MIXED METAL OXIDE ANODES

IMPRESSED CURRENT CATHODIC PROTECTION

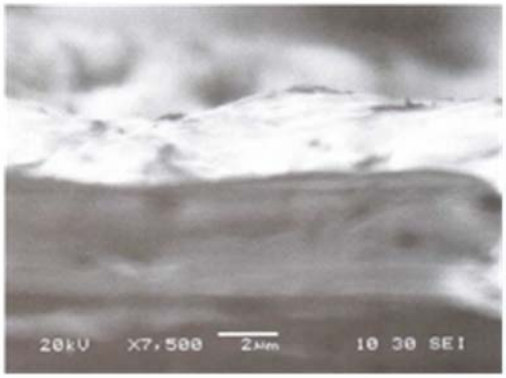
KORTEK
Corrosion Technologies Co. Ltd.

APPLICATION

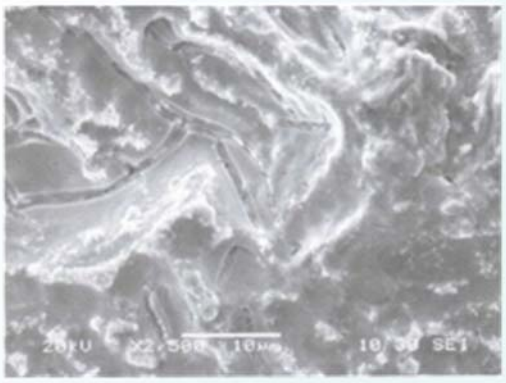
- Marine Structures,
- Seawater Intakes,
- Deepwell Groundbeds,
- Horizontal Groundbeds,
- Distributed Anodes,
- Tank Internals& Tank Bottoms

Suitable to use in soil, mud, carbonaceous & pet coke backfill, fresh, brackish and sea water. minimise its ohmic resistance to ground.

COATING SURFACE QUALITY



Coating cross section



Coating surface

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KORTEK
Corrosion Technologies Co. Ltd.

Ti/MMO Ribbon Anode

MMO ribbon anodes are manufactured using titanium substrate which meets ASTM B265 Grade 1 Standard and coated with Mixed Metal Oxide (Ir/Ta).

Nominal Dimensions:

Width: 6.35mm
Thickness: 0.635mm
Standard coil Length: 152.4meter
Shipping coil weight: 2.8kgs

Chemical Composition:

ASTM B338 Grade I

C%	Fe%	N%	O%	H%	Other(Single)	Other(Total)	Ti
0.08 max	0.20 max	0.03 max	0.18 max	0.015 max	0.10 max	0.40 max	Balance

Current output and Life: 17mA/meter for 50 year

Ti Conductor Bar

Titanium conductor bar are manufactured using titanium substrate which meets ASTM B338 Grade 1 Standard.

Nominal Dimensions:

Width: 12.7mm
Thickness: 0.90mm
Standard coil Length: 152.4meter
Shipping coil weight: 7.8kgs

Chemical Composition:

ASTM B338 Grade I

C%	Fe%	N%	O%	H%	Other(Single)	Other(Total)	Ti
0.08 max	0.20 max	0.03 max	0.18 max	0.015 max	0.10 max	0.40 max	Balance

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IMPRESSED CURRENT CATHODIC PROTECTION

MMO/TITANIUM TUBULAR ANODE

High performance MMO anodes suitable for soil, sea mud, seawater, and fresh water environments. In seawater, the suggested working current density is 600Amps/m2, and in fresh water and soil the suggested current density is 100Amps/m2.

The substrate confirm to ASTM B338 Grade I and the active coating material consist of iridium oxide and tantalum oxide..

ASTM B338 Grade I	CHEMICAL COMPOSITION							
	Fe max	C max	N max	H max	O max	Other element (single)	Other elements (total)	Ti
	0.20	0.08	0.03	0.015	0.18	＜0.1	＜0.4	Balance

The typical MMO anodes supplied by KORTEK as below:

Item No.	Standard Dimension	Current Density	Current Output	Working Life
1	16mm dia. X 500mm	100Amps/m2	2.5 Amps in soil	20 Years
		600Amps/m2	15 Amps in seawater	20 Years
2	16mm dia. X 1000mm	100Amps/m2	5 Amps in soil	20 Years
		600Amps/m2	30 Amps in seawater	20 Years
3	25mm dia. X 500mm	100Amps/m2	4 Amps in soil	20 Years
		600Amps/m2	23.5 Amps in seawater	20 Years
4	25mm dia. X 1000mm	100Amps/m2	8 Amps in soil	20 Years
		600Amps/m2	48Amps in seawater	20 Years
5	25mm dia. x 1500mm	100Amps/m2	12Amps in soil	20 Years
		600Amps/m2	72Amps in seawater	20 Years
6	32mm dia. X 500mm	100Amps/m2	5 Amps in soil	20 Years
		600Amps/m2	30 Amps in seawater	20 Years
7	32mm dia. X 1000mm	100Amps/m2	10 Amps in soil	20 Years
		600Amps/m2	60 Amps in seawater	20 Years
8	32mm dia. X 1220mm	100Amps/m2	12 Amps in soil	20 Years
		600Amps/m2	74 Amps in seawater	20 Years

KORTEK is also supplying the MMO tubular anodes as per client's request dimensions.

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MMO WIRE ANODES

IMP 01-04

IMPRESSED CURRENT CATHODIC PROTECTION

KORTEK
Corrosion Technologies Co. Ltd.

MMO Piggyback Wire anode is an ideal CP product to replace the conventional anodes used to protect tank bottom, underground vessel, pipeline. KORTEK's sock anode are made from high grade titanium wire with Mixed Metal Oxide catalyst, and can last for more than 50 years.

Application:
1 Tank bottom
2 Underground vessels
3 Pipelines

Material Specification:
Substrate: ASTM B348 Grade I / II
Catalyst: Mixed Metal Oxide
Cable: HMWPE, XLPE/PVC, Kynar/HMWPE, etc.
MMO wire to cable connection: Crimp
Connection: 5meters to 10meters each

Advantages:
Easy handling and installation
Cost effective
Up to 50 years life time
Customized anode output and life

MMO wire diameter	1.0mm	1.5mm	3.0mm
Titanium substrate	ASTM B348 Grade I / II		
Mixed Metal Oxide Catalyst	Ir-Ta		
Current output for 20 years life	67mA/m	89mA/m	195mA/m
Current output for 30 years life	45mA/m	65mA/m	130mA/m
Current output for 50 years life	28mA/m	41mA/m	78mA/m
Backfill	Calcium Petroleum Coke		
Sock Material	Porous non-woven fabrics		
Sock dimension	38mm Diameter		
Length per reel	150 Meters (Customized length at requested)		
Customized roll length and output is available at request			

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IMPRESSED CURRENT CATHODIC PROTECTION

MMO Piggyback Wire Sock Anode is an ideal CP product to replace the conventional anodes used to protect tank bottom, underground vessel, pipeline.

KORTEK's sock anode are made from high grade titanium wire with Mixed Metal Oxide catalyst, and can last for more than 50 years.

Application:

- Tank bottom
- Underground vessels
- Pipelines

Material Specification:

- Substrate: ASTM B348 Grade I / II
- Catalyst: Mixed Metal Oxide
- Cable: HMWPE, XLPE/PVC, Kynar/HMWPE, etc.
- MMO wire to cable connection: Crimp
  Connection: 5meters to 10meters each

Advantages:

- Easy handling and installation
- Cost effective
- Up to 50 years life time
- Customized anode output and life

Typical Anode Specification:

MMO wire diameter	1.0mm	1.5mm	3.0mm
Titanium substrate	ASTM B348 Grade I / II		
Mixed Metal Oxide Catalyst	Ir-Ta		
Current output for 20 years life	67mA/m	89mA/m	195mA/m
Current output for 30 years life	45mA/m	65mA/m	130mA/m
Current output for 50 years life	28mA/m	41mA/m	78mA/m
Backfill	Calcium Petroleum Coke		
Sock Material	Porous non-woven fabrics		
Sock dimension	38mm Diameter		
Length per reel	150 Meters (Customized length at requested)		
Customized roll length and output is available at request			

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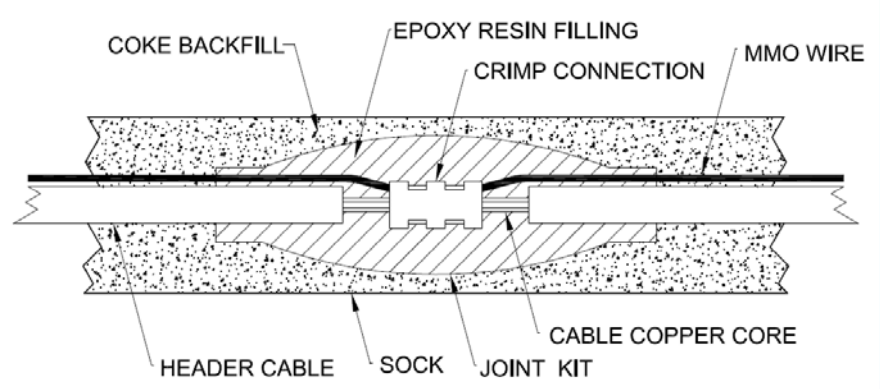
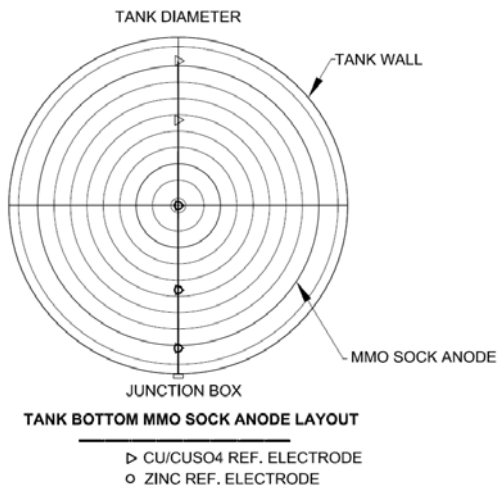
Anode Fabrication:



Typical anode header cable is 8AWG or 10AWG High Molecular Weight Polyethylene conform to ASTM D1248, Type 3, Class C, Category 5. which proved the ideal cathodic protection cable for onshore project. The MMO wire to cable is connected by a high pressure crimp and sealed in a joint kit with epoxy resin to make sure low electric resistance and symmetrical current distribution from a continuous length of at least 150meters. The high quality calcium petroleum coke backfill will improve the working environment of the MMO wire and the current density as well.

Tank bottom Cathodic Protection:

The anode was buried in sand which is about 400mm under the tank bottom from the center of the tank circle to the tank wall. Proper space between the sock anode should be maintained in order to provide desire current distribution. After the layout of the sock anode, the anode should connected to the power cable by special cable joint kit to make sure perfect electric connection. And then all anode cable together with reference electrode cable should connected to the outer junction box.



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SILICON IRON ANODES

IMPRESSED CURRENT CATHODIC PROTECTION

KORTEK
Corrosion Technologies Co. Ltd.

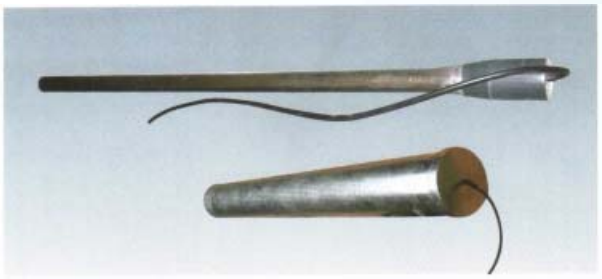
KORTEK's Silicon Iron anodes are made by Chill Casting in metal mould. The anodes have higher density, more compact crystal structure and low consumption rate, thus have longer life.

Our SiFe anodes are made according to ASTM A518-86 (grade 3) standard.

APPLICATION

- Offshore Structures,
- Underground Pipelines,
- Horizontal Groundbeds,
- Distributed Anodes,

Suitable to use in soil, mud, carbonaceous & pet coke backfill, fresh, brackish and sea water.



ELECTROCHEMICAL PROPERTIES

Type	C	Mn	Si	Cr	Mo	Cu	P	S	Fe
BS 1591:1975 SiCr144	≤1,40%	≤0,50	14,25-15,25%	4,00-5,00%	-	-	≤0,25%	≤0,10%	Balance
ASTM A518-99 Grade 3	0,70-1,10%	≤1,50	14,20-14,75%	3,25-5,00%	≤0,20%	≤0,50%	-	-	Balance

Type	Dimension				Surface Area		Weight	
	Dia		Length					
	in	mm	in	mm	ft2	m2	lbs	kg
YS-R02	1,5	38	35,5	900	1,29	0,12	16,53	7,5
YS-R03	1,5	38	47,25	1200	1,72	0,16	22,05	10
YS-R04	1,5	38	60	1524	2,04	0,19	28,66	13
YS-R05	2	50	35,5	900	1,72	0,16	29,76	13,5
YS-R06	2	50	47,25	1200	2,15	0,2	36,38	16,5
YS-R07	2	50	60	1524	2,80	0,26	47,18	21,4
YS-R11	3	76	35,5	900	3,01	0,28	74,96	34
YS-R12	3	76	47,25	1200	3,23	0,3	88,18	40
YS-R13	3	76	60	1524	4,20	0,39	110,01	49,9

All dimensions and weights shown are nominal. Actual dimensions/weight will be adjusted according to drawings.

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CARBONACEOUS BACKFILL

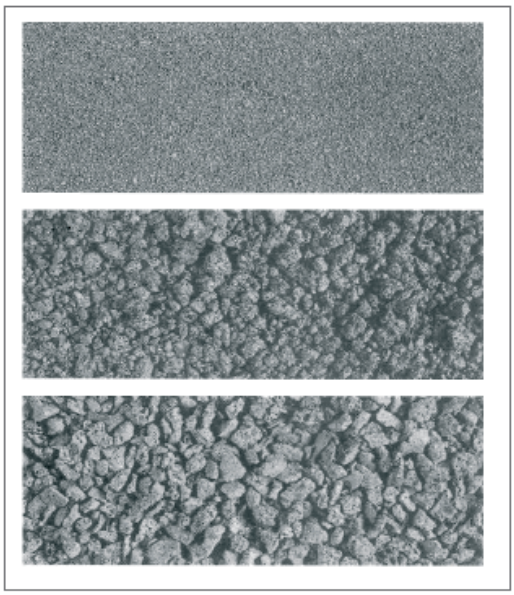
IMPRESSED CURRENT CATHODIC PROTECTION

KORTEK
Corrosion Technologies Co. Ltd.

APPLICATION

Impressed current cathodic protection groundbeds and packaged impressed current anodes.

CARBONACEOUS BACKFILL DATA



TYPICAL ANALYSIS			
Moisture	(ISO 589:2008)	8.87	--
Ash	(1501171-97)	11.46	12.58
Volatile Matter	(ISO 562-98)	0.93	1.02
Fixed Carbon	By Calculation	78.74	86.40
Sulphur	(ASTM D 3177-02)	0.66	0.72
Phosphorus		--	0.0126

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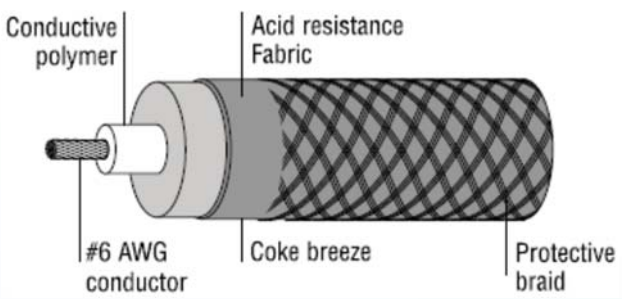
AnodeFlex 1500

KORTEK
Corrosion Technologies Co. Ltd.

IMPRESSED CURRENT CATHODIC PROTECTION

Construction: Five basic elements:
Central Copper Conductor: #6 AWG. Serving as a low resistance busbar to deliver the required current distance without incurring substantial longitudinal voltage drop.
Conductive polymer: 0.5 in (13mm) in diameter special extrusion, sealing the copper conductor from chemical attack, yet allowing current to low through it, from the conductor to the environment all along its length.

Coke breeze: Pre-packaged, high performance calcined petroleum coke breeze, serving as the active matrix in which the electrochemical reactions take place. Designed for min. 20 years service life at max current output of 16mA/ft (52mA/m).
Fabric jacket: İntegrated woven, acid resistant and porous jacket holding the coke breeze in place around the anode.
Protective braid: Tough, porous, non-conductive braid enhancing the abrasion and damage resistance of the fabric jacket.



Product Selection Guide	
Recommended Max Design Current Output in Soil	52 mA/m (16 mA/ft)
Min Installation and Storage Temperature	-18˚C (0˚F)
Min Bend Radius	500mm (20 in)

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AnodeFlex 1500

IMPRESSED CURRENT CATHODIC PROTECTION

KORTEK
Corrosion Technologies Co. Ltd.

Product Dimensions

Nominal diameter	28 mm (1.5 in)
Weight	1,49 Kg/m (1.0 lb/lt)
Length	494 m ±6m (1620 ft ±20 ft)
Coke breeze requirements	1.15 kg/m (0.77 lb/ft)

Property	**Test method**	**Typical Value**
Copper Condactor		
Dimension	ASTM B-263	6 AWG
Resistance	ASTM B-193	1.5×10^{-3} Ohm/m
Conductive Polymer		
Dimensions	ASTM B-263	Pass
Volume resistivity	ASTM B-193	1.5 Ohm-cm
Coke Breeze		
Fixed carbon	ASTM D-172	99.7%
Resistivity	G.L.C – C -12A @ 23˚C (73˚F), 10 bar (145psi)	0.4 Ohm-cm
Fabric Jacket		
Weight	Min. 200 g/m²	229 g/m²
Bursting strength	ISO 3303	575 N
Abrasion resistance	ASTM D-4157	219 cycles to fature
Fluid resistance	Internal immersion test 6 months	Pass
Chlorine resistance	Internal immersion test 6 months	Pass
UV resistance	ASTM G-53 @ 60˚ C (140˚ F), 8 hrs @ 50˚ C (122˚ F), 4 hrs condensation	55% tear strength loss

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AnodeFlex - Splice

KORTEK
Corrosion Technologies Co. Ltd.

IMPRESSED CURRENT CATHODIC PROTECTION

The AnodeFlex™ 1500 Tee Splice kit is designed for 3-way connections of the AnodeFlex™1500 anode strand and lead wire(s). The splice consists of a heat shrinkable tee boot, factory installed over a crimped 3-way connection of anode lead wire double coated with a high-molecular-weight polyethylene insulation.
The long term performance of AnodeFlex™1500 is conditional upon keeping the base copper conductor and electrical connection isolated from water.

Typical Kit Compenent Dimension for AnodeFlex™1500 – End Cap Splice

Description	Type dimension	Requirement in mm (In)
Abrasion paper	Width×Length	50×150 (1.97×5.90)
Tie wraps	Length	170 (6.69) min.
Aluminum tape	Width×Length	50×150 (1.97×5.90)
Sealing mastic strip	Width×Thickness×Length	50×3×1400 (1.97×0.12×55.12)
Heat shrinkable tublng	Length Inside diameter supplied Inside diameter recovered Wall thickness recovered	400 ± 10 (15.75 ± 0.39) 50 (1.97) min.

Typical Functional Properties for AnodeFlex™1500 –In-Line Splice

For all test methods below, see Berry Plastics specification RUD 6056 entitled “Specification for Cap, Splice and Tee Sealing Splices for use with AnodeFlex™ 1500 Long Line Anode”.

Property	Conditions	Requirement
Internal pressure resistance	23˚C, 1 Bar, 24 h	No leakage
External pressure resistance	23˚C, 10 Bar, 24 h	No water ingress
Corrosion Resistance	23˚C	Pass
Impact	23˚C, 100 Nm, blunt blade	Pass with 25 kV
Penetration	23˚C, 72 h, needle: Diam. 1.8 mm, 2.5 kg	Pass with 25 kV

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AnodeFlex – End Cap

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Corrosion Technologies Co. Ltd.

IMPRESSED CURRENT CATHODIC PROTECTION

The AnodeFlex™ 1500 End Cap Splice kit is designed to seal the exposed end of an AnodeFlex™ 1500 anode circuit.
The heat-shrinkable tubing, sealant and accessories, have been specifically designed to environmentally protect the termination in direct burial soil application uring the entire anode life.
The long term performance of AnodeFlex™1500 is conditional upon keeping the base copper conductor and electrical connections isolated from water.

Typical Kit Compenent Dimension for AnodeFlex™1500 – End Cap Splice

Description	Type dimension	Requirement in mm (In)
Abrasion paper	Width × Length	50 × 150 (1.97 × 5.90)
Tie wraps	Length	170 (6.69) min.
Aluminum tape	Width × Length	50 × 150 (1.97 × 5.90)
Sealing mastic strip	Width × Thickness × Length	50 × 3 × 250 (1.97 × 0.12 × 9.84)
End Cap	Length	57 (2.24) min.
	Inside diameter (as supplied)	22 (0.87) min.
	Inside diameter (fully recovered)	7 (0.28) max.
Heat shrinkable tublng	Length	150 ± 10 (5.90 ± 0.39)
	Inside diameter supplied	50 (1.97) min.
	Inside diameter recovered	16 (0.63) max.
	Wall thickness recovered	2 (0.079) min.

Typical Functional Properties for AnodeFlex™1500 – End Cap Splice

For all test methods below, see Berry Plastics specification RUD 6056 entitled Specification for Cap, Splice and Tee Sealing Splices for use with AnodeFlex™ 1500 Long Line Anode.

Property	Conditions	Requirement
Internal pressure	23˚C, 1 Bar, 24 h	No leakage
External pressure resistance	23˚C, 10 Bar, 24 h	No water ingress
Corrosion Resistance	23˚C	Pass
Impact	23˚C, 100 Nm, blunt blade	Pass with 25 kV
Penetration	23˚C, 72 h, needle: Diam. 1.8 mm, 2.5 kg	Pass with 25 kV

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IMP 05-01

TRANSFORMER RECTIFIER

KORTEK
Corrosion Technologies Co. Ltd.

IMPRESSED CURRENT CATHODIC PROTECTION

Suitable to use various kinds of reference electrode including zinc electrode, Ag/AgCl electrode and Cu/CuSO4 electrode.

The unit's reliability and stability is significant improved by using all series of integration & modularization electronic circuit. The updated integration & modularization also simplified the operation and maintenance work of circuit.

By using the high impedance digital meters which enable the unit's input impedance reaches 5MΩ the unit's potential measurement precision is much improved.

Auto error conversion system can insure the system convert to the preset constant current status at a time of the failure of the cathodic protection system, such as the potential diversification caused by instruments, anodes, circuits, reference electrode, etc.

Overload protection, short protection circuits are configured to insure the safety of the unit. The unit is preinstalled with three sets of surge arrester (8-20 Ms) which on anode & cathode terminals 40 KA, reference electrode terminal 40 KA and AC input terminal 40KA respectively, additional surge arrestors are optional.

Single circuit board design which provide considerable advantage in repairing and maintenance.

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IMP 05-01

TRANSFORMER RECTIFIER

IMPRESSED CURRENT CATHODIC PROTECTION

KORTEK
Corrosion Technologies Co. Ltd.

AIR & OIL COOLED RECTIFIERS

Item/Parameter	Single Phase	Three Phase	PWM Switch	Mounted Type	Portable Type
Frequency	50Hz-60Hz	50Hz-60Hz	50Hz-60Hz	50Hz-60Hz	50Hz-60Hz
AC Input Voltage	220V	380V	220V	220V	220V
DC Output Voltage(Variable)	DC 0-50V	DC 0-100V	DC 0-50V	DC 0-50V	DC 0-50V
DC Output Current	0-50A	0-300A	0-80A	0-40A	0-20A
Current Limiting	0-30A	0-200A	0-60A	0-30A	0-15A
Set Potential	0-±3V	0-±3V	0-±3V	0-±3V	0-±3V
Constant Potential Precision	≤5mV	≤5mV	≤5mV	≤5mV	≤5mV
Constant Current Precision	≤1%	≤1%	≤1%	≤1%	≤1%
Input Impedance	>5MΩ	>5MΩ	>5MΩ	>5MΩ	>5MΩ
Ripple	≤3%	≤3%	≤3%	≤3%	≤3%
Surge Arrester	Configured	Configured	Configured	Configured	Configured
Working Style	Continuous	Continuous	Continuous	Continuous	Continuous
IP Protection(Optional)	IP54-IP66	IP54-IP66	IP54-IP66	IP54-IP66	IP54-IP66
AC Noise Immunity	≥24V	≥24V	≥24V	≥24V	≥24V
Remote Data Transmission & Remote Control	Optional	Optional	Optional	Optional	Optional
Circuit Sutructure	Modularization	Modularization	Modularization	Modularization	Modularization

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IMP 06-01

JUNCTION BOX

KORTEK
Corrosion Technologies Co. Ltd.

IMPRESSED CURRENT CATHODIC PROTECTION

APPLICATION

Junction boxes for positive and negative current distribution and control , and for resistance bonding are available to meet exact client specifications.

Suitable for onshore and marine environments in safe and hazardous areas.

When specifying a CPC Junction Box assembly please clarify specific hardware and components required.

ENCLOSURES

Stainless Steel 316L & 304,	Aluminium	Explosion Proof
Painted Mild Steel	Plastic	GRP
Galvanised and Painted	Cast Iron	Custom Finishes

Please also specify IP, NEMA or Hazardous area classification required.

ACCESSORIES

Resistors	Metering	Diodes
Shunts	Monitoring	Labelling
Support Frames	Transducers	Switches
Copper Links	Terminals	Security / Locking

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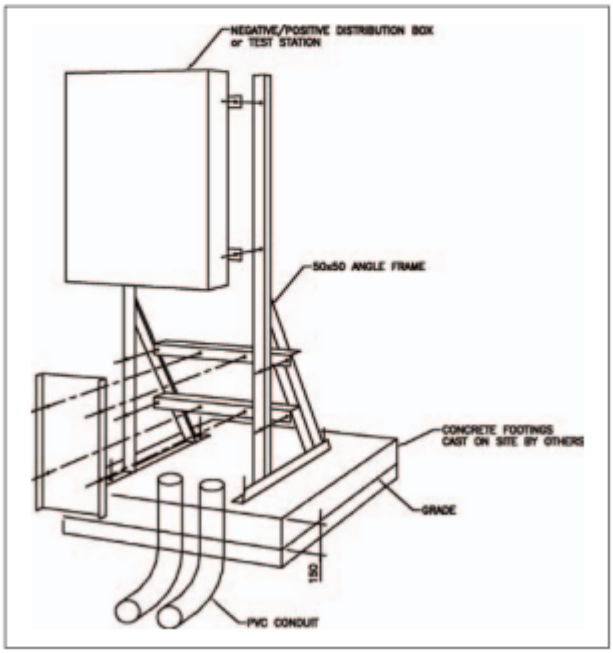
KORTEK
Corrosion Technologies Co. Ltd.

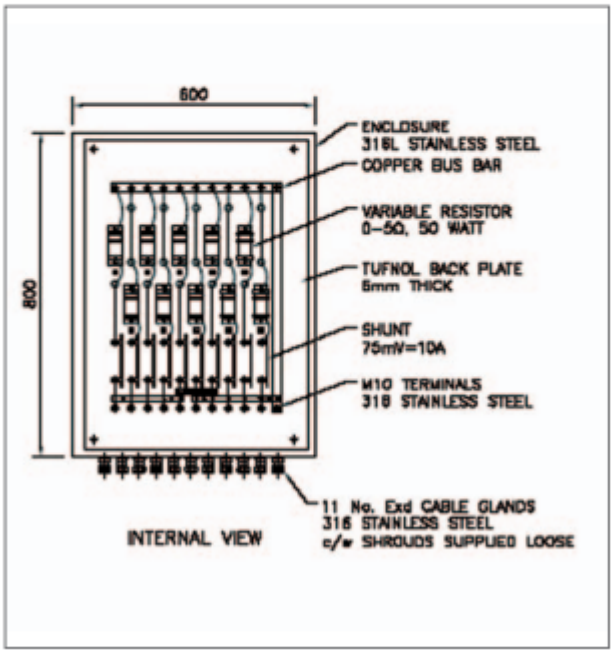
CABLE ENTRY

Cable entry can be made by any type of proprietary cable gland, or by conduit and hub assemblies allowing the safe passage of multiple cables into the enclosure.

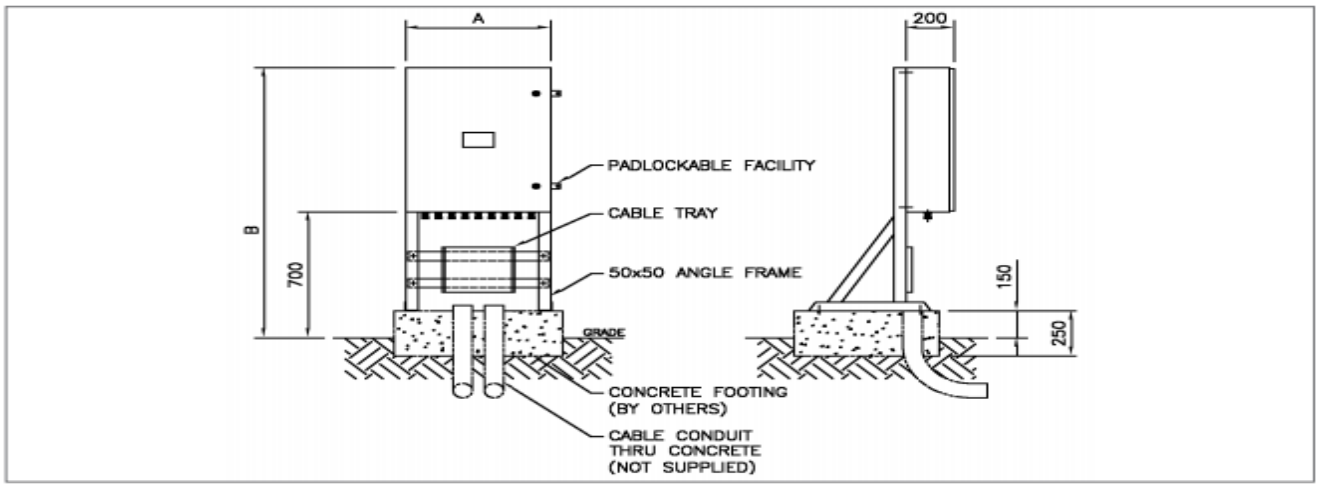
TYPICAL JUNCTION BOX ARRANGEMENT



TYPICAL INTERNAL LAYOUT OF ANODE JUNCTION BOX



TYPICAL JUNCTION BOX SUPPORT ARRANGEMENT



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