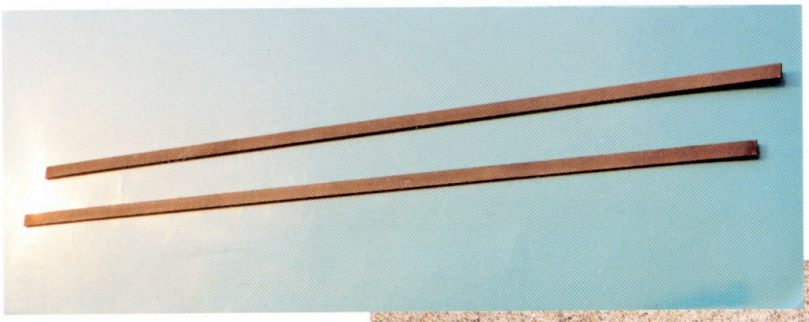
Platinized wire is also available.

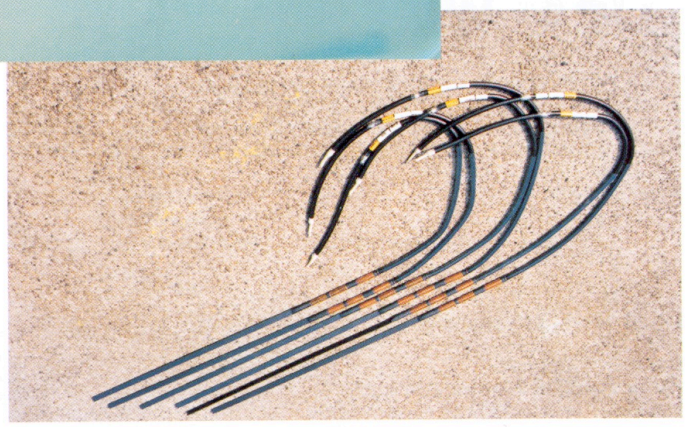
Tantalum and Niobium substrate materials are available on request.

4. LIDA® STRIPS

LIDA® strips consist of titanium strips coated with soil (ST), Fresh Water (FW), mixed metal oxide coating.
— Delivered in standard length of 3m, they can be easily cut to different lengths, depending upon the CP current needs.
— Ideal for single anode assemblies, such as canistered anodes or shallow continuous groundbeds.
— Electrical connection to all type of CP cables can be made with standard epoxy kit splice.

	Max Current output / metre AMPS (Temperature from 5 to 70° C)
Soil with backfill	4
Soil without backfill	2
Fresh water	5
Standard length	3 m
Width	20 mm
Thickness	3 mm
Electrical resistance	0,0092 Ohm/m
Weight/meter	0,27 Kg





5. LIDA® PLATES AND DISKS

Plates and disks are made according to customer design and can be supplied complete of titanium current feeder, threaded or not.

Main applications for LIDA® plates and disks are cathodic protection of ship hulls and other metallic structures exposed to sea water.

Standard thickness for titanium sheets are 0.5 - 1 - 3 - 4 - 5 - 6 - 8 - 10 - 15 mm.

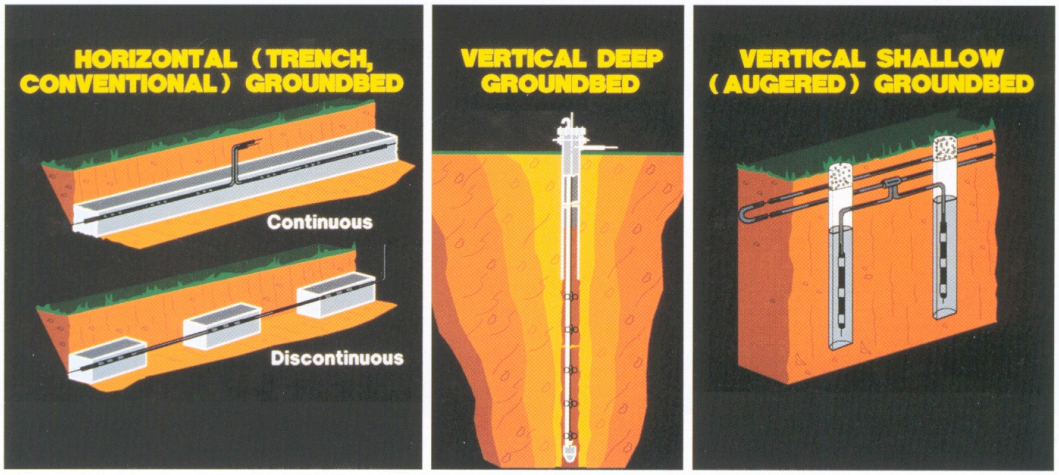
Platinized plates and disks are also available.

Tantalum and Niobium substrate material are available on request.

LIDA® : SOIL APPLICATIONS

Tubular LIDA® assemblies are installed in deep, shallow vertical and horizontal groundbeds.

LIDA® strips and LIDA® wire are an economical and practical solution for shallow vertical and horizontal groundbeds.



INSTALLATION OF LIDA® STRINGS

STEP 1

OPEN THE BOX

String characteristics:

- Current output: 80 A
  (High current output)
- n° 10 anodes ST 2.5/100
- Cable length: 100 m.
- Net weight: 95 Kg.
  (Lightweight)

STEP 2

TAKE THE LIDA® STRING OUT OF THE BOX

- The LIDA® string is delivered ready for installation.
  (Saving of installation time)

STEP 3

INSERT THE LIDA® STRING INTO THE GROUNDBED

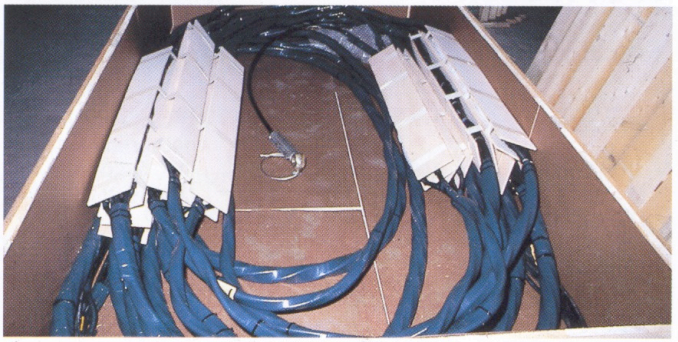
- No cranes or special tools are necessary for the installation.
  (Saving of installation costs)
- Installation is usually done manually by one or two installers.
  (Easy installation)

LIDA®: OFFSHORE AND MARINE APPLICATIONS

Cathodic protection with impressed current in sea water is used where, for technical or economic reasons, this method is more convenient than with sacrificial anodes. This is the case, for instance, for coastal structures such as piers, harbor installations, and platforms where protection with sacrificial anodes requires an unacceptable weight of anodic material, and in the retrofitting of all structures in deep waters where the replacement of sacrificial anodes poses economic and technical problems. LIDA® anodes can be used to great advantage in the protection of the above mentioned structures.

TENSIONED STRING: MORE THAN 65.000 AMPERES INSTALLED WORLDWIDE

This consists of one or more tensioned steel or Kevlar™ supporting ropes, which serve as a mechanical support to the anode cable and LIDA® tubular anodes.



SOME METHOD OF INSTALLATION OF LIDA® ANODES FOR MARINE APPLICATION:

PILE MOUNTED ANODES:

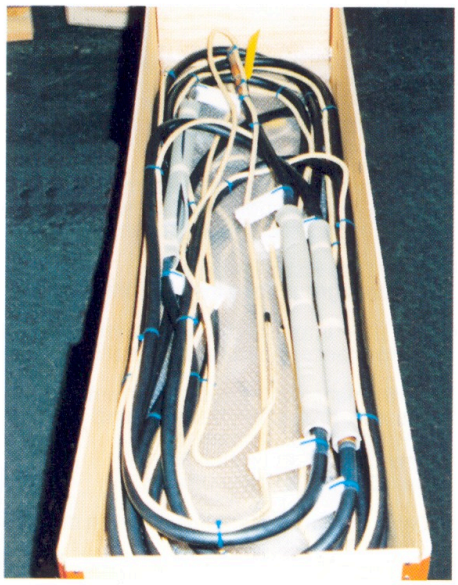
LIDA® tubular, rod or plate anodes can be assembled onto support of plastic material and used as pile mounted anodes. Double Armoured cable is available.

BURIED REMOTE STRINGS:

In this case, the anode structure consists of an armoured feeder cable on which the LIDA® anodes are assembled. The anode strings are then laid on the sea bottom or buried in it. This is considered a sea mud installation.

SEA BOTTOM SLED ANODES:

LIDA® anodes can be assembled onto GRP or concrete sleds or other support frames to allow remote current delivery to the structure

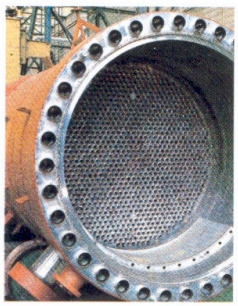


Kevlar™ tensioned string ready for delivery

LIDA®: INDUSTRIAL APPLICATIONS

A variety of different metallic structures can be cathodically protected such as chemical and petrochemical plants, refineries, storage tank farms, and power stations. In a power station, for example, cathodic protection is required for cooling water intakes, screening equipment, cooling water pumps, condenser water boxes, pipe networks, and oil storage tanks. Each one of these metallic structures requires proper cathodic protection designed to meet protective current requirements and current distribution.

The most pertinent qualities required of the anode material for such uses are the capability to operate at different current densities and the availability of different shapes to fit various geometric requirements. LIDA® rods are used for the protection of condenser water boxes and internal surfaces of pipes. LIDA® wire, strips and rods are used in protecting screening equipment and water intake structures.



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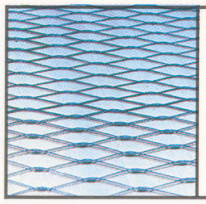
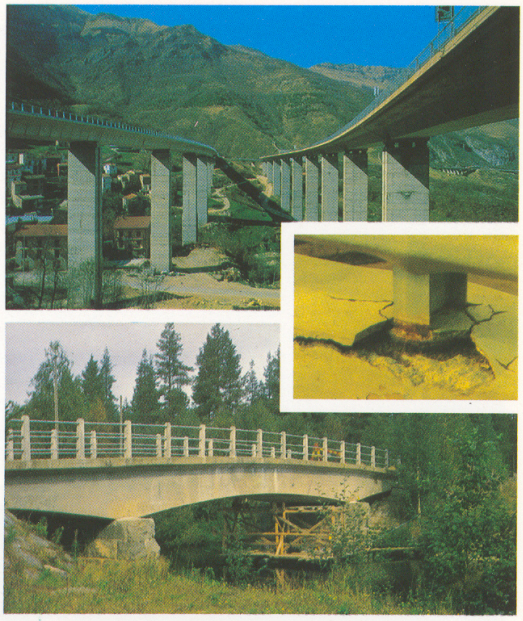


ACTIVATED TITANIUM ANODE NET FOR CATHODIC PROTECTION OF STEEL IN CONCRETE

LIDA® NET

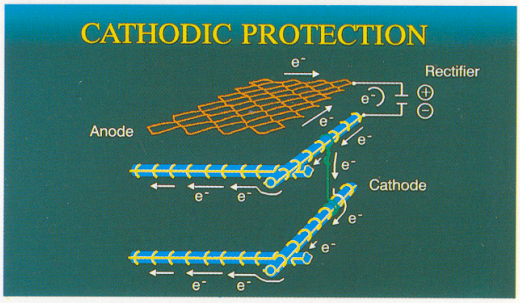
THE CORROSION OF STEEL IN CONCRETE

The corrosion of steel in concrete is one of the toughest challenges facing the construction industry worldwide. The cost of replacing all of the defective bridgedecks in the U.S.A. alone has been estimated to exceed 100 billion dollars.
Corrosion of the reinforcing steel in parking garages, buildings and concrete pads (in petrochemical process plants) is a major problem with staggering economic implications. The most common corrosion process starts when critical quantities of chlorides (from de-icing salts; from sea water in the spray zone or tidal areas) penetrate to the level of the reinforcing steel. The corrosion product of steel, rust, occupies several times the volume of the original steel, exerts high stresses upon the surrounding concrete and ultimately cracks it. Cracks develop into fissures, accelerating the introduction of more chlorides, and causing further corrosion and cracking. The result is spalling, delamination, potholing, and weakening of the structure.



CATHODIC PROTECTION WITH LIDA® NET IS THE REMEDY

Traditional approaches to control the corrosion of steel in concrete attempt to prevent the contaminants from reaching the reinforcing steel. It has been revealed, however, that these interventions do not attack the root of the problem, i.e. the salt already inside the concrete.
As The FHWA has concluded, (see box), the use of cathodic protection can stop corrosion in already salt-contaminated concrete. Cathodic protection can also be used as corrosion prevention technique when applied to new concrete structures: future corrosion caused by chloride contamination can be prevented from the beginning of the life of the concrete structures.
By connecting the LIDA® anode net and the rebar (cathode) to a low level D.C. power supply, the steel is made cathodic and no further corrosion can occur.



Quote from a letter of the
FEDERAL HIGHWAY ADMINISTRATION (FHWA)

..... The only rehabilitation technique that has proven to stop corrosion in salt contaminated bridge decks regardless of the chloride content is cathodic protection..... .

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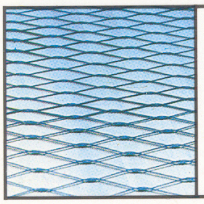


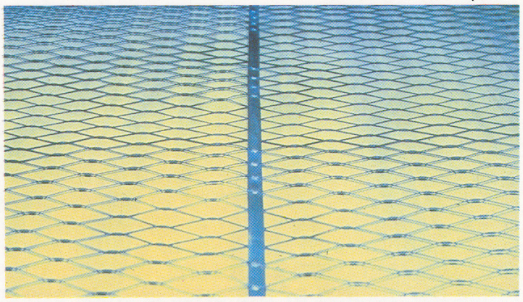
ACTIVATED TITANIUM ANODE NET FOR CATHODIC PROTECTION OF STEEL IN CONCRETE

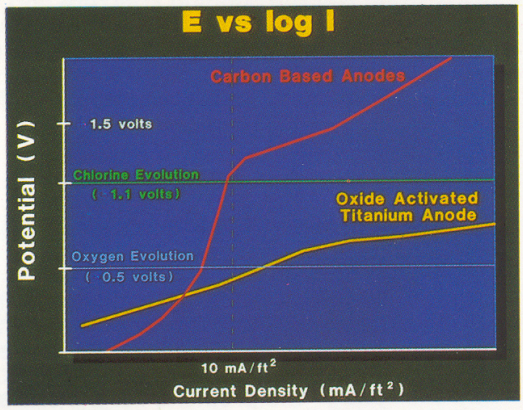
LIDA® NET

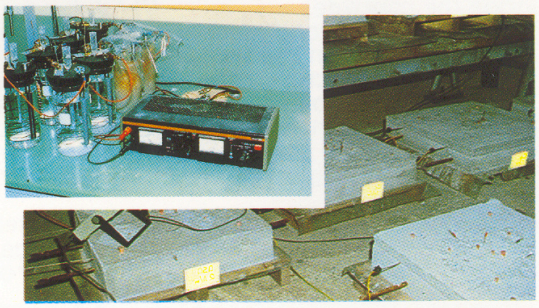
THE LIDA® NET

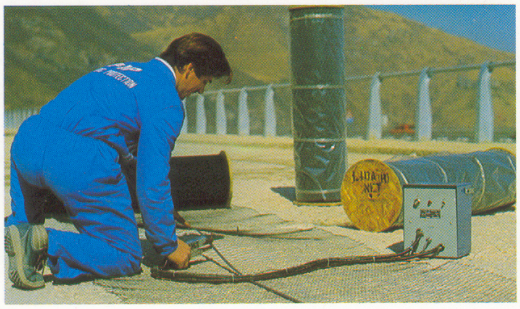
LIDA® is the Leader in Mixed Metal Oxide Anode Technology.
LIDA® impressed current anodes have been used for the cathodic protection of buried or submerged metal structures since the early 1970's. The LIDA® Anode Net was introduced in the 1980's for cathodic protection of steel in concrete.

- ☐ TOUGH BASE METAL - The LIDA® Anode Net utilizes expanded Titanium as the substrate to provide a strong, flexible, corrosion-resistant, lightweight and stable base for the system. Since the Titanium is not consumed by the electrochemical reactions at the anode, there exists a strong permanent bond to the surrounding concrete.
- ☐ ACTIVATION COATING - The inert, electroconductive catalytic coating on the LIDA® Anode Net consists of a mixed metal oxide applied via a ceramic process. This coating exhibits negligible consumption. Whereas carbon based anode systems produce a mixture of chlorine, oxygen and carbon dioxide, the LIDA® Anode Net produces mainly oxygen. LIDA® Anodes generate less acidity than carbon based anodes. When long life and minimal effect on the integrity of the concrete are of prime concern, the LIDA® Anode Net is the choice.
- ☐ TESTED AND PROVEN - Concrete slabs, were part of an extensive testing programme conducted on the LIDA® Anode Net to determine the longest life, optimum coating composition and ideal anode current density. LIDA® Anode Net is proven with installations around the world.
- ☐ EVEN CURRENT DISTRIBUTION - The highly expanded mesh pattern provides uniform cathodic protection current to the rebars. Low electrical resistance and suitably spaced conductor bars ensure that current reaches all points. Redundancy of paths makes the LIDA® Anode Net immune to failure from cracks, fissures, core samples or sawcuts.
- ☐ PRE-FABRICATED - The LIDA® Anode Net arrives at the jobsite ready to be rolled out, fastened down and connected. Quick, all-weather installation is possible because there is no need to wait for curing, mixing of chemicals, cutting of slots or spraying of paints. There are no electrical splices in the concrete.
- ☐ QUALITY CONTROL - The LIDA® Anode Net is expanded, coated and packed at the De Nora Permelec facilities in Milan, Italy, under stringent quality control conditions. Only grade 1 Titanium is used for the substrate. The ceramic coating process is monitored at each step of the activation cycle. Quality control certificates are provided on request.









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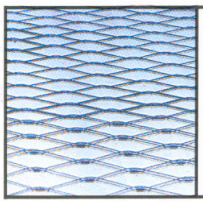

ACTIVATED TITANIUM ANODE NET FOR CATHODIC PROTECTION OF STEEL IN CONCRETE

LIDA® NET

LIDA® NET IS EASY TO INSTALL

1 PREPARATION

Thorough investigation of the structure must be made prior to application of LIDA® Anode Net. The evaluation should include potential mapping, condition surveys, continuity tests and a disbondment check.
The concrete surface should then be prepared in accordance with the usual pre-overlay procedures such as scarification, repair of delaminations and sand (or water) blasting. Permanent reference cells may be installed at this stage.

2 INSTALLATION

The LIDA® Anode Net is unrolled onto the prepared concrete surface from 1,2 m wide 50 m long rolls. The net is then trimmed 5 to 10 cm away from all exposed metal or concrete irregularities (such as bridgedeck expansion joints, drains, scuppers, curbs, columns).
Titanium conductor bars are now welded to the LIDA® Anode Net.
The LIDA® Net is achored to the concrete surface by means of plastic fasteners: (typically 5 to 15 are required per square meter of concrete surface, depending on the orientation of the net).
The ends of the conductor bars are extended into a junction box for connection to the power source.
The system is tested for electrical short circuits prior to placement of the overlay.
The LIDA® Anode Net is overlayed using any commonly used and accepted cementitious overlay material.

3 ENERGIZATION

The Titanium conductor bars are wired to a DC power supply which is adjusted by means of simple controls to provide the desired protective current to the rebar.
A periodic maintenance program should be implemented to assure the proper level of protection is achieved over the structure.
Typical power requirements are less than ten watts per 100 m² of concrete surface.

LIDA® NET installed in the San Gottardo tunnel Switzerland

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ACTIVATED TITANIUM ANODE NET FOR CATHODIC PROTECTION OF STEEL IN CONCRETE

LIDA® NET

LIDA® NET SPECIFICATIONS

Technical Data	LIDA® CN 15	LIDA® CN 25	LIDA® CN 35
Maximum rated current output per unit of concrete surface	20 mA / m2	30 mA / m2	40 mA / m2
FHWA maximum anode current density (*)	110 mA / m2	110 mA / m2	110 mA / m2
(*) **Anode current density may be increased to 220 mA / m2.** In the short term, during initial polarization, the anode current density may be increased to 400 mA / m2.			
Substrate material	ASTM 265 TITANIUM grade 1		
Catalyst	Mixed Metal Oxide for Oxygen Evolution		
Nominal diamond dimensions	85 mm x 38 mm	62 mm x 22 mm	40 mm x 19 mm
Nominal thickness (Approx)	1,8 mm	1,8 mm	2 mm
Lengthwise Electrical Resistance (1,2 m wide strip)	0,080 ohms / m	0,070 ohms / m	0,039 ohms / m
Widthwise Electrical Resistance with current distributor bar type 1:	0,013 ohms / m	0,011 ohms / m	0,009 ohms / m
with current distributor bar type 2:	0,017 ohms / m	0,013 ohms / m	0,011 ohms / m
Net roll nominal dimensions			
Width	1,2 m	1,2 m	1,2 m
Length	50 m	50 m	50 m
Weight per roll (Approx)	9 Kg	13 Kg	16 Kg
weight/m2 of net (Approx)	0,15 Kg / m2	0,22 Kg / m2	0,27 Kg / m2
Current Distributor			Electrical resistance
Type 1	15 mm (width) x 1 mm (thickness)		0,037 ohms / m
Type 2	10 mm (width) x 0,5 mm (thickness)		0,11 ohms / m

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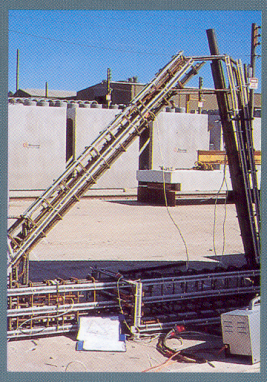
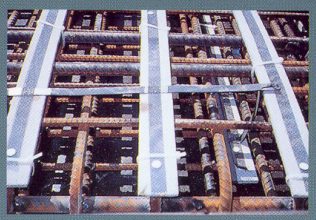
LIDA® GRID

ACTIVATED TITANIUM MESH RIBBON FOR CATHODIC PROTECTION OF STEEL IN CONCRETE



- ❑ Tough base metal: titanium grade I
- ❑ Unique, inert, electrocatalytic mixed metal oxide coating
- ❑ Long anode life
- ❑ Tested and proven with installations around the world
- ❑ Patented

- ❑ **STRIP WIDTH AND SPACING CAN BE VARIED TO FINE TUNE CATHODIC PROTECTION CURRENT REQUIREMENTS**



It can be installed on rebar cages, before concrete pouring by means of plastic or cementitious spacers

LIDA® is a trademark of Oronzio De Nora S.A. - Switzerland

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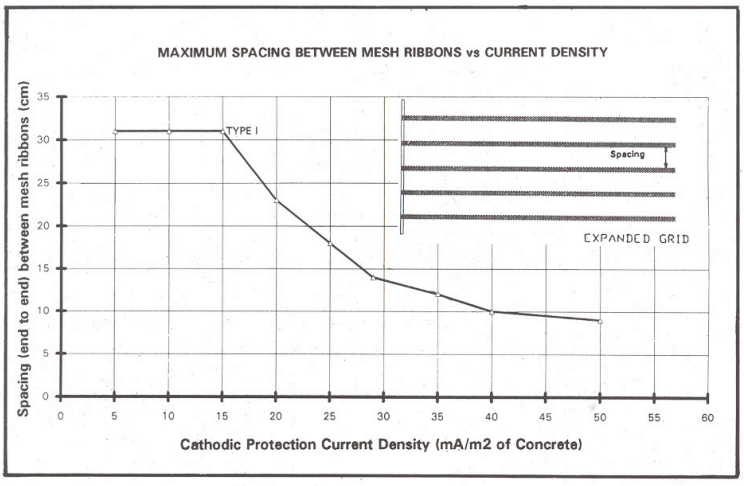
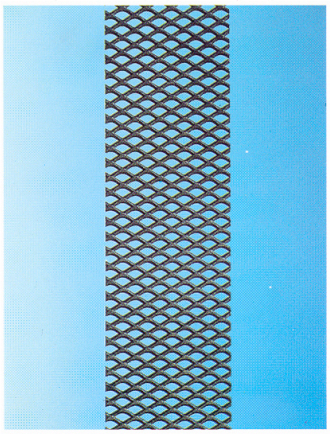
LIDA®	ACTIVATED TITANIUM EXPANDED MESH RIBBON FOR CATHODIC PROTECTION OF STEEL IN CONCRETE	LIDA®

MATERIAL SPECIFICATIONS		
MESH RIBBON	Unit	Type I
Current Rating at 110 mA/m²	mA/m	5,5
Dimensions Width	mm	20
Thickness	mm	0,5
Unit Lengths	m	26
Actual anode surface	m²/m	0,048
Weight (Approx) per roll of 26 m	g/roll	400
Electrical resistance	Ohm/m	0,48
ANODE CONCRETE INTERFACE MAXIMUM CURRENT DENSITY		
FHWA limit	mA/m²	110
Short-term limit	mA/m²	220
SUBSTRATE COMPOSITION		Titanium Grade I
CATALYST		Noble mixed metal oxide
CURRENT DISTRIBUTOR		
Width	mm	15
Thickness	mm	1
Weight	g/m	68
Electrical resistance	Ohm/m	0,040





Mesh Ribbon Type I:
actual mesh size

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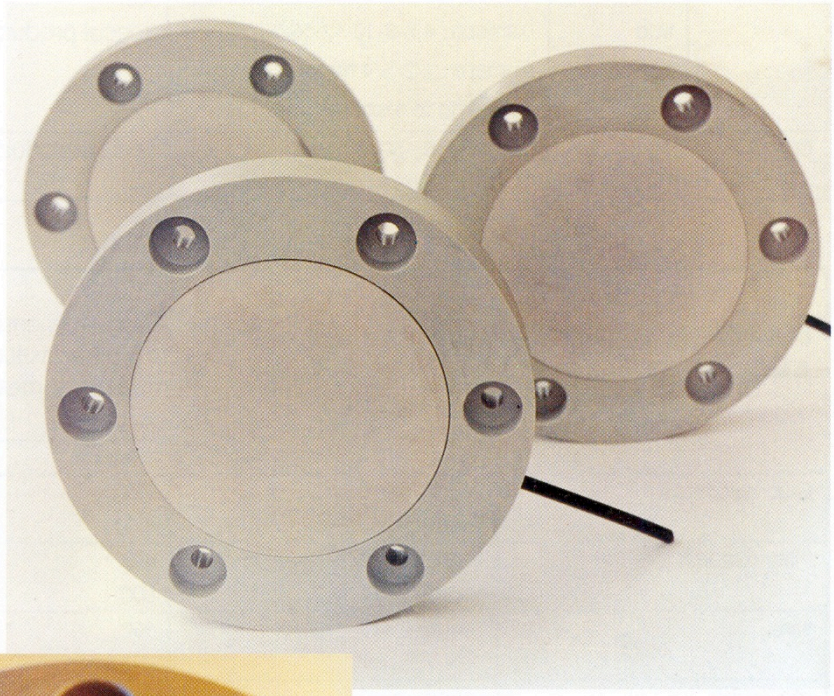
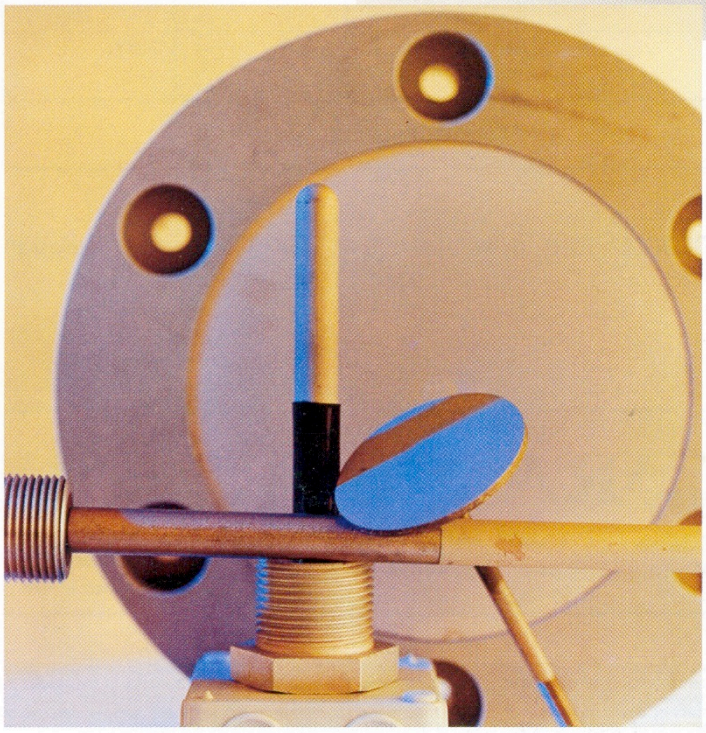
PLATINIZED ANODES

Platinized anodes are composite anodes where the activation is made of a thin layer of Platinum (typical thickness ranges from 2.5 μ to 5 μ) and the base metal can be Titanium or in special cases, Niobium or Tantalum.



Typical applications:

- Ship hulls
- Wharves
- Jetties
- Piers
- Sea water intakes
- Industrial equipments



- Lightweight
- Easy to install
- High current output
- Long life

NOTE: according to DIN standards 4119, 6620 and 51601, platinum may only be used for the internal cathodic protection of containers where adequate safety precautions have been taken. If necessary, platinized anodes can be replaced by LIDA® MMO anodes without noticeable differences in performance and durability.

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MATERIALS LIST FOR PLATINIZED ANODES

The substrate materials are available in the following shapes and sizes.
Special sizes available on request.

MATERIALS	GEOMETRY	STANDARD DIMENSIONS	
Titanium Niobium Tantalum	Plate Tube	Thickness: 0.5 - 10 mm Diameter: 25.4 mm to 40 mm	Titanium version in stock
	Rod Wire Mesh	Diameter: 4-6-8-10-12-16-20-25 mm Diameter: 1/2/3/4 mm According to expanded metal list	Special production for niobium, tantalum
Cu / Ti	Rod Wire	Diameter: 5 - 30 mm Diameter: 4 mm	Special production

MAXIMUM DIMENSIONS OF ANODES AVAILABLE

If larger dimensions are required, it is possible to joint individual pieces by welding or by mechanical means.

		TITANIUM	NIOBIUM	TANTALUM
Expanded metal	Length (mm) Width (mm)	2.500 1.000	2.500 1.000	2.500 1.000
Plate material	Length (mm) Width (mm)	800 800	800 800	800 800
wire	Length (mm)	100	50	50
rod / tube	Length (mm)	2.500	2.500	2.500
Ti/Nb or Ta copper cored	Available on request			

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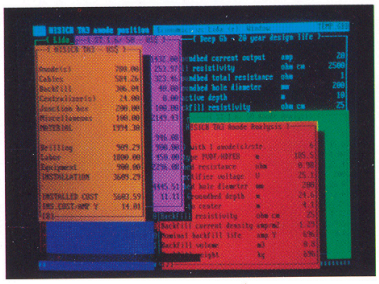
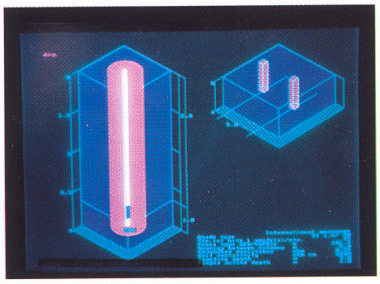
LIDA® SOFTWARE

LIDA® software is available for use with compatible computers to design:

DEEP GROUNDBEDS
HORIZONTAL CONTINUOUS GROUNDBEDS
SHALLOW VERTICAL GROUNDBEDS

and offers economic comparisons with other impressed current anode systems.





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