Earthing System

Lightning Protection System

Solar System

Exothermic Welding System

Cathodic Protection System

Earthing System
Page 5-24

Lightning Protection System
Page 25-58

Solar System
Page 59-74

Exothermic Welding System
Page 75-106

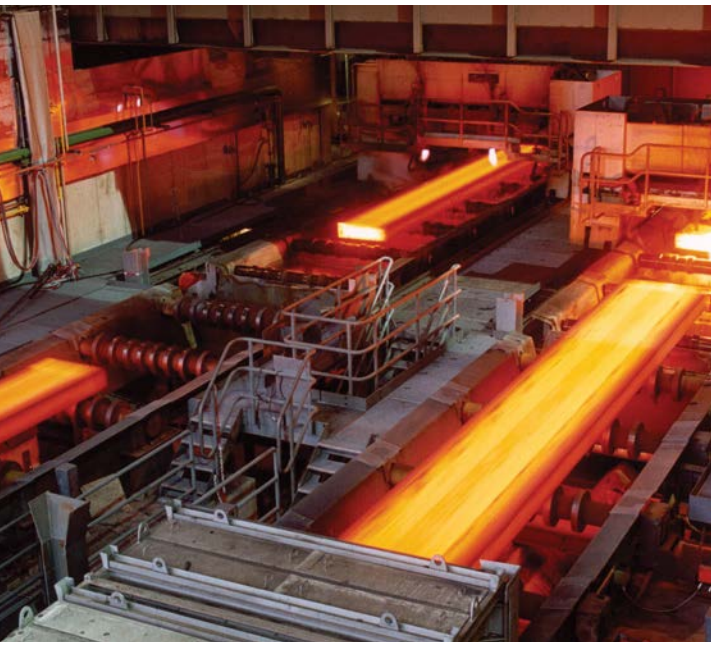
Cathodic Protection System
Page 107-131

Tavan Gostaran Zino

Tavan Gostaran Zino Co. has been established as a specialized company, taking advantage of the modern sciences with the aim of designing, production (supplement), and installation of the following items:

Electrical and Instrumentation
Earthing system
Lightning protection
Cathodic protection (corrosion control)
New energies systems (Solar systems)

By relying on its 20-year experience since its establishment, human resources and knowledge of its engineers and experts, and by transferring of modern technologies and methods and their employment, **Tavan Gostaran Zino Co.** has received a considerable growth in implementing EPC work in various industries including oil, gas, petrochemical, refineries, power plants, and electricity posts.



Engineering Service Range
Earthing and Lightning Protection Systems

1. Site Survey

1.1. Soil study

1.1.1.Soil resistivity test (Wenner Four-Electrode Method)

1.1.2. Soil pH test

1.2. Lightening rod installation survey

1.3. Lightning protection level and method survey

2. Designing

Designing is done according to the documented standards and procedures in the system and relevant to the received information from section 1, as well as the existing maps in the system designing with the lowest cost and the best performance. At this point, the initial plan for the installation, running, and implementation, and the calculation tables are also suggested.

3. Post-Implementation Survey

1. Earth resistance system survey using 62% method, Slope method and etc.
2. Voltage contact detection
3. Voltage pitch survey
4. Continuity testing of ground and lightning protection systems
5- Leak testing

SWISSCERT

Certificate

SWISS CERT Pvt. Ltd. hereby certifies that the Quality Management System of

TAVAN GOSTARAN ZINO CO.

UNIT 5, NO.5,4TH ALLEY, SABOUNCHI ST., TAKHTI SQ., BEHESHTI AVE., TEHRAN, IRAN

has been assessed and found to be in accordance with the requirements of the

Quality Management System ISO 9001:2008

and scope of supply detailed below

EPC CONTRACTOR: EARTHING & LIGHTNING SYSTEM, CATHODIC PROTECTION SYSTEM, EXPLOSION-PROOF EQUIPMENT, INSTRUMENTATION EQUIPMENT, SOLAR SYSTEM, HEAT TRACING SYSTEM

Subject to the continued satisfactory operation of the client's Quality Management System, this Certificate is valid for a period of Three years from: 30.05.2016

412, BEST SKY TOWER, NETAJI SUBHASH PLACE, PITAMPURA, DELHI - 110 034, INDIA
This Certificate will be valid until 29.05.2019
Certificate Number: 311813 A, Rev. No: 00

Director Operations

DAC
CB 004

Managing Director

SWISSCERT

Certificate

SWISS CERT Pvt. Ltd. hereby certifies that the Management System of

TAVAN GOSTARAN ZINO CO.

UNIT 5, NO.5,4TH ALLEY, SABOUNCHI ST., TAKHTI SQ., BEHESHTI AVE., TEHRAN, IRAN

has been assessed and found to be in accordance with the requirements of the

Quality Management - Customer Satisfaction ISO 10002: 2014

and scope of supply detailed below

EPC CONTRACTOR: EARTHING & LIGHTNING SYSTEM, CATHODIC PROTECTION SYSTEM, EXPLOSION-PROOF EQUIPMENT, INSTRUMENTATION EQUIPMENT, SOLAR SYSTEM, HEAT TRACING SYSTEM.

Subject to the continued satisfactory operation of the client's Management System, this Certificate is valid for a period of Three years from: 30.05.2016

412, BEST SKY TOWER, NETAJI SUBHASH PLACE, PITAMPURA, DELHI - 110 034, INDIA
This Certificate will be valid until 29.05.2019
Certificate Number: 311813 F, Rev. No: 00

Director Operations

Managing Director

SWISSCERT

Certificate

SWISS CERT Pvt. Ltd. hereby certifies that the Management System of

TAVAN GOSTARAN ZINO CO.

UNIT 5, NO.5,4TH ALLEY, SABOUNCHI ST., TAKHTI SQ., BEHESHTI AVE., TEHRAN, IRAN

has been assessed and found to be in accordance with the requirements of the

HSE Management System standards

and scope of supply detailed below

EPC CONTRACTOR: EARTHING & LIGHTNING SYSTEM, CATHODIC PROTECTION SYSTEM, EXPLOSION-PROOF EQUIPMENT, INSTRUMENTATION EQUIPMENT, SOLAR SYSTEM, HEAT TRACING SYSTEM.

Subject to the continued satisfactory operation of the client's HSE Management System, this Certificate is valid for a period of Three years from: 30.05.2016

412, BEST SKY TOWER, NETAJI SUBHASH PLACE, PITAMPURA, DELHI - 110 034, INDIA
This Certificate will be valid until 29.05.2019
Certificate Number: 311813 D, Rev. No: 00

Director Operations

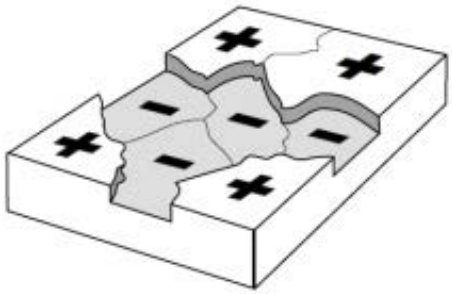
Managing Director

Cathodic Protection System

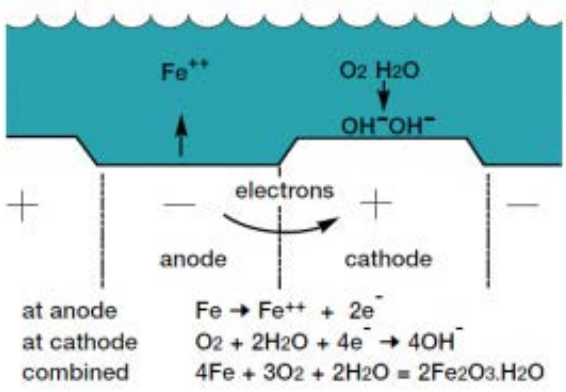
How Does Steel Corrode?

To understand cathodic protection, you must first understand how corrosion is caused. For corrosion to occur, three things must be present:

1. Two dissimilar metals
2. An electrolyte (water with any type of salt or salts dissolved in it)
3. A metal (conducting) path between the dissimilar metals



The two dissimilar metals may be totally different alloys – such as steel and aluminum – but are more likely to be microscopic or macroscopic metallurgical differences on the surface of a single piece of steel. In this case we will consider freely-corroding steel, which is non-uniform.



If the above conditions exist, the following reaction takes place at the more active sites: (two iron ions plus four free electrons):

$2Fe \Rightarrow 2Fe^{++} + 4e^{-1}$

The free electrons travel through the metal path to the less active sites, where the following reaction takes place: (oxygen gas is converted to oxygen ion - by combining with the four free electrons - which combines with water to form hydroxyl ions).

$O_2 + 4e^- + 2H_20 \Rightarrow 4\ OH^-$

Recombinations of these ions at the active surface produce the following reaction, which yields the iron-corrosion product ferrous hydroxide: (iron combining with oxygen and water to form ferrous hydroxide).

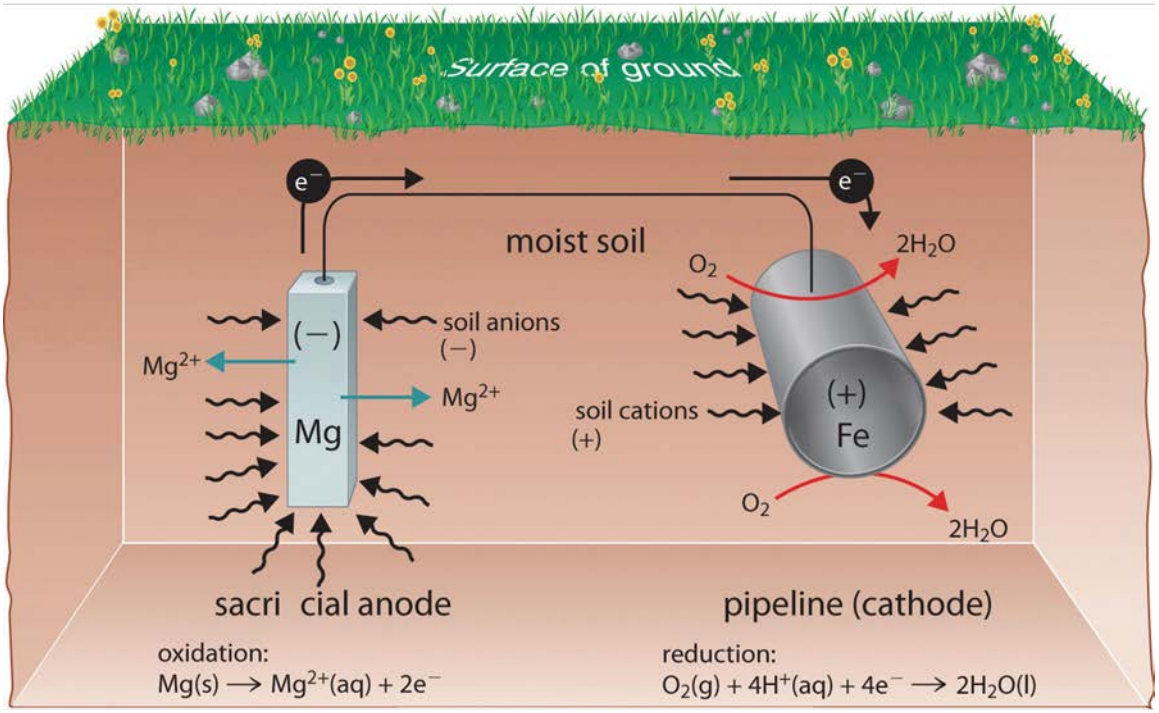
$2Fe + O^2 + 2H_2O \Rightarrow 2Fe\ (OH)2$

This reaction is more commonly described as 'current flow through the water from the anode (more active site) to the cathode (less active site).

How Does Cathodic Protection Stop Corrosion?

Cathodic protection prevents corrosion by converting all of the anodic (active) sites on the metal surface to cathodic (passive) sites by supplying electrical current (or free electrons) from an alternate source.

Usually this takes the form of galvanic anodes, which are more active than steel. This practice is also referred to as a sacrificial system, since the galvanic anodes sacrifice themselves to protect the structural steel or pipeline from corrosion.



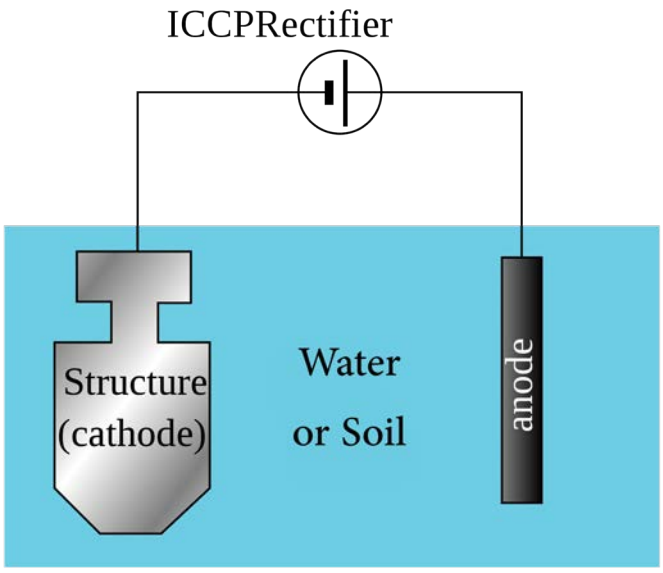
In the case of aluminum anodes, the reaction at the aluminum surface is: (four aluminum ions plus twelve free electrons)

$4Al \Rightarrow 4AL^{+++} + 12\ e^{-}$

And at the steel surface: (oxygen gas converted to oxygen ions which combine with water to form hydroxyl ions).

$3O_2 + 12e^{-} + 6H_20 \Rightarrow 12OH^{-}$

As long as the current (free electrons) arrives at the cathode (steel) faster than oxygen is arriving, no corrosion will occur.



Cathodic Protection Systems

SACRIFICIAL ANODE SYSTEMS

The electrical current an anode discharges is controlled by Ohm's law, which is:

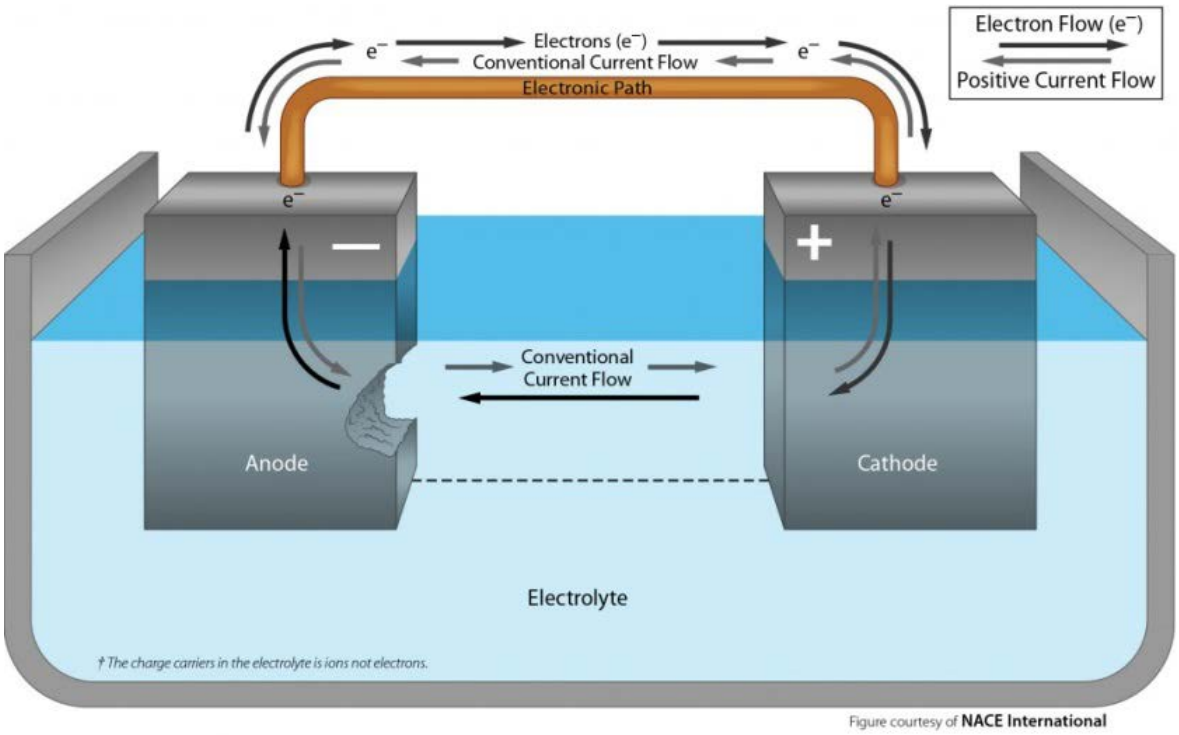


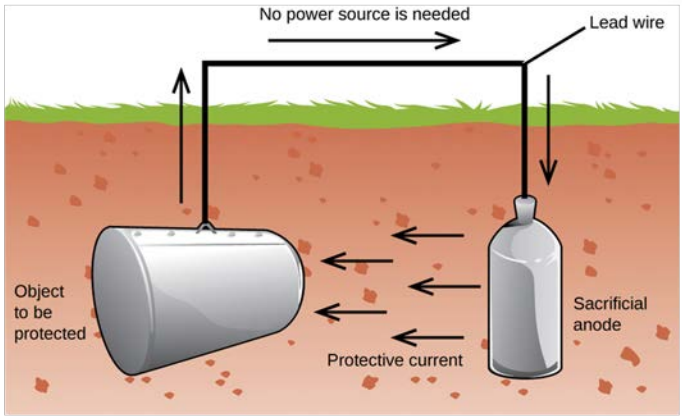
Figure courtesy of **NACE International**

I=E/R
I= Current flow in amps
E= Difference in potential between the anode and cathode in volts
R= Total circuit resistance in ohms

Initially, current will be high because the difference in potential between the anode and cathode are high, but as the potential difference decreases due to the effect of the current flow onto the cathode, the current gradually decreases due to polarization of the cathode. The circuit resistance includes both the water path and the metal path, which includes any cable in the circuit. The dominant value here is the resistance of the anode to the seawater.

For most applications, the metal resistance is so small compared to the water resistance that it can be ignored (although this is not true for sleds or long pipelines protected from both ends). In general, long, thin anodes have lower resistance than short, fat anodes. They will discharge more current but will not last as long.

Therefore, a cathodic-protection designer must size the anodes so that they have the right shape and surface area to discharge enough current to protect the structure and enough weight to last the desired lifetime when discharging this current.
The length of the anode determines how much current the anode can produce, and consequently, how many square feet of steel can be protected. The cross section (weight) determines how long the anode can sustain this level of protection

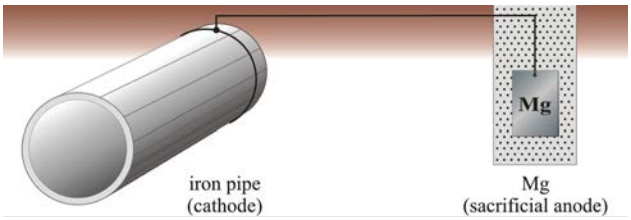


Sacrificial Anodes type

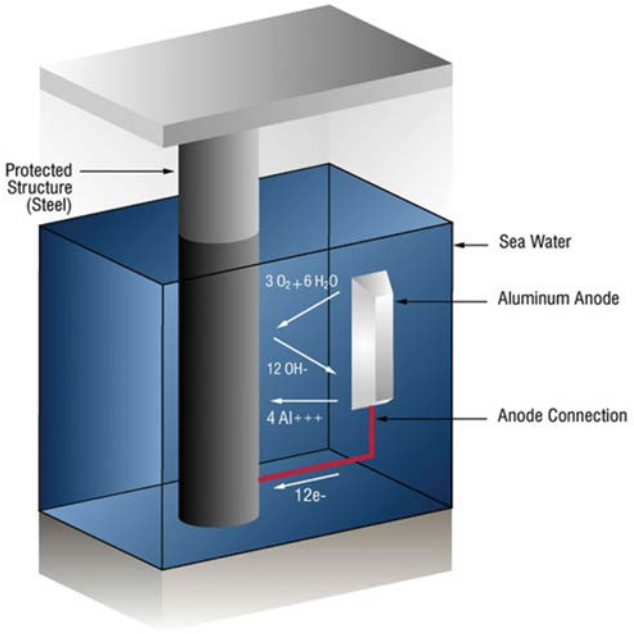
I) Magnesium: Magnesium is the most common sacrificial anode used to protect buried structures in the soil. Magnesium anodes are also used to protect domestic water heaters and reservoirs, heat exchangers, condensers and other structures that are in contact with water.

Excreted anodes are divided into two categories in terms of chemical composition and type of application:

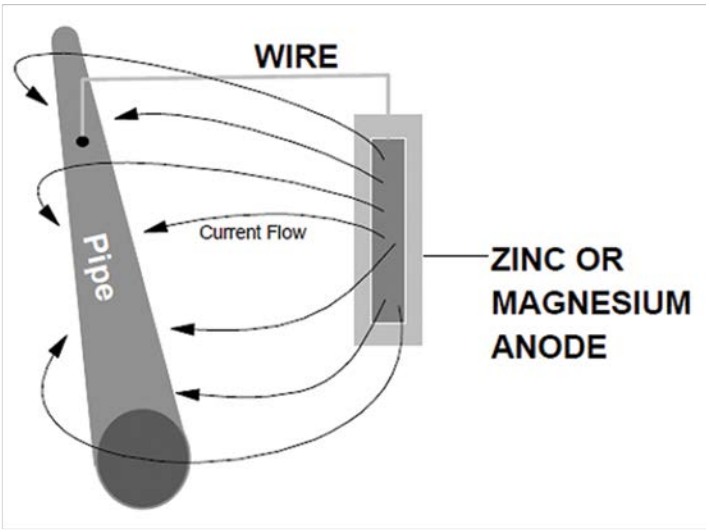
1) Standard Magnesium Anode (AZ63)
2) High potential anemone (M1C)



II) Aluminum Anode: The main application of these anodes is for the cathodic protection of steel structures in seawater. However, these anodes can also be used in rare cases in fresh water or soil. In order to prevent the formation of an aluminum peroxide layer on the anode surface which significantly reduces the anode function, the chemical composition of the aluminum anodes is usually utilized by an activator such as mercury or indium



III) Zinc Anode: Zinc anodes are used to protect structures immersed in fresh or salty water. Of course, these anodes are also used to protect buried structures in the soil.
Zn anodes are classified in terms of chemical composition and application type in two categories:
1) I-type alloy designed for use in seawater.
2) Standard type zinc alloy (Type II) formulated for use in fresh water and soil.

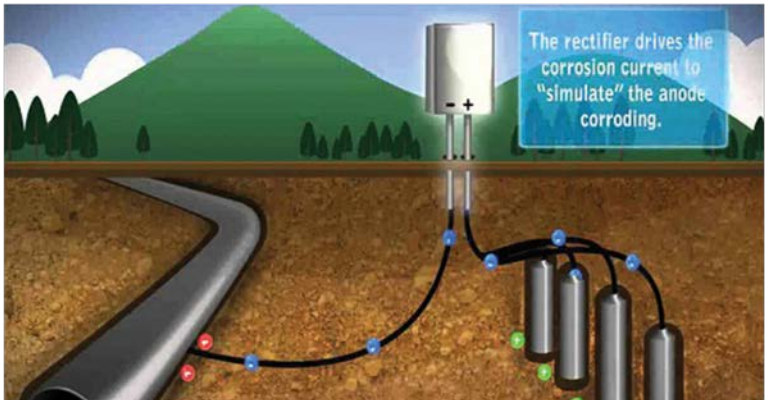


IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) SYSTEMS

Due to the high currents involved in many systems (larger structures, or where electrolyte resistivity is high, galvanic anodes cannot economically deliver enough current to provide protection), it is not uncommon to use impressed-current systems that use anodes of a type (ICCP anodes) that are not easily dissolved into metallic ions. This causes an alternative reaction: the oxidization of the dissolved chloride ions.

$$2Cl^- \Rightarrow Cl_2 + 2e^-$$

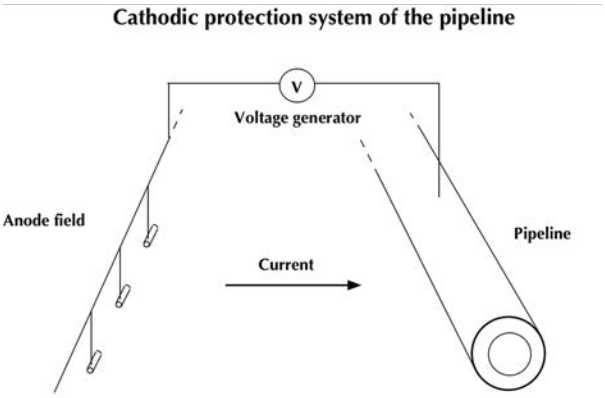
These consist of anodes connected to a DC power source, often a transformer-rectifier connected to AC power. In the absence of an AC supply, alternative power sources may be used, such as solar panels, wind power or gas powered thermoelectric generators.



ICCP Anodes Type

I) High silicon Cast Iron: The cast iron anode is probably the most used anode in flow injection systems in buried plants in the soil. The presence of high silicon and chromium in the alloy results in a sharp increase in the corrosion resistance and can guarantee the life span of the existing equipment for a long time to come.

II) Mixed Metal Oxide: The core of the anode MMO is generally selected from Titanium 1 or 2, which is activated by a complex metallic oxide coating (Ta2O5, IrO2) for use and application in soil, carbon bundles, freshwater, seawater, and Also suitable concrete

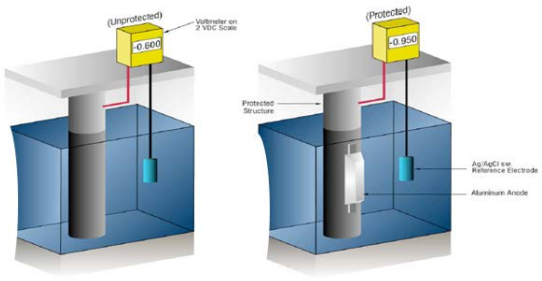


How do we know when we have enough cathodic protection?

We can verify that there's enough current by measuring the potential of the steel against a standard reference electrode, usually silver silver/chloride (Ag/AgCl sw.), but sometimes zinc (sw.).

Current flow onto any metal will shift its normal potential in the negative direction. History has shown that if steel receives enough current to shift the potential to (-) 0.800 V vs. silver / silver chloride (Ag / AgCl), the corrosion is essentially stopped.

Due to the nature of the films which form, the minimum (-0.800 V) potential is rarely optimum, so designers try to achieve a potential between (-) 0.950 V and (-) 1.000 V vs. Ag/AgCl sw.



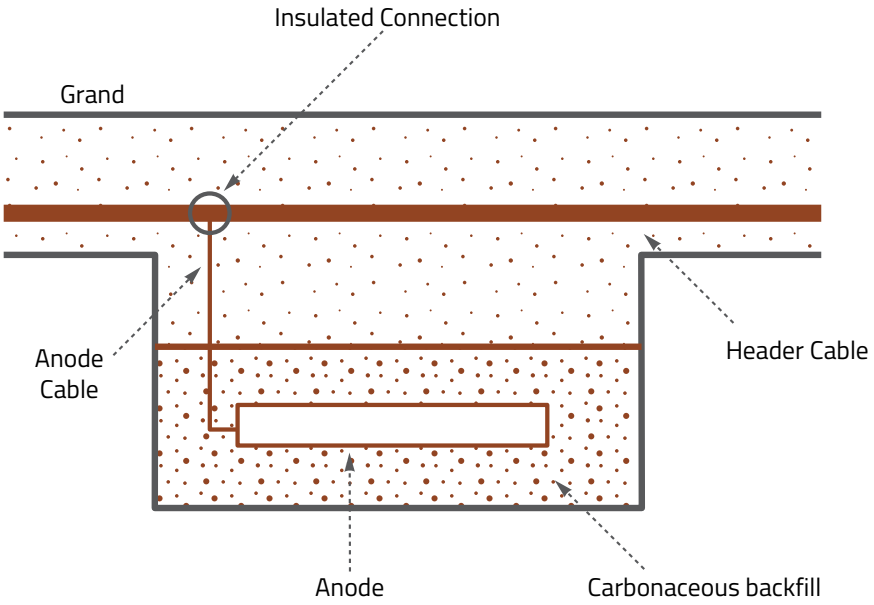
Cathodic Protection Ground beds

Usually, according to the information obtained from the Plant and the information obtained from measuring the Soil resistivity, as well as the equipment shall be protected at site , the ground bed type will be selected.
Depending on the physical shape and type of backing, the Ground beds are divided into two main categories: Shallow Ground bed and Deep well ground bed:

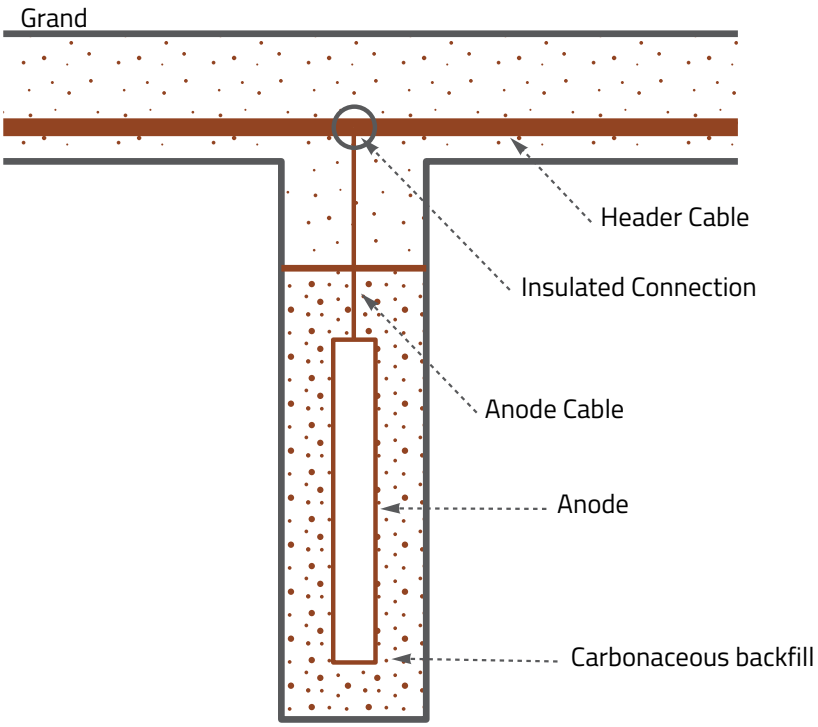
Shallow Ground bed

The depth of this type of GB is usually up to 5 meters. It is indicated in the following two categories:

1- Horizontal Ground bed:
The anodes will be installed horizontally in Backfill, attention to Chemical interactions vent pipe shall be considered.



2- Vertical Ground bed
The anodes will be installed vertically in Backfill, attention to Chemical interactions vent pipe shall be considered.

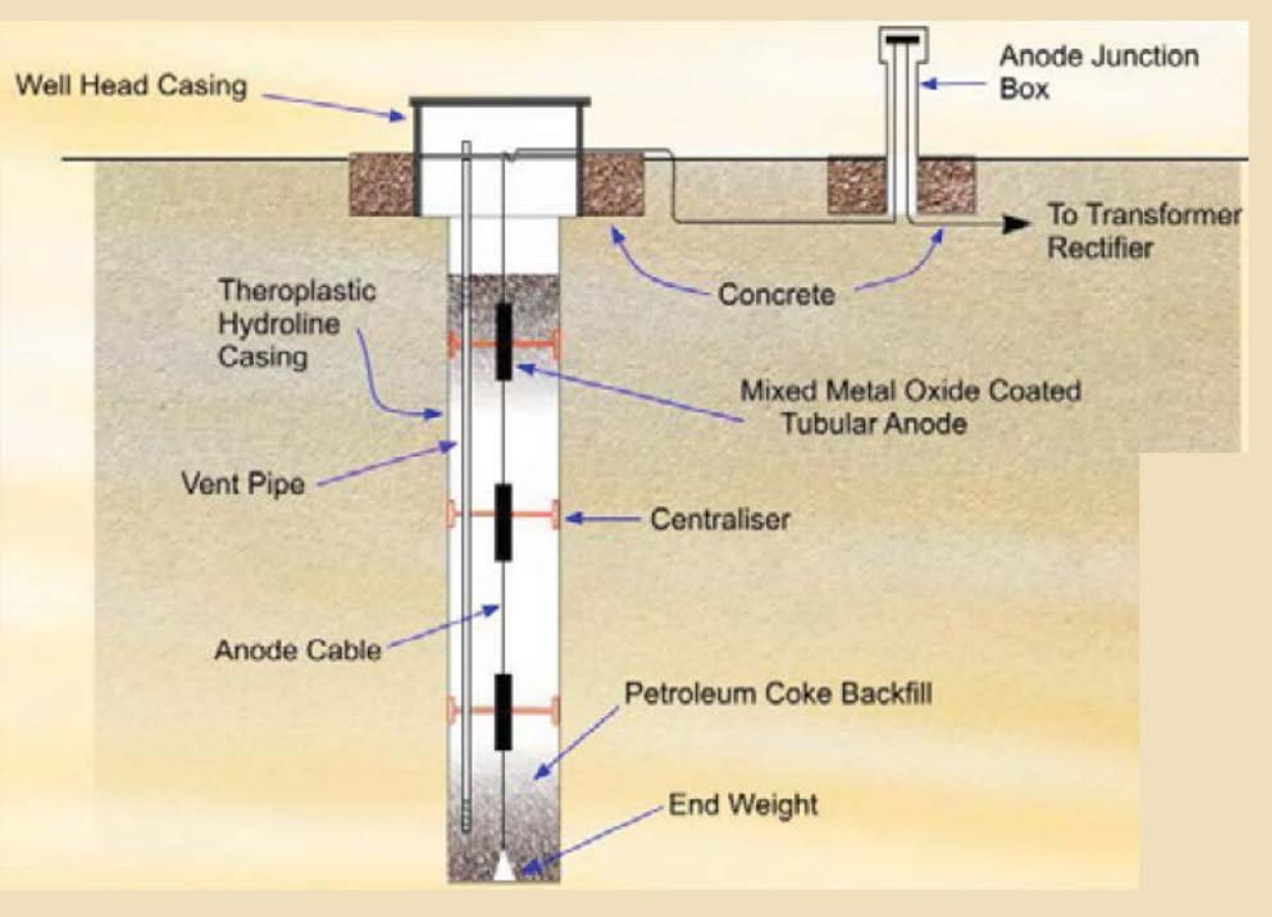


Deep well ground bed

A deep well anode system consists of two zones – the active area, which extends from the bottom of the hole to the top of the coke column, and the inactive zone. Typically, the inactive area ranges from 15m to 30m and its purpose is to assure that the anodes are sufficiently remote from the structure to ensure good current distribution. The active area is where the anodes are located. Deep well ground bed have Dry and Wet type.

1- Dry Type:
In dry Deep well ground bed anodes installed in backfill.

2- Wet type:
In wet Deep well ground bed anodes installed in Water.



ICCP Equipment

Transformer Rectifier:

Transformer Rectifier is used for cathodic protection of buried pipelines across the country, storage tanks at terminals /refineries and other buried structures.

TRUs are used to prevent submerged (Soil or water) metallic structures from corrosion. All submerged Pipelines (Oil, water etc.), concrete structure of bridges/ buildings / sea ports etc. can be protected from corrosion by doing CP.

To obtain the optimum level of protection under varying conditions, it is necessary to vary the impressed current continuously so as to maintain a constant level of protective potential at the structure. This continuous monitoring and control can be achieved by providing an automatic control for the cathodic protection system.

MOD of Operation:

Auto Reference Mode

The operation of the TRUs in this mode will be fully Automatic and will be controlled by reference electrode feedback. The unit will automatically maintain reference voltage within ± 15 mv of the set value under all conditions.

Manual Mode

The DC output voltage of TRU will be controlled in 24 symmetrical steps by means of a separate Autotransformer with Coarse & Fine tapping.

CV-CC Mode

The unit will be operated in Constant Voltage or Constant Current mode.
In constant voltage mode the DC output voltage will be settable from 0 to rated value in step less manner by means of voltage adjustable pot.

In constant current mode the DC output current will be settable from 0 to rated value in step less manner by means of current adjustable pot.

Anodes

High Silicon Cast Iron Rod Anodes

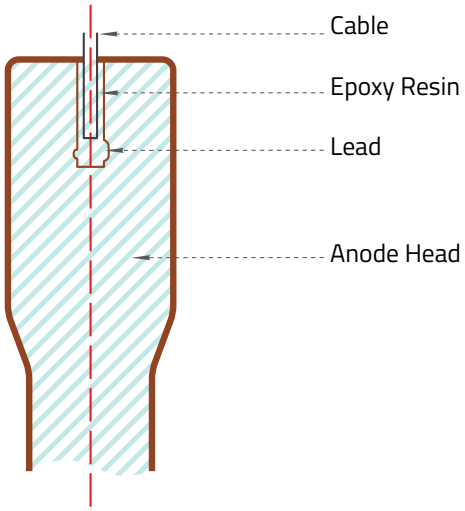
High silicon cast iron anodes have been used for more than 4 decades in the underground corrosion protection of structures. During this period of time, the anodes have proved one of the most profitable cathodic protection materials. This has led to a long demand for these products.

Solid cast anodes of solid chromium ferrosilicon can be used on soil and water. Its chemical composition (Table 1) causes the anode work effectively in saline environments, brackish water and other environments containing saline environments, brackish water and other environments containing chloride ions. The anodes also operate very well in deep well and underground applications where usually hydrogen gases are generated.

Table1: HSCI Chemical Composition

"C" Type	"N" Type	Element
0.9-1	0.9-1	Carbon
14.25-14.75	14.25-14.75	Silicon
1.5 max	1.5 max	Manganese
0.2 max	0.2 max	Molybdenum
0.5 max	0.5 max	Copper
4.3-5	0	Chromium
Remainder	Remainder	Iron

The anodes can be installed with backfill or bare, the use of backfill improves the efficiency on applications in non-aqueous lands. The backfill increases the discharge area and decrease consumption rate.



The routine type of this Anode mention in table 2

Table 2:HSCI Routin Type

Code	Type	Nominal Dimension (App)				Weight	
		Diameter		Length			
		In	mm	In	mm	Lb	Kg
ZIHR 260	Rod	2	51	60	1500	44	22.7
ZIHR 360	Rod	3	76	60	1500	110	49
ZIHC 2180	Canister	--	180	--	1800	--	--
ZIHC 3200	Canister	--	200	--	2000	--	--

MIXED METAL OXIDE ANODES

Mixed metal oxide (MMO) anode has become the industry standard where reliable performance and long life is paramount. With the additional advantages of light weight, variety of sizes, configurations and good electrical connectivity, MMO offers an ideal choice for the Corrosion Engineer for many varied applications.

Mixed Metal Oxide Coating has been designed for use in all cathodic protection applications. The MMO coating consists of mainly IrO2/Ta2O5 and is suitable for use in soils, carbonaceous backfill, fresh and brackish water, seawater and concrete. Operating parameters are varied for each parameter and are tabled below.

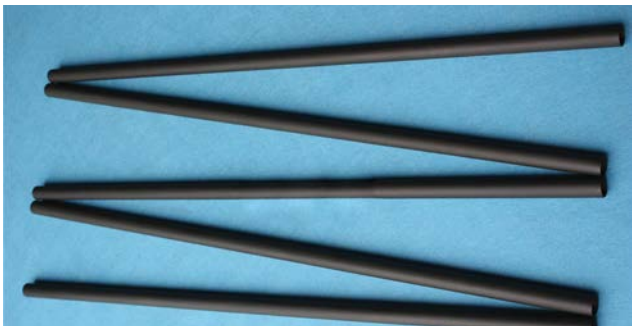
The titanium substrate remains constant throughout the design life of the anode is manufactured using titanium which meets ASTM B338 Grade 1 or 2 Standards.

MMO Anode				
"C" Type	"N" Type	Nominal Dimension (App)		Weight (Kg)
		Diameter (mm)	Length (m)	
ZIMT 2505	Tubular	25	0.500	0.5
ZIMT 2510	Tubular	25	1	1
ZIMT 3205	Tubular	32	0.500	0.5
ZIMT 3210	Tubular	32	1	1
ZIMC 2180	Tubular - Canister	180	1.8	---
ZIMC 2200	Tubular - Canister	200	2	---
ZIMC 3180	Tubular - Canister	180	1.8	---
ZIMC 3200	Tubular - Canister	200	2	---

* Coil Length

MMO Tubular Anode

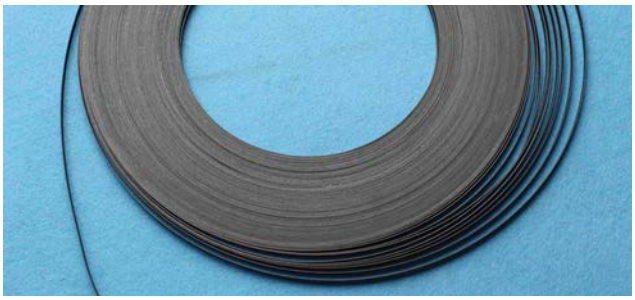
MMO tubular anodes have an extremely low consumption rate. The titanium substrate remains constant throughout the design life of the anode.



The anodes are resin filled and helium tested for an effective seal of the connection. The cable end of the anode is protected with a Teflon sleeve. Tubular anodes are center connected and tested for resistance (less than 0.001 ohms). A variety of cable types and sizes are available. Several anodes may be fitted to a single cable to form a string of anodes for use in deep well ground beds.

MMO Ribbon Anode

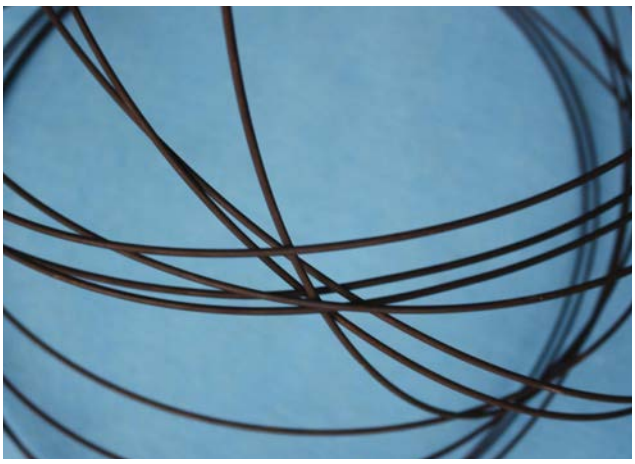
MMO Ribbon Anode Usage for Reinforced Concrete Structures & Tank Bottoms.



MMO Anode				
"C" Type	"N" Type	Nominal Dimension (App)		Weight (Kg)
		Diameter (mm)	Length (m)	
ZIMR 0635	Ribbon	6.35	100 *	1.50

MMO Wire Anode

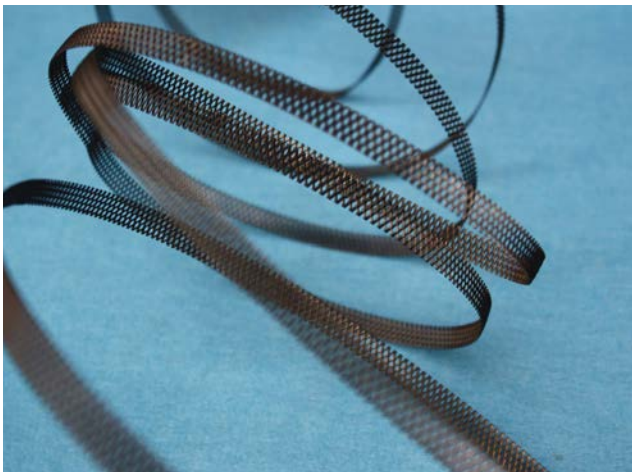
Tank Bottoms, Tank Internals, Pipeline Internals, Canister Anodes, Continuous Horizontal Ground beds, Discontinuous Horizontal Ground beds, Shallow Vertical Ground beds, Deep Anode Ground beds



MMO Anode				
"C" Type	"N" Type	Nominal Dimension (App)		Weight (Kg)
		Diameter (mm)	Length (m)	
ZIMW 0015	Wire	1.5	100 *	1.00
ZIMW 0030	Wire	3	100 *	3.00
ZIMP 0015	piggy bag	1.5	---	---
ZIMP 0030	piggy bag	3	---	---

MMO Mesh Anode

Anode ribbon mesh is composed of a precious metal oxide catalyst sintered to an expanded Titanium mesh substrate. The Anode Ribbon Mesh is used as a key component in the Cathodic Protection of Reinforced Concrete Structures



MMO Anode				
"C" Type	"N" Type	Nominal Dimension (App)		Weight (Kg)
		Diameter (mm)	Length (m)	
ZIMM 0010	Mesh	10	100 *	1.40
ZIMM 0013	Mesh	13	100 *	1.90
ZIMM 0015	Mesh	15	100 *	2.80
ZIMM 0020	Mesh	20	100 *	3.80

Backfill

Petroleum coke breeze is a carbon backfill which is used around impressed current anodes for underground cathodic protection applications. It is used to:

- •Reduce the resistivity of the environment surrounding the anode to increase the amount of current the anode can discharge
- •Extend the anode surface area, thus increasing the amount of current the anode can discharge
- •Reduce consumption of the anode since the carbon becomes the part of the anode consumed before the anode itself.

While the main purpose of coke breeze backfill is to reduce the anode-to- earth circuit resistance and to increase anode service life, it also helps to eliminate gas blockage and drying tendencies.

According to IPS Standard we have product 3 type of backfill

Property	Type 1	Type 2	Type 3
Carbon content (min.)	80	90	95
Moisture Content (max.)	5	5	1
Ash Content (max.)	15	5	3
Total Sulphur Content (max.)	1	5	1
Volatile matter Content (max.)	5	5	1

Premium backfills with high carbon contents and low contact resistance values do not have to cost an arm and a leg. It is made from petroleum coke breeze, which is calcined to remove hydrocarbons and moisture.

Anode Centralizer

The anode centralizer is a nonmetallic, PVC welded assembly used to hold the anode, cable and vent pipe in the center of a deep anode cathodic protection system. The sturdy centralizer will easily slide into the borehole without sharp edges to catch on irregular surfaces. It is manufactured with holes for attaching the supplied plastic cable ties used for securing the vent pipe and the anode.

Product Benefits

-Non-metallic, will not damage the anode cable or cause electrical short
-Easy to install
-Secures anode and vent pipe
-Installs without hang-ups

Galvanic System Equipment

In this type of application the naturally occurring electrochemical potentials of different metals are used to provide protection. Sacrificial anodes are coupled to the structure under protection and conventional current flows from the anode to the structure as long as the anode is more "active" than the structure. As the current flows, all the corrosion occurs on the anode which "sacrifices" itself in order to offer protection from corrosion to the structure.

the galvanic series for common metals is shown below Table. On the active side of the drawing the metals such as zinc, aluminum and magnesium appear. These metals and their alloys are the most commonly used sacrificial anodes

Metal	Potential with respect to a Cu:CuSO4 reference electrode in neutral pH environment (volts)
Carbon, Graphite, Coke	+0.3
Platinum	0 to -0.1
Mill scale on Steel	-0.2
High Silicon Cast Iron	-0.2
Copper, brass, bronze	-0.2
Mild steel in concrete	-0.2
Lead	-0.5
Cast iron (not graphitized)	-0.5
Mild steel (rusted)	-0.2 to -0.5
Mild steel (clean)	-0.5 to -0.8
Commercially pure aluminium	-0.8
Aluminium alloy (5% zinc)	-1.05
Zinc	-1.1
Magnesium Alloy (6% Al, 3% Zn, 0.15% Mn)	-1.6
Commercially Pure Magnesium	-1.75

Magnesium Anode

Magnesium Anode is used for Temporary protection of buried pipelines, protection of well coated buried pipelines, and protection of small marine structures, "Hot spot" locations for buried & submerged steel structures, Protection of well coated buried pipelines, internal protection of water tanks, pipeline casing sleeves. Suitable for use in soils, mud, fresh water, brackish water and sea water.

Magnesium anodes are classified into two categories in terms of chemical composition and type of application:

1) Standard Magnesium Anode (AZ63)
2) High potential Magnesium Anode (M1C)

Code	Type	Width (mm)	Height (mm)	Length (mm)	Gross Weight (Kg)
ZSMg 0017	17 Lb	90	90	650	7.7
ZSMg 0032	32 Lb	140	140	500	14.5
ZSMg 0060	60 Lb	114		1525	27

Note:

Other size will be supply according to your order.

Element	Standard	High Potential
Aluminum (%)	5.3 - 6.7	0.01 max
Zinc (%)	2.5 - 3.5	---
Manganese (%)	0.15 - 0.7	0.5 - 1.3
Silicon (%)	0.1 max	0.05 max
Copper (%)	0.02 max	0.02 max
Nickel (%)	0.002 max	0.001 max
Iron (%)	0.003 max	0.03 max
All Others (%)	0.3 max	0.3 max
Magnesium (%)	Remainder	Remainder

Zinc Anode

Zinc has been used as a sacrificial anode material in seawater since 1824. Modern zinc anodes used for Cathodic Protection are cast from high purity zinc (99.99%) alloyed with aluminum and cadmium with limitations on the level of lead, iron and copper.

Typical applications include, submarine pipelines, ballast tanks, offshore structures, storage tank internals, quay walls, water tanks, marine applications and ships hulls.

Zinc anodes are classified in terms of chemical composition and application type in two categories:

1) Zinc Sea Alloys (Type I) designed for use in seawater.
2) Zinc standard alloy (Type II), which is formulated into fresh water and soil.

Zinc Chemical Composition		
Element	**Type 1**	**Type 2**
Aluminum	0.1 – 0.5	0.005 Max
Cadmium	0.025 – 0.07	0.003 Max
Iron	0.005 Max	0.0014 Max
Lead	0.006 Max	0.003 Max
Copper	0.005 Max	0.002 Max
Other	0.1 Max	---
Zinc	Remainder	Remainder

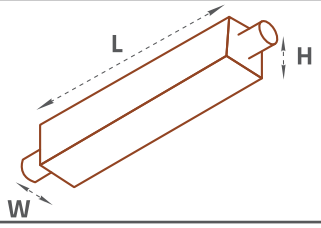
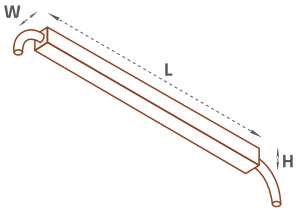
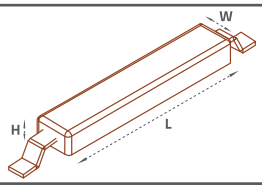
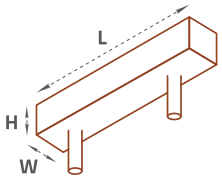
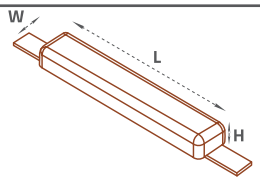
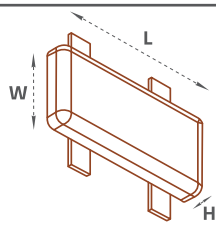
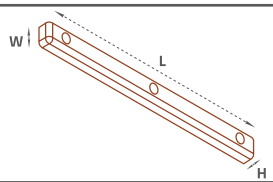
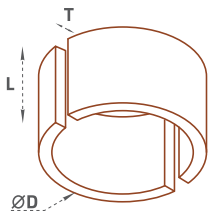
Note:

All size will be supply according to your order.

Aluminum Anode

Aluminum alloy anodes have been formulated primarily for use in seawater. Alloys are also capable of achieving high output capacity in mud and brackish water of resistivity up to 150 Ohm.cm. Aluminum anodes have approximately three times the capacity of Zinc alloys.

Aluminum Chemical Composition			
Element	**Type 1**	**Type 2**	**Type 3**
Zinc	0.30 – 0.05	0.30 – 6.0	2.5 – 5.75
Indium	---	---	0.015-0.040
Hg	0.30 – 0.05	0.30 – 0.05	---
Cadmium	---	---	0.002 max
Silicon	0.11-0.21	0.11-0.21	0.12 max
Iron	0.13 Max	0.13 Max	0.09 max
Copper	0.006 Max	0.006 Max	0.003 max
Other	0.02 Max	0.02 Max	0.02 max
Aluminum	Remainder	Remainder	Remainder

Al Anode					
Code	**Type**	**L (mm)**	**W (mm)**	**H (mm)**	**App. Weight (Kg)**
ZSAl T1140		1190	235	235	140
ZSAl T1190		1585	235	235	190
ZSAl T1200		1400	246	246	200
ZSAl T1300		2380	235	235	300
ZSAl T1310		2330	246	246	310
ZSAl T2170		1190	235	235	170
ZSAl T2235		1585	235	235	235
ZSAl T2220		1400	246	246	220
ZSAl T2330		2380	235	235	330
ZSAl T2325		2330	246	246	325
ZSAl T3018		300	75	31	1.8
ZSAl T3024		350	80	32	2.4
ZSAl T3035		500	80	32.5	3.5
ZSAl T3108		500	80	100	10.8
ZSAl T4170		1190	235	235	170
ZSAl T4230		1585	235	235	230
ZSAl T4220		1800	246	246	220
ZSAl T4330		2380	235	235	330
ZSAl T4310		2330	246	246	310
ZSAl T5018		300	75	31	1.8
ZSAl T5024		350	80	32	2.4
ZSAl T5035		500	80	32.5	3.5
ZSAl T5108		500	80	100	10.8
ZSAl T6031		300	150	26	3.1
ZSAl T6037		300	150	31	3.7
ZSAl T6065		300	150	54	6.5
ZSAl T6070		300	150	58	7
ZSAl T6075		300	150	62	7.5
ZSAl T7081		1200	50	50	8.1
ZSAl T7101		1500	50	50	10.1
ZSAl T7126		1200	62.5	62.5	12.6
ZSAl T7158		1500	62.5	62.5	15.8
Code	**Type**	**T (mm)**	**L (mm)**	**D (mm)**	**App. Weight (Kg)**
ZSAl T8203		78	600	498.8	203
ZSAl T8105		43	600	498.8	105
ZSAl T8094		43	550	489.3	94
ZSAl T8119		53	580	469.2	119
ZSAl T8105		53	500	478.8	105

Note:

Other size will be supply according to your order.

Backfill

This type of backfill is generally used in the case of Galvanic Cathodic Protection. A typical mixture in the case of soil with high resistivity consists of 75% powdered and hydrated gypsum (calcium sulfate), 20% bentonite clay and 5% sodium sulfate. Bentonite absorbs water, expands and makes good contact between the soil and anode, reducing groundbed resistance.

In cases in which soil has low moisture content, 75% bentonite and 25% gypsum is used. A mixture of 50% molding plaster and 50% bentonite clay works well with the zinc anodes.

Other Equipment

Boxes

The cathodic protection system, generally used below boxes:

-Positive / Negative box: connection positive and negative Cable
-Bond box: connection pipes or … in CPS together
-Test Box: Measuring CP parameter
-Marker: To specify the pipe route, Ground bed and …

Equipment of boxes will be considered according to Application. the CP designer can be used below equipment in boxes :

- Terminals
- Shunt
- Resistor
- Measuring Device
- Read switch
- Gland

Note that the enclosure, painting, Increase Protection (IP) and ect. of boxes Shall be specify according to area Classification.
We have supply all boxes for safe or hazardous area Classification.

Boxes:

Safe Boxes	
Standard	Project Specification / IPS
Material	Mild steel
Thickness	2 & 3 mm
Paint	Yes (as per request)
Input / output Cable	Pipe / Gland
Stand	Free stand / wall mounted ….
Terminal	Stud terminal, Modular Terminal Blocks

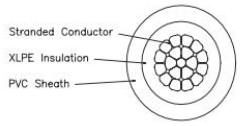
EX Box	
Standard	Project Specification
Material	Aluminum / stainless steel
Zone	1 & 2 (IIB /IIC , T1 ~ T6)
Input / output Cable	Gland
Stand	Free stand / wall mounted ….
Terminal	Modular Terminal Blocks

Cable

The cathodic protection cable is single core with copper conductor. Cable are rates 0.6 / 1.2 Kv (according to IEC Standard)

Isolation:

-PVC cover: polyvinyl chloride
- XLPE/PVC : cross-linked polyethylene
-HMWPE: High molecular weight polyethylene



NYY (CU/PVC/PVC)					
Part No.	**Nominal cross section area of conductor (mm2)**	**Insulation Thk. (mm)**	**Sheath Thk. (mm)**	**Overal Diame-ter (mm)**	**Weight (Kg/Km)**
ZWP 010	1x10	1.0	1.4	8.9	165
ZWP 016	1x16	1.0	1.4	9.9	232
ZWP 025	1x25	1.2	1.4	11.6	334
ZWP 035	1x35	1.2	1.4	12.2	418
ZWP 050	1x50	1.4	1.4	13.8	574
ZWP 070	1x70	1.4	1.4	15.5	770
ZWP 095	1x95	1.6	1.5	17.7	1031
ZWP 120	1x120	1.6	1.5	19.2	1270
ZWP 150	1x150	1.8	1.6	21.3	1580
ZWP 185	1x185	2.0	1.7	23.5	1941

N2XY (CU/XLPE/PVC)					
Part No.	**Nominal cross section area of conductor (mm2)**	**Insulation Thk. (mm)**	**Sheath Thk. (mm)**	**Overal Diame-ter (mm)**	**Weight (Kg/Km)**
ZWX 010	1x10	0.7	1.4	8.3	147
ZWX 016	1x16	0.7	1.4	9.3	211
ZWX 025	1x25	0.9	1.4	11.0	309
ZWX 035	1x35	0.9	1.4	11.6	391
ZWX 050	1x50	1.0	1.4	13.0	537
ZWX 070	1x70	1.1	1.4	14.9	732
ZWX 095	1x95	1.1	1.5	16.7	973
ZWX 120	1x120	1.2	1.5	18.4	1212
ZWX 150	1x150	1.4	1.6	20.5	1511
ZWX 185	1x185	1.6	1.6	22.5	1848

PVDF / HMWPE					
Part No.	**Nominal cross section area of conductor (mm2)**	**Insulation Thk. (mm)**	**Sheath Thk. (mm)**	**Overal Diame-ter (mm)**	**Weight (Kg/Km)**
ZWH 006	1x6	1.0	1.65	8.42	96
ZWX 010	1x10	1.0	1.65	9.35	135
ZWX 016	1x16	1.0	1.65	10.40	197
ZWX 025	1x25	1.2	1.65	12.10	312
ZWX 035	1x35	1.2	1.65	13.20	398
ZWX 050	1x50	1.4	1.65	15.00	541

Copper-Copper Sulfate Reference Electrode (Cu/CuSo4)

Copper sulfate reference electrodes (CSE) are the most commonly used reference electrode for measuring potentials of underground structures and also for those exposed to fresh water. CSE are not suitable for use off-shore environments or in a chloride electrolyte as the chloride ions migrate through the porous plug and contaminate the CSE.

The portable type CSE are composed of a copper rod, saturated solution of copper sulfate and a non-conducting cylinder with a porous plug at the bottom as shown in above picture.

AFIC can supply a wide range of CSE those are intended to use in soil applications and are made for portable use or for permanent installations i.e., suitable to use along the pipeline route or under the above grade storage tanks etc.

Silver chloride electrode

Silver-silver chloride (Ag-AgCl) reference electrodes are most commonly used for testing cathodic protection corrosion control system in sea water environments. The Ag-AgCl electrode is also used in concrete structures. There are two types of Ag-AgCl reference electrodes; in one type the silver electrode is exposed to seawater and in the other the electrode is immersed in a potassium chloride (KCl) solution contained in a cylinder with a porous plug.

Zinc Reference Electrode

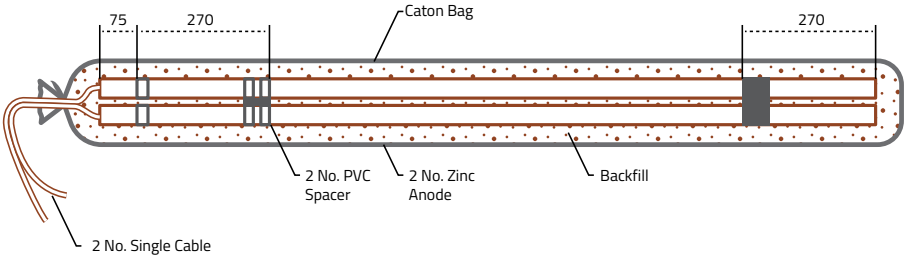
Zinc is commonly used for onshore and offshore corrosion potential measurement. Zinc reference electrodes are not stable in carbonates or at high temperatures. For underground use, the zinc electrode is packaged in a cotton bag containing the same backfill as used around zinc anodes. In off-shore zinc electrodes used bare.

Zinc Earthing Cell

The combines two zinc reference cells, insulated from one another. One electrode would typically be connected to the protected structure, the other to an earthing device. The electrodes are surrounded by low resistivity backfill allowing large stray currents to pass between them. The enables the structure to be earthed to ground with providing a direct connection

Size Bare	2 No 35 x 35 x 1525mm c/w 12mm Dia M.S. Core Extending 25mm At One End
Size Packaged	165mm Dia x 1700mm Length
Cable	1 x 25mm2 XLPE/PVC (Black) x 5m Length (Or To Client Specification)

Zinc Composition	
Cu	0.005% max
Al	0.10 – 0.50%
Fe	0.005% max
Cd	0.025 – 0.07%
Pb	0.006% max
Others	0.10% total
Zn	Remainde



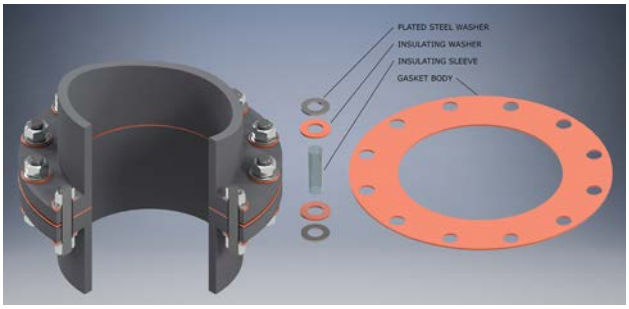
Polarization Cell

Polarization cell protects against induced AC current and ground fault current on buried pipelines. Polarization cells permit low-level voltage of cathodic protection to uniform flow and prevent hazardous voltages. Liquid Polarization cell consist of multiple plates of steel arranged, fixed and immersed in 30% KOH (Potassium Hydroxide) solution. Specially selected oil layer stop the evaporation of solution to some extend. It is advisable to verify the solution level periodically. Polarization cell is fitted in transparent body to check solution level. Normal storage of cell does not have any internal voltage and act as a grounding switch in presence of high voltage. Polarization cell works on electrochemical principle. Installed plates with large surface area polarize and allow in developing safe DC voltage suitable for cathodic protection. As the voltage increases from DC or AC voltage, the polarization film breaks and polarization cell conduct current. Specially designed polarization cells have properties to retain solution level to the maximum period with specially added floating oil. Polarization cells are designed to protect personnel and equipment from electrical disturbances. The polarization cells are rated from 5KA to 100KA AC fault capacities in 5KA steps. The other type of polarization cell is soli State device, Used in safe or hazardous area. AC fault current is 7, 10, 15, 20, 35, 50 & 70 KA

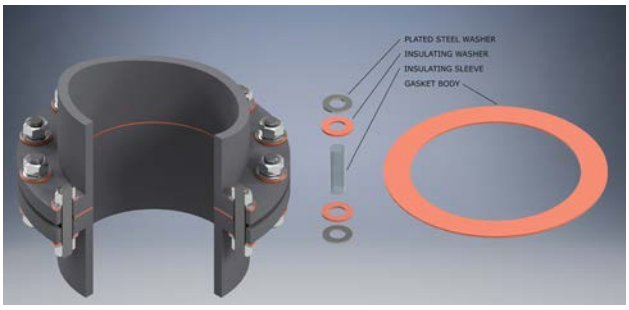
INSULATING FLANGE KITS

Flange insulation kits for metallic pipelines are available for all flange sizes, types, pressure ratings and materials. Flange insulation kits are commonly installed at each end of a pipeline to electrically isolate the pipe for other buried foreign metallic structures and plant grounding systems therefore limiting the amount of cathodic protection current required to protect the pipeline.

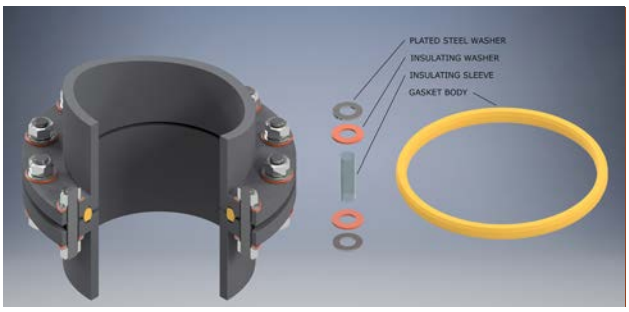
TYPE "E" GASKETS
Have the same outside diameter as the flanges, and are made with precision-located bolt holes. They are easy to Centre and will prevent foreign material from becoming lodged between the flange faces and "shorting out" the flange insulation. Type "E" gaskets are available in a wide variety of materials



TYPE "F" GASKETS
Are made to fit within the bolt hole circle of the flange faces. The outside diameter of the gasket is slightly larger than the inside diameter of the bolt hole circle. They are available in a wide variety of materials.



TYPE "D" GASKETS
Type "D" Are made specifically to fit into the ring groove of RTJ flanges. They are available in reinforced phenolic and other materials.

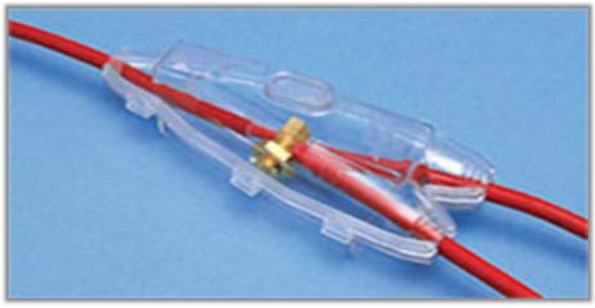


INSULATING SLEEVES AND WASHERS
Are available in complete kits, with or without a gasket. Sleeves and washer are available as separate parts or as a one-piece moulded unit. Sleeves and washers are enclosed in a strong polyethylene bag to eliminate any possibility of loss.

Cable Connecting

Splicing kit

The splicing kit will be used in onshore and marine, splicing kit suitable for plastic or rubber insulated cable 600/1000 V . There are 2way and 3way (Y or T shape) splicing kit

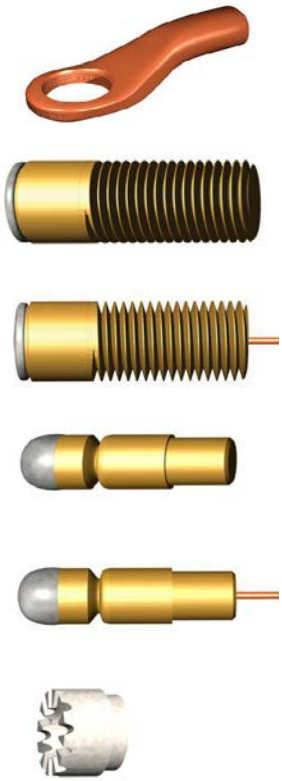


Pin Brazing

Pin brazing is Fast and easy connection, used to ensure a safe electrical connection to different types of steel structures. The pin brazing method is well suited for joints between pipes, connection to measuring cables, installation of sacrificial anodes, test posts and many other applications. More about the pin brazing process...

Pin Brazing Equipment

EasyBond Model MKII, Standard Pin Brazing Kit
Pin Holder, direct or threaded pins (size M8, M10 & M12)
Ferrule Holder, direct or threaded pins (size M8, M10 & M12)
Brazing Pins with Fuse Wires
Ceramic Ferrules
Cable Lugs



Cathodic Protection Engineering Services

Engineering services include system design, technical recommendations, soil analysis, water analysis, close interval potential surveys, system checkouts, troubleshooting, maintenance, personnel training, as well as recommendations for repair and cost estimates. Included in our array of installation services are deep and conventional anode installations, sacrificial anode installations, tank system installations, abandonments, and system relocation and repair.

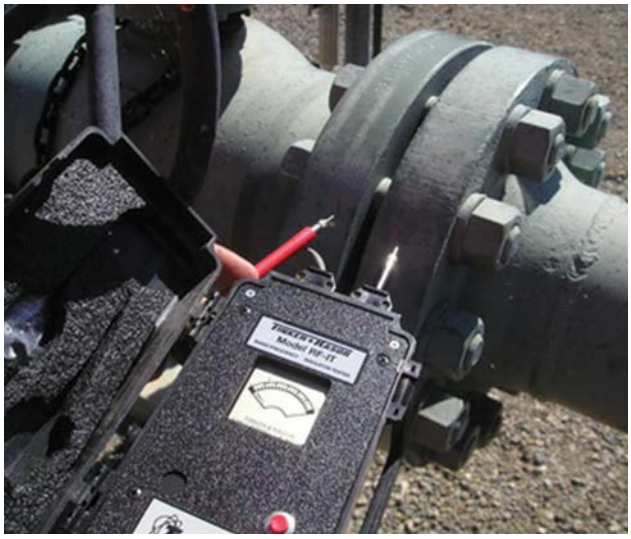
Engineering project types include oil and gas production, all submerged pipelines, water and waste water facilities, storage facilities, offshore structures, marine facilities, as well as municipal and government facilities.

Design & Analysis Services

- Cathodic Protection Drawings & Specifications
- Economic Feasibility & Budget Estimates
- Failure Analysis
- Computer & Instrument Grounding Designs
- Research & Development

Field Services

- Current Requirement Testing
- Line Current - Natural & Applied
- Stray Current & Interference Testing
- Pipe & Cable Locating
- Electrical Short Locating
- Electrical Continuity, Isolation & Resistance Testing
- Coating Holiday Testing
- Rectifier Monitoring
- Soil & Water Analysis
- Stray Current & Interference Testing
- Underwater Surveys
- Rectifier Troubleshooting
- Cathodic Protection System Troubleshooting
- Long Term Data Acquisition
- Cathodic Protection System Maintenance



Installation Services

Deep Anode Drilling
Complete C.P. System Installation
C.P. System Repair
C.P System Relocation
C.P. System Abandonment

Code and Standard

ASME Standard (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)
ASTM
API (American Petroleum Standard)
BSI (British Standard Institution)
NACE (National Association of Corrosion Engineers)
IPS (Iranian Petroleum Standard)
IEC (International Electrotechnical Commission)
DNV
Peabody

www.ZinoGlobal.com

Tel. +9821 88 17 87 10
+9821 88 17 87 15
Fax +9821 88 17 87 07
Email info@zinoglobal.com