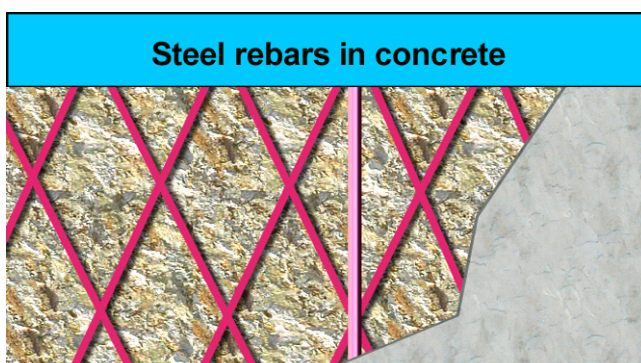
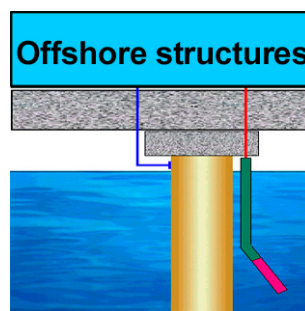
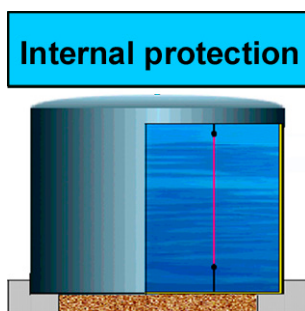
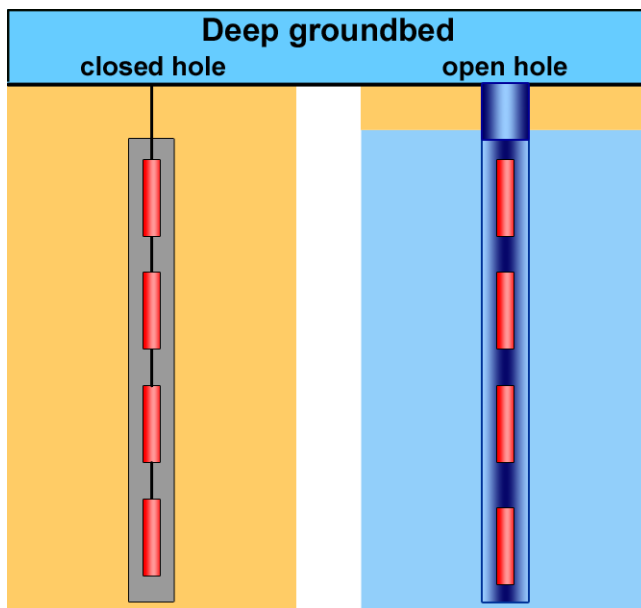
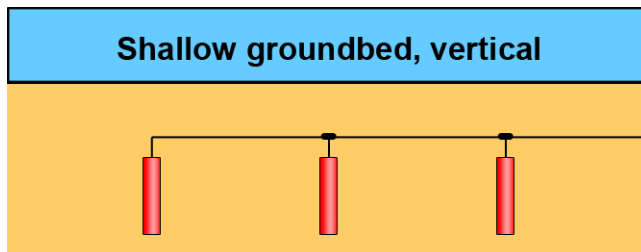
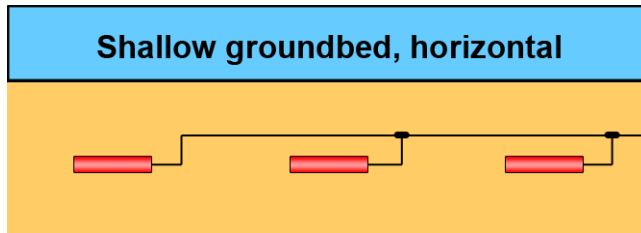


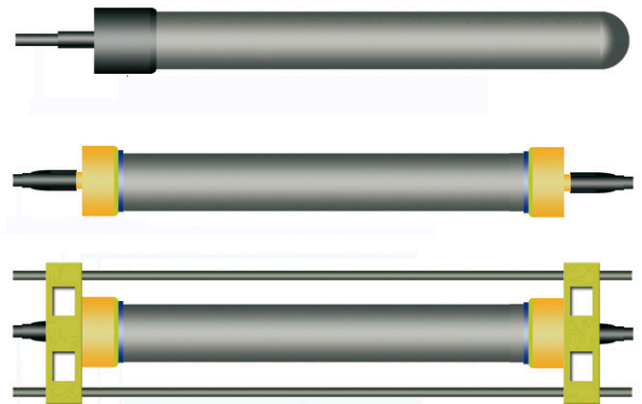
# IMPRESSED CURRENT ANODES

## Types of groundbeds and anode applications



## Anode material

### Magnetite anodes



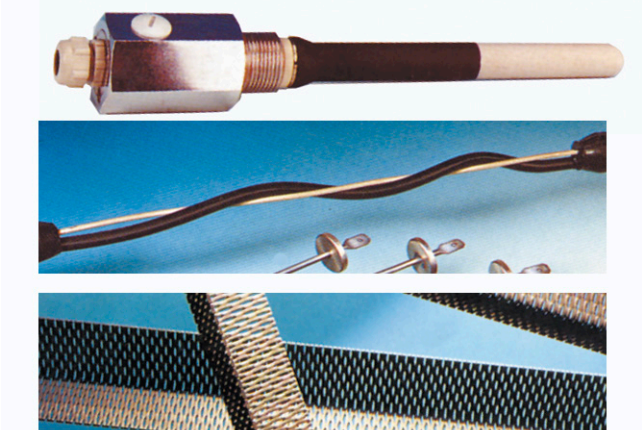
### Silicon iron anodes



### Mixed metal oxide anodes



### Pt/Ti-Ta-Nb anodes



Magnetite ( $\text{Fe}_3\text{O}_4$ ) is a natural mineral with good conductivity and a high degree of oxidation that makes it resistant to corrosion even at high temperatures. Careful alloying with other minerals can produce anodes with excellent electrochemical properties and mechanical strength.

The magnetite anode is casted in hollow cylindrical forms to minimise weight and to facilitate cable-to-anode connections at the centre of the anode. This center cable-to-anode connection allows a uniform current distribution at the anode surface.

The surface of the anode in the hollow centre is lined with a layer of copper of optimum thickness and length to ensure a highly reliable current conduction between cable connector and anode.

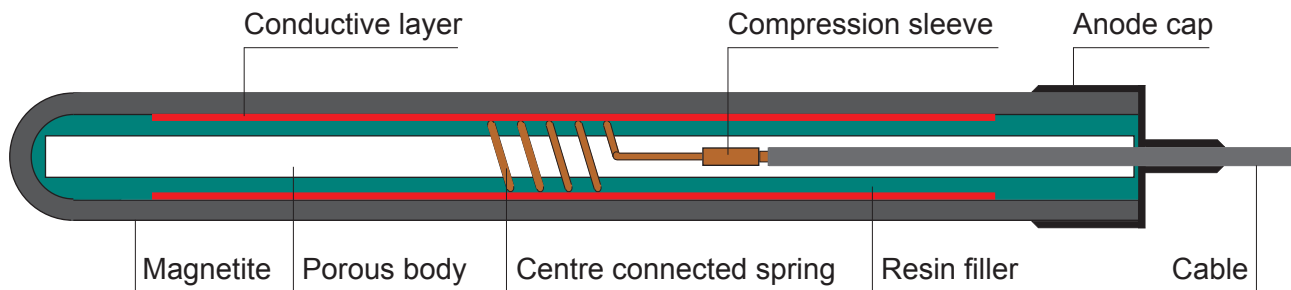
The hollow annular space is filled with a dielectric compound after the cable connection is made and the ends of the anode are sealed with anode caps to prevent ingress of foreign matter.

### Special features:

- operates at high current densities with extremely low dissolution
- not susceptible to ripple in DC supply
- no limit on DC voltage output
- light weight and easy to install, removable for inspection and reinstallation
- centre cable-to-anode connection for uniform current distribution and consumption of anode surface

Specific gravity	4.7 - 4.8 kg / dm <sup>3</sup>
Brinell hardness	344 HB
Bending strength	5 kN / cm <sup>2</sup>
Density	4.71 g / cm <sup>3</sup>
Melting point	1500 °C
Consumption rate	0.02 kg/A year
Current density <sup>1)</sup>	0.7 A/dm <sup>2</sup>

<sup>1)</sup> depends on environment



### Highlights:

The magnetite anode performance has been tested for several years. Endusers, technical analysts and independent research laboratories have regularly confirmed its reliability as an anode.

### Quality and value additions:

- independent series of examinations and selection of castings for the making of the anodes
- experienced-based selection of anode caps and lead materials according to enduser specifications and environmental conditions
- impregnable anode cap connections with corrosion resistant material and special welding process
- special electrical resistance and potential tests to confirm uniform current distribution without hot spots
- controlled sealing of anode hollow annular space with special dielectric compound
- a full range of accessories for easy installation, inspection and replacement according to enduser specified requirements and environmental conditions

## IMPRESSED CURRENT ANODES

### Magnetite anodes

Document No.: 04-100-R1

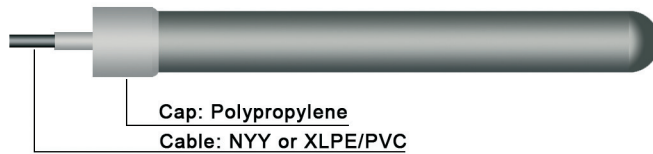
Sheet: 2 of 5

German Cathodic Protection



#### TYPE: MA-U

Surrounding electrolyte: neutral soil and water without chlorine and sulphate content  
Applications: shallow groundbeds, deep groundbeds



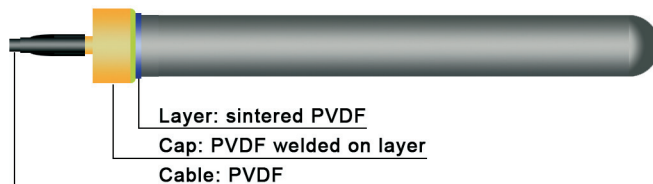
Cap: Polypropylene

Cable: NYY or XLPE/PVC

Diameter	60	mm
Total length	720	mm
Effective length	670	mm
Total weight	6.0	kg
Minimum effective mass	4.7	kg
Surface area	13.4	dm <sup>2</sup>
Max. current load	3.0	A

#### TYPE: MA-CS

Surrounding electrolyte: chlorine and/or sulphate containing soil or stagnant water  
Applications: shallow groundbeds, deep groundbeds



Layer: sintered PVDF

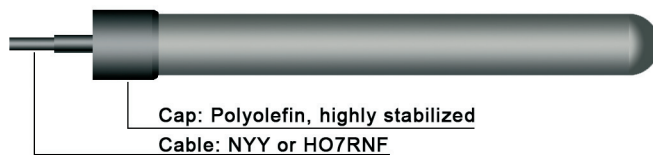
Cap: PVDF welded on layer

Cable: PVDF

Diameter	60	mm
Total length	760	mm
Effective length	710	mm
Total weight	6.0	kg
Minimum effective mass	4.7	kg
Surface area	13.4	dm <sup>2</sup>
Max. current load	6.0	A

#### TYPE: MA-SEA

Surrounding electrolyte: flowing seawater or brackish water  
Applications: platforms, jetties, harbours



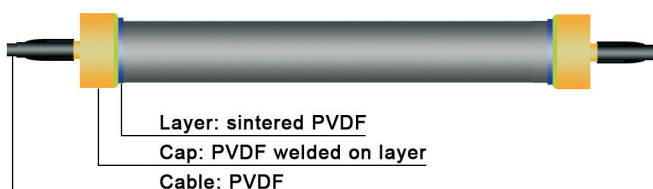
Cap: Polyolefin, highly stabilized

Cable: NYY or HO7RNF

Diameter	60	mm
Total length	760	mm
Effective length	710	mm
Total weight	6.0	kg
Minimum effective mass	4.7	kg
Surface area	13.4	dm <sup>2</sup>
Max. current load	16.0	A

#### TYPE: MA-CHAIN-1

Surrounding electrolyte: chlorine containing soil or stagnant water  
Applications: deep groundbeds open hole, deep groundbeds closed hole, water tanks



Layer: sintered PVDF

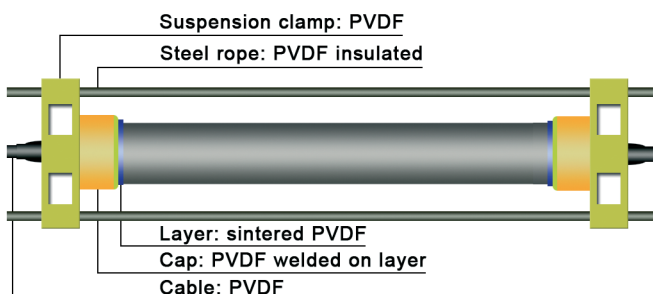
Cap: PVDF welded on layer

Cable: PVDF

Diameter	60	mm
Total length	740	mm
Effective length	600	mm
Total weight	6.2	kg
Minimum effective mass	4.7	kg
Surface area	11.3	dm <sup>2</sup>
Max. current load (groundbeds)	6.0	A
Max. current load (tanks)	16.0	A

#### TYPE: MA-CHAIN-2

Surrounding electrolyte: chlorine containing soil or stagnant water  
Applications: deep groundbeds open hole, deep groundbeds closed hole, water tanks



Suspension clamp: PVDF

Steel rope: PVDF insulated

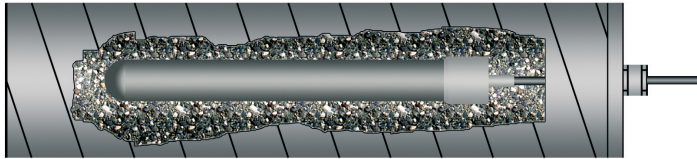
Layer: sintered PVDF

Cap: PVDF welded on layer

Cable: PVDF

Diameter	60	mm
Total length	740	mm
Effective length	600	mm
Total weight	6.2	kg
Minimum effective mass	4.7	kg
Surface area	11.3	dm <sup>2</sup>
Max. current load (groundbeds)	6.0	A
Max. current load (tanks)	16.0	A

CANISTER FOR TYPE: MA-U + TYPE: MA-CS



COKE BACKFILL

Minimum carbon content	90	%
Maximum moisture content	5	%
Maximum resistivity	1	$\Omega\text{m}$
Density	700-950	$\text{kg/m}^3$
Maximum particle size (dia.)	20	mm

Standard canister	Diameter	Length	Total weight
CAN 10	160 mm	1000 mm	22 kg
CAN 15	300 mm	1500 mm	85 kg
CAN 20	300 mm	2000 mm	110 kg
CAN 21	160 mm	2100 mm	46 kg



### Type: MA-CHAIN-1

Maximum carrying load of fixing device up to 1.10 kN

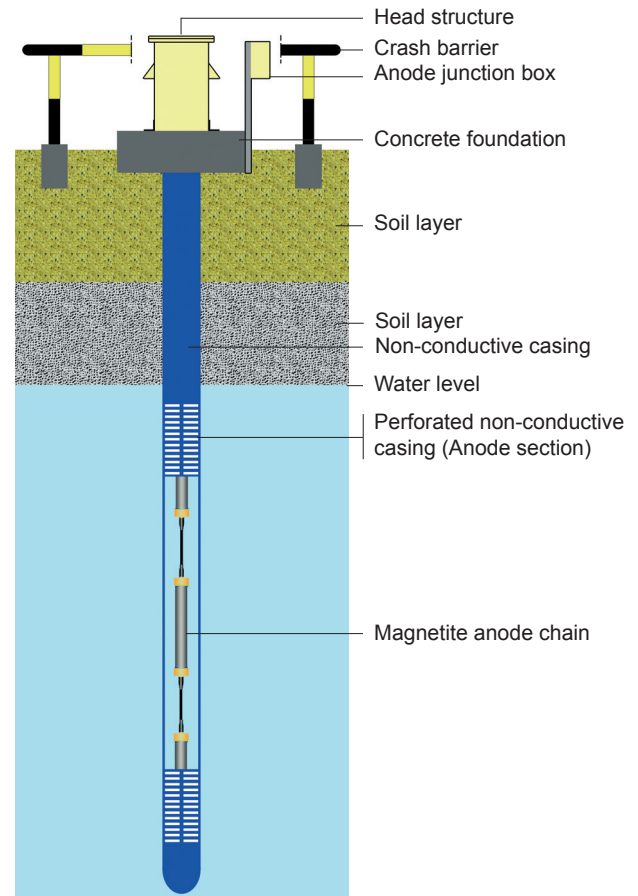
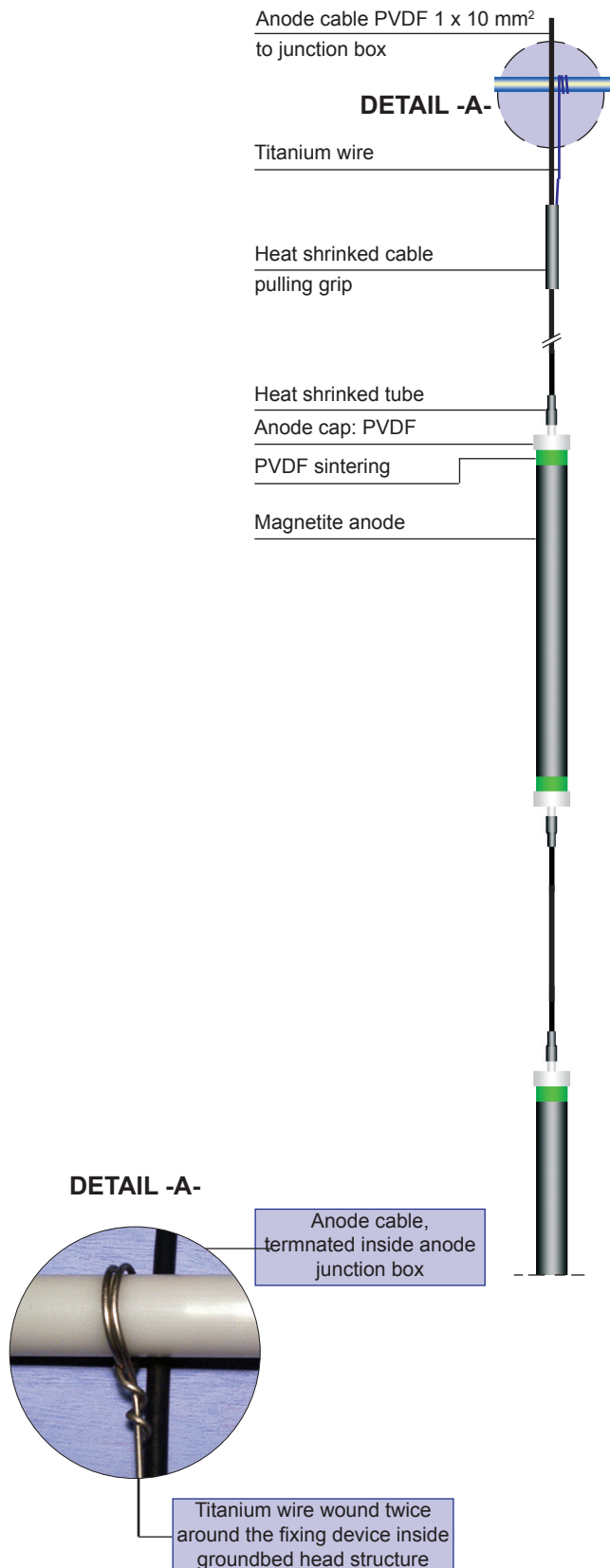
Special type magnetite anode chains that can be used for either open or closed hole deep well anode groundbeds.

As open hole anode groundbed they, can be used in conjunction with non-conductive slotted casing without backfill but they can also be used in close hole groundbeds with coke backfill material in case of unstable or non-existing static water level.

All parts of anodes, anode chains and suspension devices are made of material resistant against low pH values, high chloride content of water and high concentrations of chlorine gas.

Each anode is centre connected to the cable using a copper compression clamp and a bronze connection spring. The internal space is filled with a two component mixture of polyurethane and polyester.

Each anode chain has one individual lead cable connection and is suspended by one heat shrunk cable pulling grip, fixed to a titanium wire, ready for fixing on suspension device inside groundbed head structure.



### Type: MA-CHAIN-2

For carrying load of fixing device > 1.10 kN

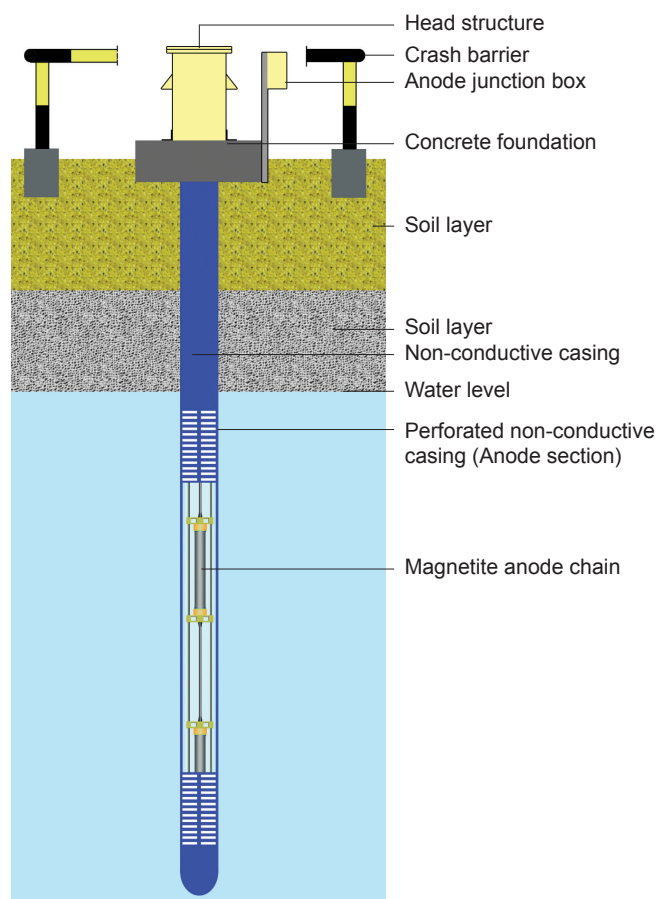
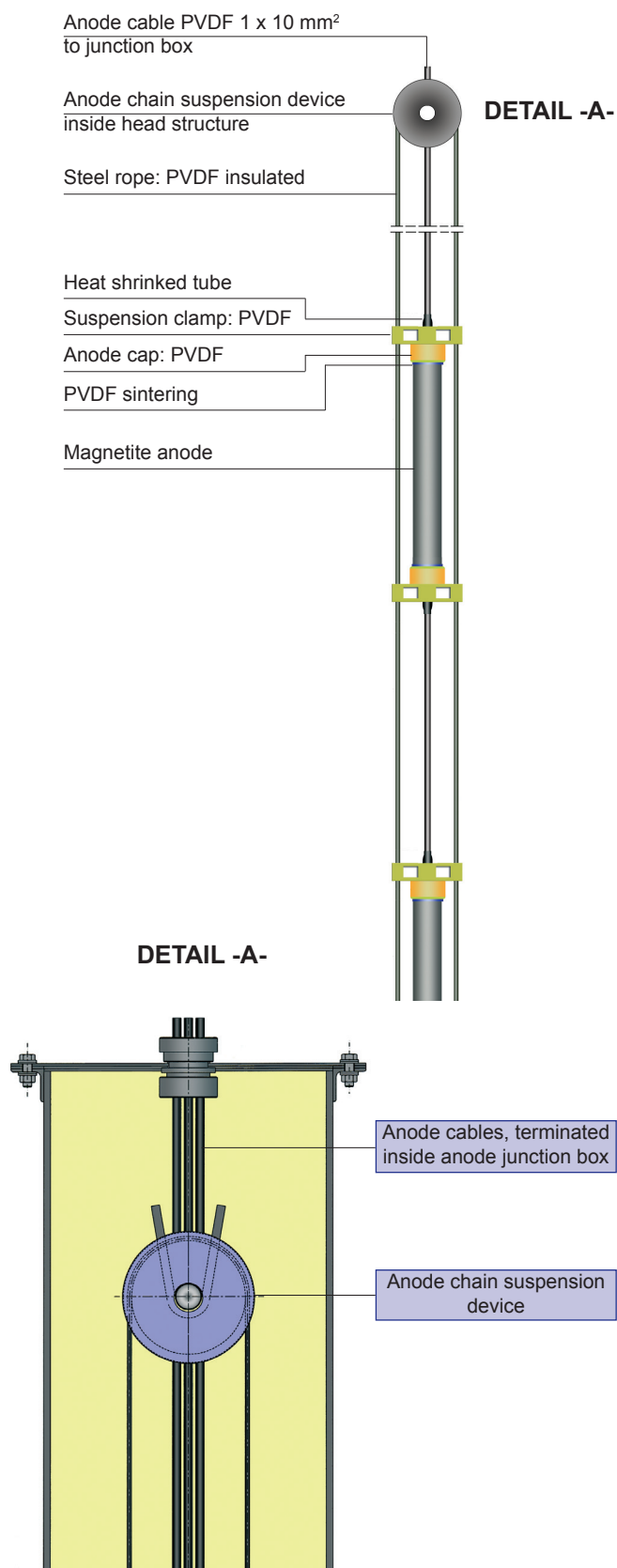
Special type magnetite anode chains that can be used for either open or closed hole deep well anode groundbeds.

As open hole anode groundbed, they can be used in conjunction with non-conductive slotted casing without backfill but they can also be used in close hole groundbeds with coke backfill material in case of unstable or non-existing static water level.

All parts of anodes, anode chains and suspension devices are made of material resistant against low pH values, high chloride content of water and high concentrations of chlorine gas.

Each anode is centre connected to the cable using a copper compression clamp and a bronze connection spring. The internal space is filled with a two component mixture of polyurethane and polyester.

Each anode chain has one individual lead cable connection ready for fixing on suspension device inside groundbed head structure.



# IMPRESSED CURRENT ANODES

## Open hole replaceable deep groundbeds

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German Cathodic Protection



### uPVC Casing



These casings withstand external pressure loading which is caused by geological formation, the depth of the groundbed, the ratio of borehole diameter to casing diameter and the position of dynamic water levels.

Perforated casings are provided with slots which run perpendicular to the pipe axis for higher collapse resistance as compared to pipes having longitudinal slots.

The perforated (open) casings have a minimum of 20 % slotted surface for a low resistance increase factor.

Microfine PP wire mesh is durably fixed over the perforated area of the casings to prevent entry by silt or foreign particles after installation.

Both perforated and unperforated casing sections are supplied with threaded joints which allow quick assembly on site.

Rigid uPVC is chemically resistant against all types of groundwater, seawater, brines, diluted acids and alkalines.

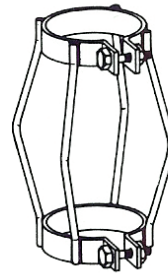
### Physical Material Properties

Properties	Value	Unit	Test method
Elasticity Modulus	2500 to 3000	N/mm <sup>2</sup>	DIN EN ISO 178
CHARPY-Impact Strength at 20 °C for uPVC; normal toughness	approx. 3 to 5	kJ/m <sup>2</sup>	DIN EN ISO 179
Density	approx. 1.4	g/cm <sup>3</sup>	DIN 53479
Tensile Strength	approx. 45 to 55	N/mm <sup>2</sup>	DIN EN ISO 527-2
Impact Resistance	max. 10 % breakage		Following DIN EN ISO 179
Vicat Softening Point, Temperature	80	°C	DIN EN ISO 306

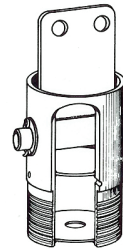
### Dimensions

Casing type	K	K	KV	K	KV
Nominal diameter ND (mm)	150	175	175	200	200
Outer diameter (mm)	165	195	195	225	225
Wall thickness (mm)	7.5	8.5	11.5	10.0	13.0
Outer diameter over socket (mm)	176	205	211	241	247
Collapse resistance (N/mm <sup>2</sup> )	0.7	0.6	1.6	0.7	1.5
Weight (kg/m)	5.5	7.4	9.8	10.0	12.8
Delivery length (m)	5.78	5.78	5.78	5.78	5.78
Thread (trapezoidal), DIN 4925	T	T	T	T	T

### Accessories



**Centraliser**  
for centralisation of casings in the borehole during installation



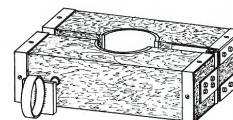
**Hoisting device with steel insert**  
for lifting and lowering the pipe sections



**Steel clamp**  
for fixing casing segments during installation



**Sealing plug**  
for the bottom end of the casing or sump pipe



**Wooden clamp**  
for fixing the casing to the top foundation





## Head structure, typical

The wellhead structure is designed for use in combination with deep well anode groundbeds.

The square hollow steel structure is internally coated with a special coating of PVDF to be resistant against chlorine gas.

The wellhead structure consists of vent pipes, an anode chain fixing device and a special conduit connection between the wellhead and the anode junction box (AJB) to prevent gas entering the AJB.

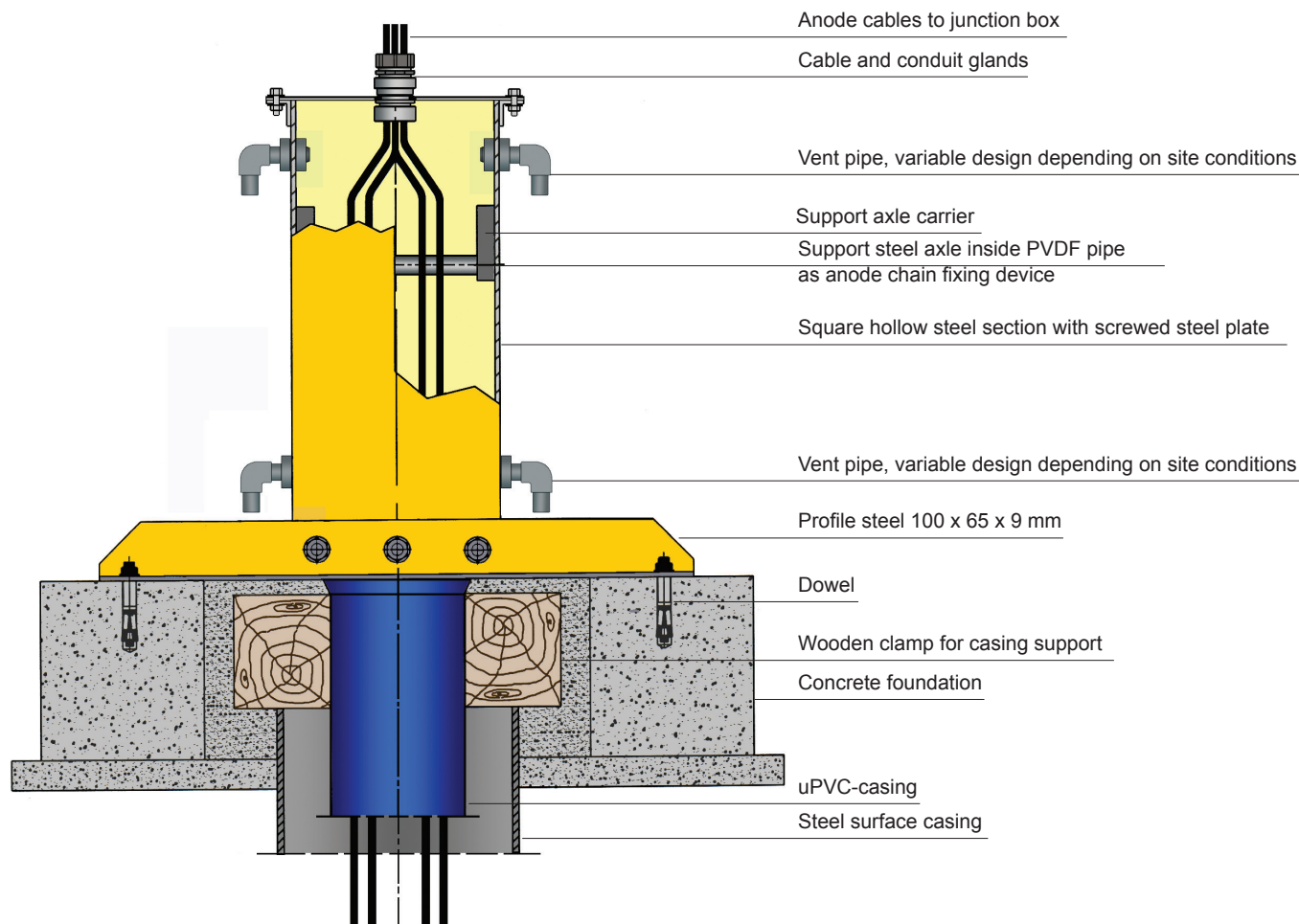
The optional crash barrier protects the wellhead structure against physical damage caused by vehicles.

Crash barriers, cables, wooden clamps, steel surface casing, uPVC casing and concrete foundations are not as standard in of well head structure.

## Head structure with crash barrier for deep groundbeds



Structure specially designed for use in oilfields, etc.



### Silicon Iron anodes (Fe/Si) (Fe/Si/CR) (Fe/Si/Mo)

High Silicon Cast Iron anodes supplied with chemical compositions according to ASTM A518 or BS 1591.

### Applications

High Silicon Cast Iron anodes are widely used in underground applications in shallow groundbeds. Their performance can be improved with coke breeze backfill.

Standard type Fe/Si-anode  
for use in neutral soil and freshwater environments.

Fe/Si/Cr and Fe/Si/Mo-anodes  
for use in aggressive acidic or alkaline soil and seawater environments.

Effectiveness of cast iron's performance as an anode depends upon the formation of a thin layer silicon oxide on its surface. This protective film is formed by oxidation.

Silicon-chromium cast iron is highly resistant to acid solutions but has a better performance in alkaline environments or in the presence of sulphate ions.

### Fabrication

Each cast iron anode is normally provided with an individual cable of varying length. Cast iron anodes are provided in both end-connected and centre-connected configurations.

Following the anode-to-cable connection, the annular space around the cable is filled with a high quality electrical sealant. Heat shrinkable anode caps are commonly used for additional protection. Cast iron anodes can be prepacked in steel canisters with carbonaceous backfill.

### Chemical Compositions of Fe/Si/Cr-Anodes

Standard	ASTM A518 Gr3		BS 1591 SiCr 14 4	
	Minimum	Maximum	Minimum	Maximum
Silicon	14.20 %	14.75 %	14.25 %	15.25 %
Chromium	3.25 %	5.00 %	4.00 %	5.00 %
Carbon	0.70 %	1.10 %		1.40 %
Manganese		1.50 %		1.00 %
Molybdenum		0.20 %		
Copper		0.50 %		
Phosphorus				0.25 %
Sulphur				0.10 %



### Characteristics

Tensile strength	103	N/mm <sup>2</sup>
Compressive strength	689	N/mm <sup>2</sup>
Brinell hardness	520	HB
Density	7.0	g/cm <sup>3</sup>
Melting point	1300	°C
Coefficient of linear expansion	1.86 x 10 <sup>-5</sup>	1/°C (0-100°C)

Environment	Current Density A/m <sup>2</sup>	Consumption Rate kg/A year	Efficiency %
Freshwater	10 - 30	0.15	90
Saltwater	10 - 50	0.50	90
Soil	10 - 30	0.30	90

**The following cable types are available as anode lead cables:**

PVC	Polyvinylchloride
PE	Polyethylene
XLPE	Cross linked Polyethylene
HDPE	High density Polyethylene
CSP	Chlorosulphonated Polyethylene
EPR	Ethylene Propylene Rubber
PVDF	Polyvinylidenefluoride

Armoured cables are also available on request.

All weights and dimensions are nominal and subject to variation in material compositions.



## IMPRESSED CURRENT ANODES

### Silicon iron anodes

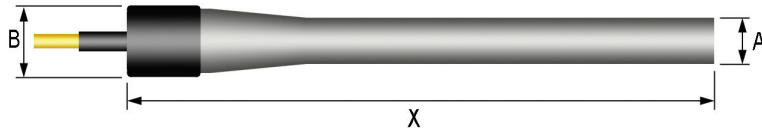
Document No.: 04-200-R1

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German Cathodic Protection

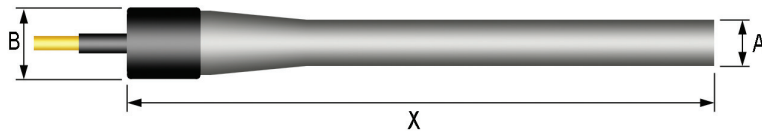


#### TYPE: 915



Total length -X-	915 mm	915 mm	915 mm	915 mm	915 mm
Diameter -A-	25 mm	38 mm	50 mm	63 mm	76 mm
Diameter -B-	50 mm	63 mm	76 mm	89 mm	101 mm
Surface area	0.08 m <sup>2</sup>	0.12 m <sup>2</sup>	0.16 m <sup>2</sup>	0.20 m <sup>2</sup>	0.23 m <sup>2</sup>
Total weight	3.2 kg	7.1 kg	14.5 kg	21.0 kg	31.4 kg

#### TYPE: 1220



Total length -X-	1220 mm	1220 mm	1220 mm	1220 mm	1220 mm
Diameter -A-	25 mm	38 mm	50 mm	63 mm	76 mm
Diameter -B-	50 mm	63 mm	76 mm	89 mm	101 mm
Surface area	0.11 m <sup>2</sup>	0.16 m <sup>2</sup>	0.20 m <sup>2</sup>	0.25 m <sup>2</sup>	0.30 m <sup>2</sup>
Total weight	4.5 kg	10.0 kg	19.0 kg	28.6 kg	38.2 kg

#### Tubular Anodes

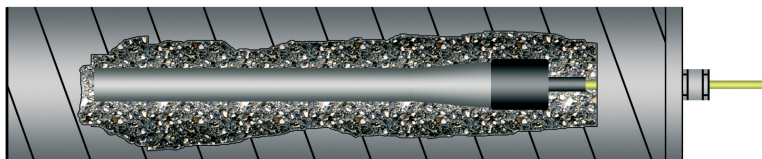


Silicon iron tubular anodes with a specially designed low resistance centre connection.

Total length	1067 mm	2134 mm	2134 mm	2134 mm	2134 mm
Diameter (outside)	68.0 mm	56.0 mm	68.0 mm	96.0 mm	122.0 mm
Diameter (inside)	45.7 mm	38.0 mm	45.7 mm	73.7 mm	99.0 mm
Approx. area	0.2 m <sup>2</sup>	0.4 m <sup>2</sup>	0.5 m <sup>2</sup>	0.6 m <sup>2</sup>	0.8 m <sup>2</sup>
Total weight	14.1 kg	20.9 kg	28.6 kg	38.6 kg	59.9 kg

All weights and dimensions are nominal and subject to variation in material compositions.

#### CANISTER FOR TYPE: 915 + TYPE: 1220



##### COKE BACKFILL

Minimum carbon content	90	%
Maximum moisture content	5	%
Maximum resistivity	1	Ωm
Density	700-950	kg/m <sup>3</sup>
Maximum particle size (dia.)	20	mm

Standard canister	Diameter	Length	Total weight
CAN 10	160 mm	1000 mm	22 kg
CAN 15	300 mm	1500 mm	85 kg
CAN 20	300 mm	2000 mm	110 kg

## IMPRESSED CURRENT ANODES

### Mixed metal oxide (MMO)

Document No.: 04-300-R1

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German Cathodic Protection



### Mixed metal oxide (MMO) anodes

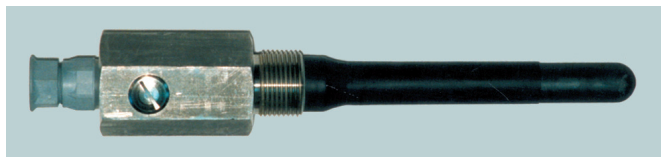
This material consists of a high purity titanium substrate with an applied mixed metal oxide coating consisting of a mixture of oxides. The titanium serves as a support for the oxide coating. The titanium functions as a valve metal by forming thin, self-healing, adherent oxide film which is acid resistant does not conduct anodic current. The oxidefilm is formed on the titanium substrate by thermal decomposition of precious metal salts that have been applied the substrate.

#### Technical data

Base metal	Titanium
MMO coating, standard	12 g/m <sup>2</sup>
MMO layer thickness	approx. 5.0 µm
Max. phase/interphase voltage	8.0 V
Max. current density	11 A/dm <sup>2</sup>
Consumption rate	approx. 0.01 g/A year

### Rod anodes

Screw-in type rod anodes with pressure resistant head structure are widely used for the internal protection of pipes, tanks, condensers and other process equipment.



#### Dimensions

Rod length	150 up to 2500 mm
Rod diameter	4 / 6 / 8 / 10 / 12 / 16 / 20 / 25 mm

### Plate anodes

Plate anode structure consists of anode plate assembled and sealed inside a support frame made of impact resistant plastic material.

Plate anodes are used for offshore structures and sluices.

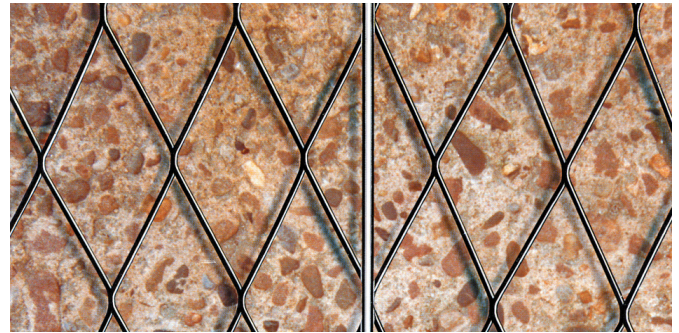


#### Dimensions

Plate length	max. 800 mm
Plate width	max. 800 mm
Plate thickness	0.5 - 10 mm

### Mesh anodes

Mesh anodes are used for the protection of steel reinforced concrete structures.



Max. current density	18.0 mA/m <sup>2</sup>	27.5 mA/m <sup>2</sup>	33.0 mA/m <sup>2</sup>
Coating	Mixed precious metal oxide	Mixed precious metal oxide	Mixed precious metal oxide
Substrate (Grade 1/ASTM B265)	Titanium	Titanium	Titanium
Width per coil	1 m	1 m	1 m
Length	10 m	10 m	10 m
Weight	120 to 130 kg	220 to 230 kg	220 kg
Mesh size	76 x 35 mm	76 x 35 mm	62 x 20 mm
Resistivity, longitudinal direction	0.120 Ω/m	0.060 Ω/m	0.060 Ω/m
Current distributor wire, diameter	3 mm	3 mm	3 mm
Length (uncoated)	100 m	100 m	100 m
or Current distributor flat profile			
Thickness	1 - 1.5 mm	1 - 1.5 mm	1 - 1.5 mm
Width	5 - 10 mm	5 - 10 mm	5 - 10 mm
Length (uncoated)	1 m	1 m	1 m

### Tubular anodes

Tubular anodes are assembled as anode chain for deep groundbed installations. The centre connected cable ensures that current can pass from the centre of one tube to the next. The materials used for the different parts of anodes and anode chains are suitable for satisfactory performance in areas with low pH-value and high chloride/chloride concentrations.



#### Dimensions

Tube length	1000 - 2500 mm
Tube diameter	25.4 / 32.0 / 40.0 / 45.0 / 50.8 mm

All weights and dimensions are nominal and subject to variation in material compositions.

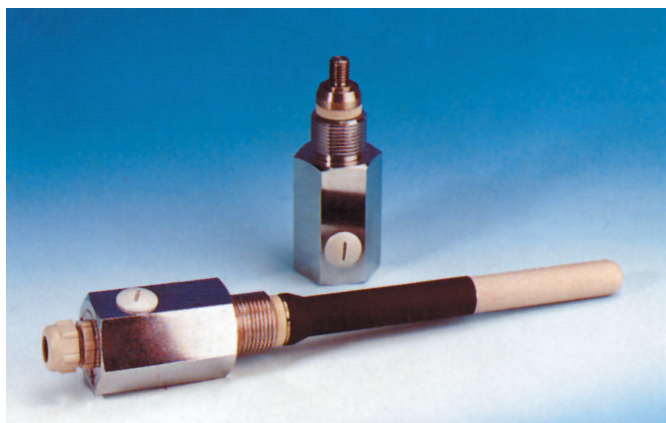


### **Platinised Titanium/Niobium/Tantalum (Pt/Ti-Nb-Ta) anodes**

Platinum is an excellent anode material due to its high conductivity and low consumption rate. Because of its high cost, it is not economical to use platinum by itself. Platinum can be made practical for use by cladding or electroplating a thin layer of platinum over a lower cost substrate. This also increases the effective anode surface area. The substrate must also be able to form an insulating oxide film under anodic conditions. The substrate materials most commonly used are titanium, niobium and tantalum. Of these, titanium is least expensive but it has a much lower breakdown potential than niobium or tantalum. Titanium oxide breaks down at anodic potentials in the 12 V range.

#### **(Pt/Ti-Nb-Ta) Rod anodes**

Screw-in type Pt/Ti-Nb-Ta rod anodes with pressure resistant head structure are widely used for internal protection of condensers and other process equipment.



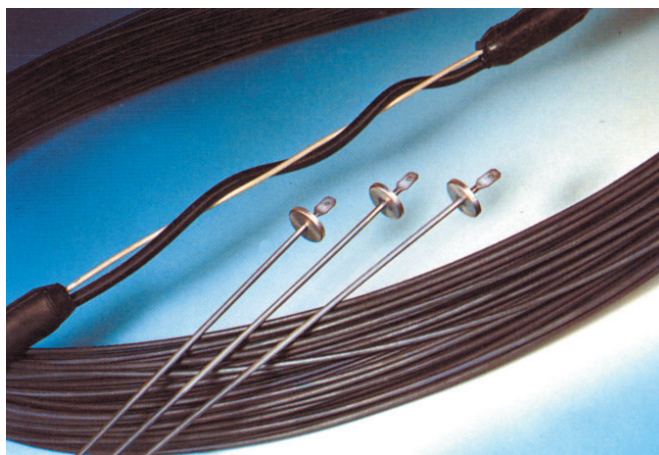
#### **Technical data**

Base metal	Titanium	Niobium	Tantalum
Max. allowable operating voltage	12 V	40 V	80 V
Rod length	150 - 2500 mm		
Rod diameter	4 / 6 / 8 / 10 / 12 / 16 / 20 / 25 mm		
Pt-coating thickness	5 / 7.5 / 10 µm		
Consumption rate	approx. 0.08 g / A year		
Max. current density	10 A / dm <sup>2</sup>		

All weights and dimensions are nominal and subject to variation in material compositions.

#### **(Pt/Ti-Nb-Ta) Wire anodes**

Pt/Ti-Nb-Ta wire anodes are used for the internal protection of water tanks and pipelines.

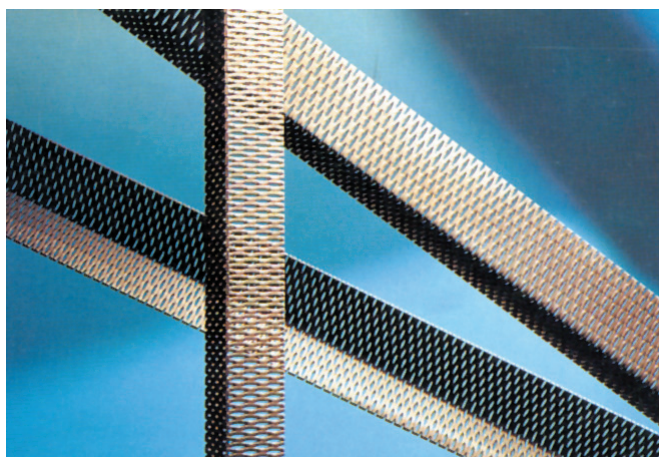


#### **Technical data**

Base metal	Titanium	Niobium	Tantalum
Max. allowable operating voltage	12 V	40 V	80 V
Wire length	100 m	50 m	50 m
Wire diameter	1 / 2 / 3 / 4 mm		
Pt coating thickness	5 / 7.5 / 10 µm		
Consumption rate	approx. 0.08 g / A year		
Max. current density	10 A / dm <sup>2</sup>		

#### **(Pt/Ti-Nb-Ta) Mesh anodes**

Pt/Ti-Nb-Ta mesh anodes are used for the protection of reinforced concrete structures.



#### **Technical data**

Base metal	Titanium	Niobium	Tantalum
Max. allowable operating voltage	12 V	40 V	80 V
Mesh length	max. 2500 mm		
Mesh width	max. 800 mm		
Pt coating thickness	5 / 7.5 / 10 µm		
Consumption rate	approx. 0.08 g / A year		
Max. current density	10 A / dm <sup>2</sup>		

## IMPRESSED CURRENT ANODES

### Accessories: LORESCO SC-2®

Document No.: 04-601-R1

Sheet: 1 of 1

German Cathodic Protection



### Super conducting earth contact backfill

Loresco type SC-2 is designed specifically for deep anode systems.



Loresco type SC-2 is a dust-free product and, according to EPA extraction tests, is extremely pure and complies with regulations governing buried products. SC-2 mixes easily with water and may be pumped into deep anode systems. Loresco SC-2 is designed to promote electronic flow between the anode surface and itself.

Loresco SC-2 is produced specifically for cathodic protection applications using an exclusive multi-step process. First, a high quality base carbon with desired characteristics is selected. Next, this carbon is calcined to a minimum temperature of 1250° C under exacting and controlled standards. This step results in semi-graphitised carbon particles with excellent conductivity.

Then, to further improve bulk conductivity, the surfaces of the individual particles are half-modified to enhance the contact conductance. This breakthrough in surface alteration ensures maximum electronic current transfer with positive anode contact. The surface alteration on the particle surfaces is not easily removed and stands up to the vigorous application methods in all field requirements.

Loresco SC-2 has a bulk density of 74 lbs. per cubic foot. The fixed carbon content is greater than 99.35% by weight. The bulk density and high fixed carbon content coupled with the assured low resistivity medium allows for longer groundbed life at a lower operating cost.

Loresco SC-2 is designed to be used in impressed current cathodic protection systems, deep or shallow. Specify Loresco SC-2 Super-Conducting Premium Earth Contact Backfill. For high current installations, Loresco SC-3 is recommended.

### Installation

Loresco SC-2 has excellent pumping qualities and when agitated in water, takes on the characteristics of heavy mud. A recommended mix is seven gallons of water per one hundred pounds. After installing SC-2, allow twenty-four hours settling time before energising. The modified surface of the carbon particles in SC-2 will achieve positive electrical contact by settling. Vibrating or compacting is not necessary.

### Material Description

Loresco SC-2 is a surface modified, blended, and sized carbon backfill.

### Specification

Bulk Density: 74 lbs. per cubic foot
Predominantly round particles
All particles surface modified for maximum electrical conductivity
Particle sizing: To be dust free with a maximum particle size of 1 mm
Minimum calcination temperature of base materials is 1250° C
Base materials are calcined under ISO 9002 quality control
No de-dusting oils are used during the manufacture of base particles

### Shipping Data

Loresco SC-2 is shipped in fifty (50) pound (22.7 kg) coated, woven polypropylene bags. SC-2 may be stored outside for limited periods (not to exceed four hundred hours of sunlight). Pallets are available with fifty bags per pallet. Proven export packaging is also available.



## Carbonaceous backfills

Impressed current anodes are usually surrounded by a carbonaceous backfill. Types of materials use include metallurgical coke and calcined petroleum coke.

The dual purpose of the carbonaceous backfill is to reduce the groundbed resistance by increasing the effective size of the anode and to provide a surface on which oxidation reactions could occur. The latter function prolongs anode life. To ensure good electrical contact, the backfill must be tamped around the anode. Resistivity of carbonaceous backfills are in the range of 10 - 50  $\Omega$  cm.

Particle size and shape are also important when specifying a backfill. Both parameters determine the contact area between anode and surrounding soil whilst influencing the porosity of the column which is important for gas ventilation. A general purpose coke breeze is for use in shallow horizontal and vertical groundbeds. It has a resistivity of approx. 35  $\Omega$  cm. For deep well applications a special calcined petroleum coke breeze is available. It has a resistivity of approx. 15  $\Omega$  cm and can be pumped.

Metallurgical coke of high quality that gives optimum performance at a low cost is available in various size ranges..

Coke backfill, prepared from calcinated petroleum coke, has been properly developed to meet all the basic requirements for an earth contact backfill. The carbon content, very high in calcined coke assures a low consumption rate of the backfill material and therefore a longer system life.

The low resistivity of calcined coke and the small particle size allow the best possible contact between the anode surface and the surrounding soil. As a consequence, this increases the anode size and allow the majority of the current to be discharged electrolytically at the backfill to soil interface.

## Shipping Data

Coke backfill is shipped in bags, each bag weighing 20 kg, 25 kg or 50 kg. Pallets are available with 20 bags, 40 bags or 50 bags. Other bag sizes are available on request.



## Specification Metallurgical Coke

Ash	10.0 %	max. 12.0 %
Volatile	1.4 %	max. 1.8 %
Sulfur	0.6 %	max. 1.0 %
Moisture	0.6 %	max. 1.0 %
Fixed carbon	89.0 %	min. 86.0 %
Grading:	0-1 mm / 1-5 mm / 2-7 mm / 3-10 mm	
Resistivity:	50 $\Omega$ cm	
Bulk density:	approx. 700 kg/m <sup>3</sup> (compacted)	

## Specification Calcined Petroleum Coke

Ash	0.1 %	max. 0.8 %
Volatile	0.6 %	max. 0.8 %
Moisture	0.1 %	max. 0.5 %
Fixed carbon	99.0 %	min. 98.0 %
Grading:	2 mm up to 8 mm	
Resistivity:	10 $\Omega$ cm	
Bulk density:	approx. 800-900 kg/m <sup>3</sup> (compacted)	