



# CATHODIC PROTECTION

SACRIFICIAL ANODES & MONITORING SYSTEM



**KC**  
Cathodic Pro  
Anti-fouling

  
**FOS INTERNATIONAL INC.**

# The world best system for Cathodic Protection & Anti-Fouling



## HISTORY

1986	01	Established	2004	02	Registered various patent of M.G.P.S and I.C.C.P system
1998	11	Accreditation of ISO 9001	2009	11	ISO 9001 : 2008 re-certified by LRQA
1999	09	Moved to New Premises located in Noksan Industrial Complex	2012	12	Export Award from KITA (Ten million dollars)
2000	01	Attended Global Marine Exhibition Posidonia, SMM, Nor-shipping, Europort, APM, INMEX, Kormarine, Marintec China	2013	12	Obtained the Korean World Class Products Award 2013
~ Present	02	Completed the expansion of Premises (Expansion Area : 3,837 m <sup>2</sup> )	2015	03	Expand a new Premises (5,400 m <sup>2</sup> ) located in Mieum Industrial Complex
2001	04	Opened the Research Institute of Anti-corrosion / fouling technology	2016	08	Registered to KHNP as certified supplier of Cathodic Protection System
2002	08	EC Attestation of Conformity (CE mark) by TUV in Germany	2017	11	Started Sacrificial Anode production in Noksan premises of Noksan Industrial Complex
2003	11	ISO 9001 : 2000 certified by LRQA	2018	01	ISO 9001 : 2015 re-certified by LRQA
			2019	02	Anode Type Approval certified by DNV-GL

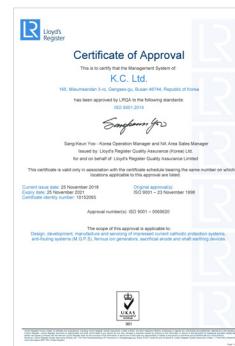
## CERTIFICATION



ALUMINUM ANODE



ZINC ANODE

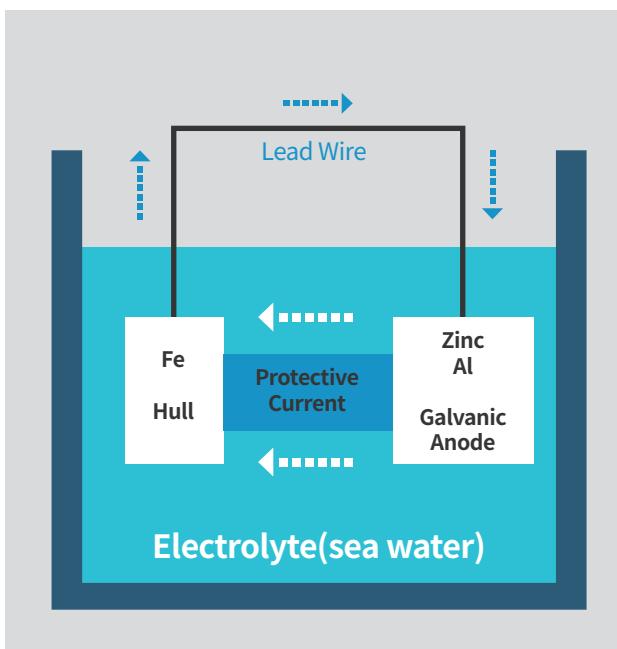


ISO9001 (2015)

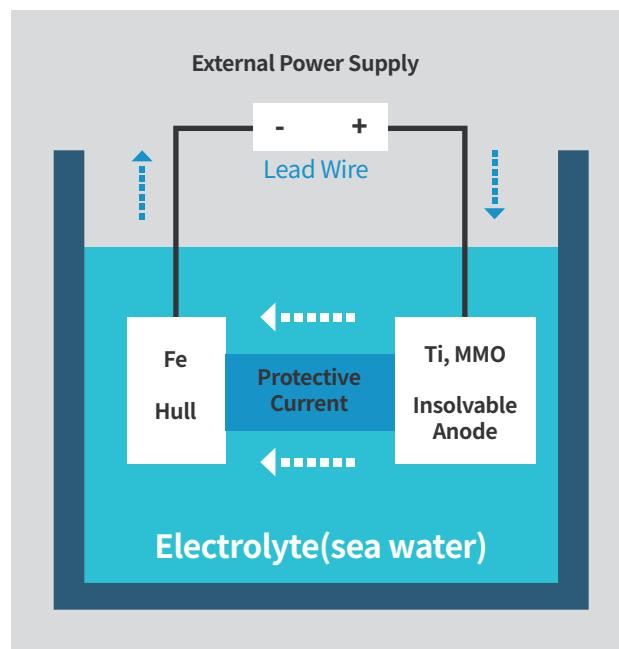


# CATHODIC PROTECTION METHOD

## Sacrificial Anode System



## Impressed Current System



### SACP Advantages

- 1 Simple Installation
- 2 No over protection
- 3 No external power source
- 4 No interference on the near pipe
- 5 Economical in case of small structure
- 6 Less maintenance cost

### ICCP Advantages

- 1 Wide range of protective area
- 2 Less consumption of anode
- 3 Easy to adjust the voltage and current
- 4 Need a small amount of anode
- 5 Economical in case of large structure
- 6 Less restriction of resistivity

### SACP Disadvantages

- 1 Limited protection range
- 2 Difficult to adjust a current
- 3 Need a lot of anodes
- 4 Must be renewed in case anodes consumed up
- 5 Expensive in case of large structure
- 6 Use only for low resistivity

### ICCP Disadvantages

- 1 Need external power source
- 2 Must be careful of over protection through over protection alarm
- 3 Must be careful of interference to near structure in case of manual mode
- 4 Need initial construction cost
- 5 Need maintenance diagnosis over log sheets

## KINDS OF SACRIFICIAL ANODE ALLOY

Metal Property	Al-Alloy Anode	Zn-Alloy Anode	Mg-Alloy Anode	Pure-Iron Anode
<b>Specific Gravity</b>	2.77	7.14	1.82	7.86
<b>Anode Potential [V]</b>	-1.10 ( Ag/Agcl Ref.)	-1.05 ( Ag/Agcl Ref.)	-1.55 ( Ag/Agcl Ref.)	-0.60 ( Ag/Agcl Ref.)
<b>Theoretical Current Capacity [A-h/Kg]</b>	2,880	820	2,200	960
<b>Effective Current Capacity [A-h/Kg]</b>	2,600	780	1,100	860
<b>Current Efficiency [%]</b>	90	95	50	90

## ANODE TEST AND MEASUREMENT



Anode Composition



Anode Performance

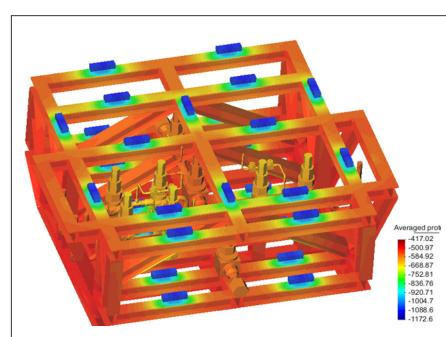


Field Measurement

## CATHODIC PROTECTION EVALUATION / MONITORING

BY BEASY AND ELSYCA SOFTWARE

- Optimization of CP design such as anode number and location, thus reducing cost of design and installation
- Validation of CP designs to determine protection potential, corrosion rate, service life
- Investigations of interference caused by nearby other metallic structures
- Easy Visualization of protection potentials and prediction of current density distribution



CP Simulation

## ALUMINIUM ANODE

The aluminum anode is an alloy anode which is mainly composed of aluminum of high purity. It has a larger current capacity and a smaller specific weight than other anodes and is widely used worldwide. It is an ideal anode for large structures requiring longterm corrosion prevention such as harbors and off-shore structures and ships.

## MERITS OF ALUMINIUM ANODE

- Economical because the current capacity per unit weight is larger than other alloy anode.
- The anode polarization is extremely small and stable current is generated
- There is no over protection due to small potential difference.
- No environmental pollution due to no harmful components
- Due to the small potential difference to iron, hydrogen generation amount is small and there is no damage caused by hydrogen generation
- The consumption of the anode is uniform

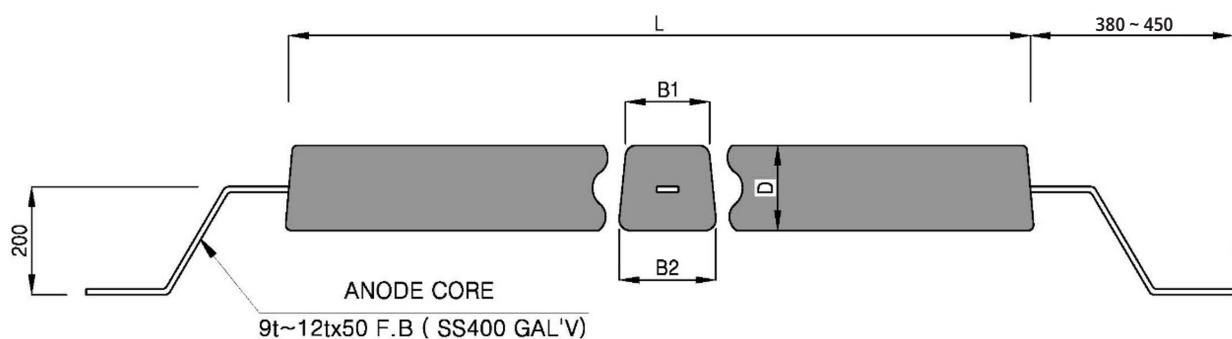
## STANDARD COMPONENTS OF ANODE

Component \ Standard	DNV-GL RP B401	US MIL 24779K	ISO 15589-2	MOFK
Al	Remainder	Remainder	Remainder	Remainder
Zn	2.5 ~ 5.75	4.0 ~ 6.5	2.5 ~ 5.75	3.0 ~ 15.0
In	0.015 ~ 0.04	0.014 ~ 0.02	0.016 ~ 0.04	0.004 ~ 0.02
Cd	Max. 0.002	-	Max. 0.002	-
Si	Max. 0.12	0.08 ~ 0.2	Max. 0.12	-
Fe	Max. 0.09	Max. 0.09	Max. 0.09	-
Cu	Max. 0.003	Max. 0.004	Max. 0.003	-
Sn	-	-	-	0.05 ~ 0.15
Mg	-	-	-	0.5 ~ 5.0
Others	-	Max. 0.1	0.02 (each)	-

MOFK : MINISTRY OF OCEANS AND FISHERIES , SOUTH KOREA

## STANDARD SIZE OF MOFK ANODE

TYPE	Nom.Dimension ( B1 + B2 ) × D × L	Nom. Weight ( Min. Kg )	Output Current ( A , $p = 30 \Omega\text{-cm}$ )	Lifetime ( Years )
MOFK A-1	(150+170)×145×335	23	1	10
MOFK A-2	(135+170)×130×585	34	1.5	10
MOFK A-3	(125+160)×125×875	47	2	10
MOFK A-4	(115+155)×120×1195	58	2.5	10
MOFK A-5	(120+155)×110×1555	71	3	10
MOFK B-1	(200+235)×230×300	45	1	20
MOFK B-2	(190+225)×205×510	63	1.5	20
MOFK B-3	(180+220)×190×765	84	2	20
MOFK B-4	(170+200)×190×1035	105	2.5	20
MOFK B-5	(165+195)×180×1340	125	3	20



MOFK : MINISTRY OF OCEANS AND FISHERIES , SOUTH KOREA

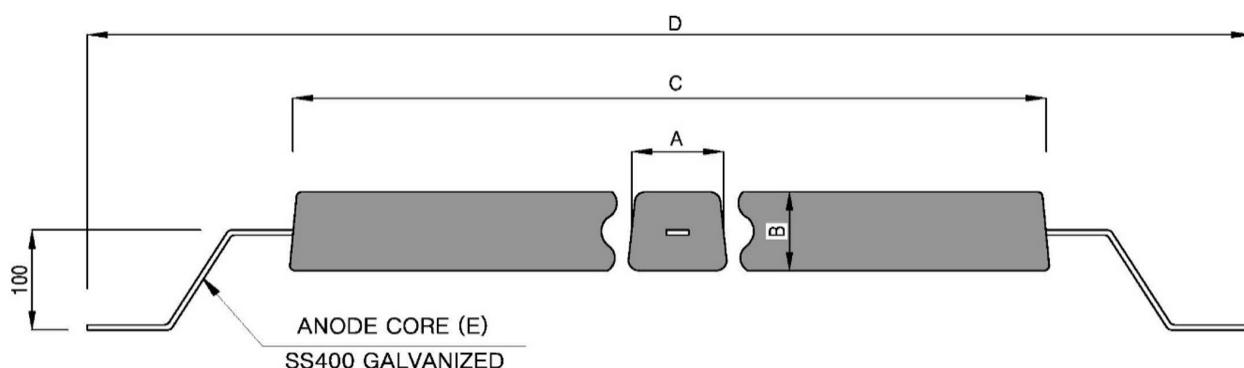




## AL ANODE | STAND OFF TYPE

### WELD TYPE

Item No.	Net Weight (Kg)	Nominal Weight (Kg)	Size (mm)				
			A	B	C	D	E
KAW-M006-048	3.2	4.8	50	50	500	820	9T x 25
KAW-M060-050	3.4	5.0	51	53	500	820	9T x 25
KAW-M061-051	3.5	5.1	50	55	500	820	9T x 25
KAW-M024-062	4.6	6.2	60	60	500	820	9T x 25
KAW-M062-064	4.8	6.4	60	62	500	820	9T x 25
KAW-M058-070	5.6	7.0	65	65	500	820	9T x 25
KAW-M004-078	6.4	7.8	70	70	500	820	9T x 25
KAW-M063-085	6.9	8.5	70	75	500	820	9T x 25
KAW-M064-084	6.8	8.4	72	72	500	820	9T x 25
KAW-M065-087	7.1	8.7	74	74	500	820	9T x 25
KAW-M066-101	8.5	10.1	80	80	500	820	9T x 25
KAW-M067-106	9.0	10.6	80	85	500	820	9T x 25
KAW-M068-118	10.2	11.8	85	90	500	820	9T x 25
KAW-M069-125	10.9	12.5	90	90	500	820	9T x 25
KAW-M005-151	13.5	15.1	100	100	500	820	9T x 25

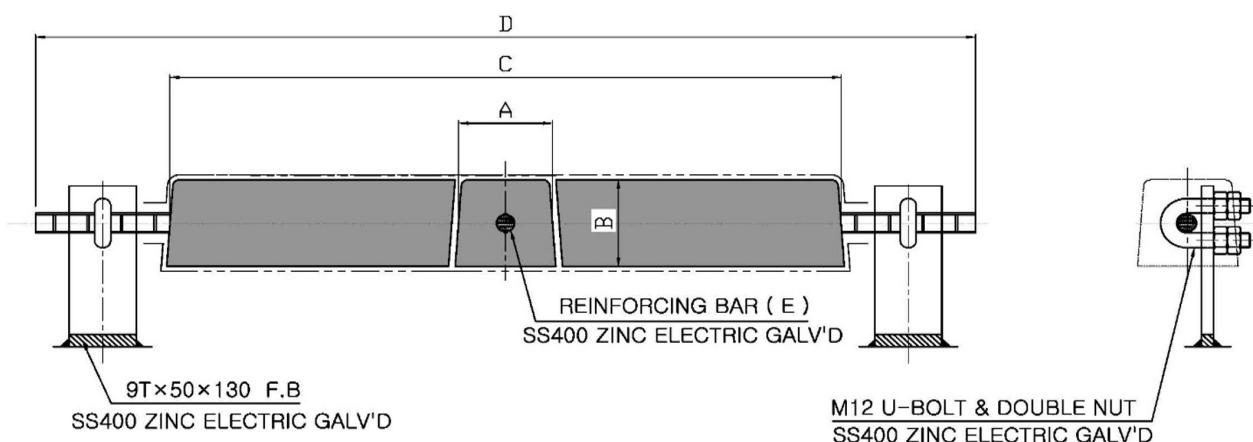


■ Other dimensions are also available on your request

## AL ANODE | STAND OFF TYPE

### BOLT TYPE

Item No.	Net Weight ( Kg )	Nominal Weight ( Kg )	Size ( mm )				
			A	B	C	D	E
KAB-M006-039	3.2	3.9	50	50	500	700	φ13
KAB-M060-042	3.5	4.2	51	53	500	700	φ13
KAB-M061-043	3.6	4.3	50	55	500	700	φ13
KAB-M024-057	4.6	5.7	60	60	500	700	φ16
KAB-M062-059	4.8	5.9	60	62	500	700	φ16
KAB-M058-067	5.6	6.7	65	65	500	700	φ16
KAB-M004-075	6.4	7.5	70	70	500	700	φ16
KAB-M063-080	6.9	8.0	70	75	500	700	φ16
KAB-M064-079	6.8	7.9	72	72	500	700	φ16
KAB-M065-082	7.1	8.2	74	74	500	700	φ16
KAB-M066-096	8.5	9.6	80	80	500	700	φ16
KAB-M067-101	9.0	10.1	80	85	500	700	φ16
KAB-M068-113	10.2	11.3	85	90	500	700	φ16
KAB-M069-120	10.9	12.0	90	90	500	700	φ16
KAB-M005-146	13.5	14.6	100	100	500	700	φ16

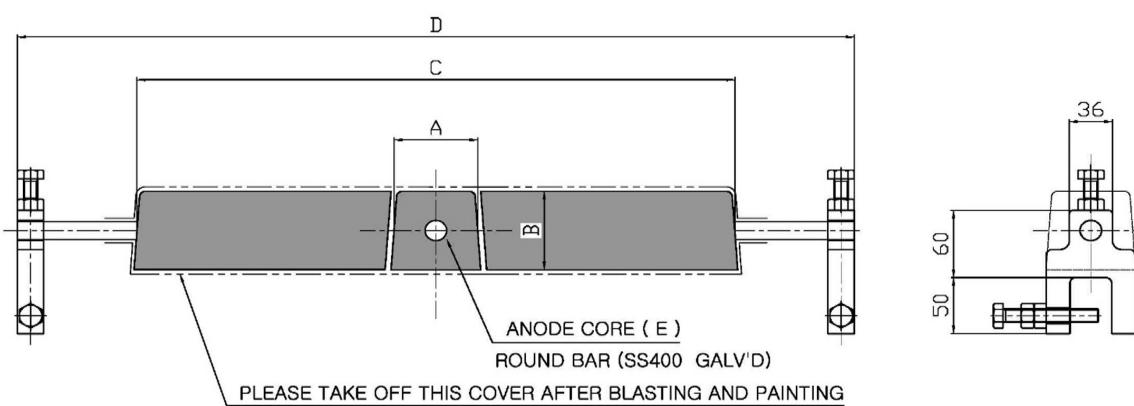


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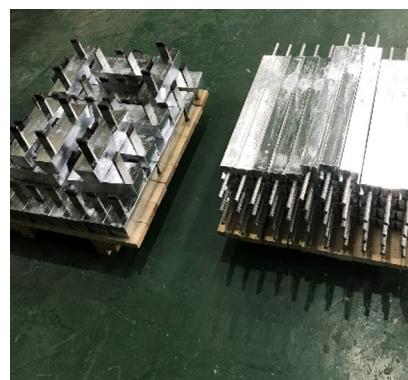
## AL ANODE | STAND OFF TYPE

### CLAMP TYPE

Item No.	Net Weight ( Kg )	Nominal Weight ( Kg )	Size ( mm )				
			A	B	C	D	E
KAC-M006-039	3.2	3.9	50	50	500	700	φ13
KAC-M061-042	3.6	4.2	50	55	500	700	φ13
KAC-M024-057	4.6	5.7	60	60	500	700	φ16
KAC-M058-067	5.6	6.7	65	65	500	700	φ16
KAC-M004-075	6.4	7.5	70	70	500	700	φ16
KAC-M065-082	7.1	8.2	74	74	500	700	φ16
KAC-M066-096	8.5	9.6	80	80	500	700	φ16
KAC-M069-120	10.9	12.0	90	90	500	700	φ16
KAC-M005-146	13.5	14.6	100	100	500	700	φ16



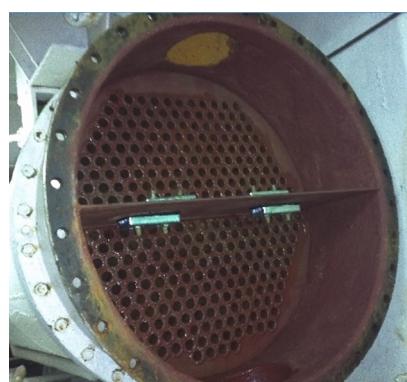
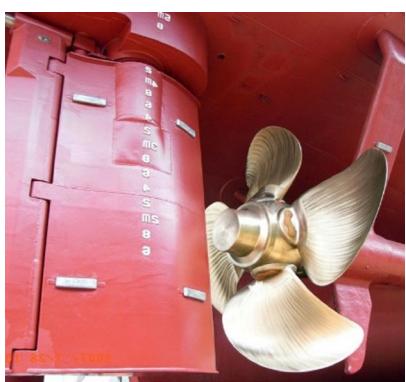
■ Other dimensions are also available on your request



## AL ANODE | FLUSH MOUNT TYPE

Item No.	Nominal Weight (Kg)	Size ( mm )					TYPE
		H	W	L	Hole Distance		
KAB-M070-006	0.6	25	70	150	75	Bolt	
KAB-M071-011	1.1	20	100	200	110	Bolt	
KAB-M016-016	1.6	30	100	200	110	Bolt	
KAB-M072-023	2.3	40	100	200	110	Bolt	
KAB-M008-043	4.3	30	150	300	160	Bolt	
KAB-M022-046	4.6	40	150	300	160	Bolt	
KAB-M026-058	5.8	40	200	300	160	Bolt	
KAB-M019-077	7.7	50	200	300	160	Bolt	
KAB-M027-095	9.5	65	200	300	160	Bolt	
KAB-M017-110	11.0	75	200	300	160	Bolt	
KAB-M050-128	12.8	90	200	300	160	Bolt	
KAB-M013-099	9.9	60	150	400	180	Bolt	
KAB-M018-134	13.4	70	180	400	180	Bolt	
KAB-M059-127	12.7	65	200	460	260	Bolt	
KAB-M028-210	21.0	110	200	460	260	Bolt	
KAB-M002-157	15.7	65	200	540	340	Bolt	
KAW-M073-048	4.8	40	150	300	6t × 32	Weld	
KAW-M074-085	8.5	57	75	800	4.5t × 32	Weld	
KAW-M075-203	20.3	69	200	560	6t × 50	Weld	

■ Other dimensions are also available on your request



## ZINC ANODE

Zinc Alloy Anodes are cast zinc alloy anodes with high purity of 99.995% or more and are widely used in seawater, seabed or similar electrolytes. In addition, since there is no risk of sparking when falling, it is mainly used in the ballast tank of the ship where flammable gas can occur.

## MERITS OF ZINC ANODE

- Since the anode polarization is very small even after a long time, the high anode potential is maintained during the period of the process, so that stable current and high current efficiency can be obtained.
- The zinc alloy anode has self-regulating ability, so that the generated current is also reduced according to the degree to which the zinc alloy anode is used so that there is no unnecessary consumption
- Small potential difference to iron, hydrogen generation amount is small and there is no damage caused by hydrogen generation
- There is no risk of spark when it falls from a high place
- Zinc compounds which are produced during the polarization of the anode is adhered to the surrounding surface and acts as a corrosion inhibitor
- Aluminum or magnesium anodes require cleaning due to many electrolytic products, but zinc anodes do not require cleaning

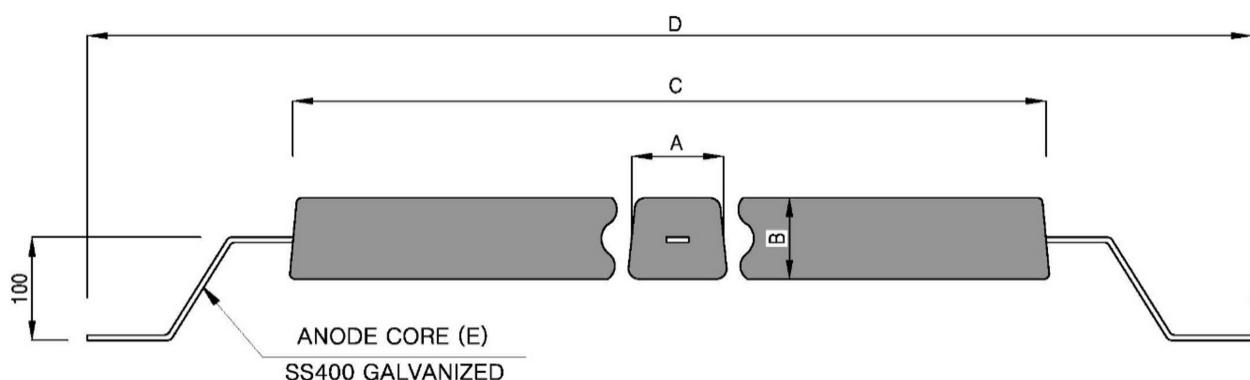
## STANDARD COMPONENTS OF ANODE

Component \ Standard	DNV-GL RP B401	US MIL 18001K	ISO 15589-2	ASTM B418-2
<b>Zn</b>	Remainder	Remainder	Remainder	Remainder
<b>Al</b>	0.1 ~ 0.5	0.1 ~ 0.5	0.1 ~ 0.5	Max. 0.005
<b>Cd</b>	Max. 0.07	0.025 ~ 0.07	0.025 ~ 0.07	Max. 0.003
<b>Fe</b>	Max. 0.005	Max. 0.005	Max. 0.005	Max. 0.0014
<b>Cu</b>	Max. 0.005	Max. 0.005	Max. 0.005	Max. 0.002
<b>Pb</b>	Max. 0.006	Max. 0.006	Max. 0.006	Max. 0.003
<b>Others</b>	-	-	-	-

## ZN ANODE | STAND OFF TYPE

### WELD TYPE

Item No.	Net Weight (Kg)	Nominal Weight (Kg)	Size (mm)				
			A	B	C	D	E
KZW-M006-097	8.1	9.7	50	50	500	820	9T × 25
KZW-M060-104	8.8	10.4	51	53	500	820	9T × 25
KZW-M061-106	9.0	10.6	50	55	500	820	9T × 25
KZW-M024-136	12.0	13.6	60	60	500	820	9T × 25
KZW-M062-141	12.5	14.1	60	62	500	820	9T × 25
KZW-M058-158	14.2	15.8	65	65	500	820	9T × 25
KZW-M004-183	16.7	18.3	70	70	500	820	9T × 25
KZW-M063-195	17.9	19.5	70	75	500	820	9T × 25
KZW-M064-193	17.7	19.3	72	72	500	820	9T × 25
KZW-M065-203	18.7	20.3	74	74	500	820	9T × 25
KZW-M066-236	22.0	23.6	80	80	500	820	9T × 25
KZW-M067-251	23.5	25.1	80	85	500	820	9T × 25
KZW-M068-281	26.5	28.1	85	90	500	820	9T × 25
KZW-M069-305	28.1	30.5	90	90	500	820	9T × 38
KZW-M005-380	34.8	38.0	100	100	500	820	9T × 50

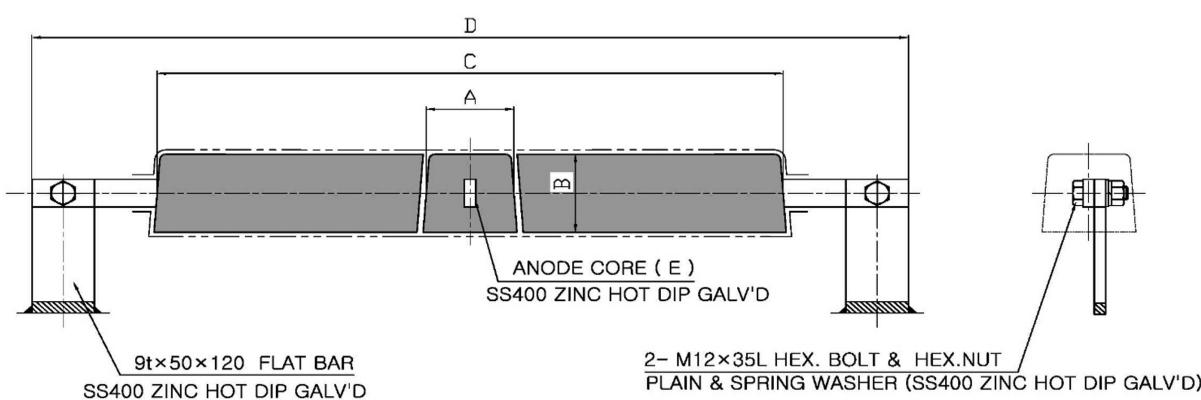


■ Other dimensions are also available on your request

## ZN ANODE | STAND OFF TYPE

### BOLT TYPE

Item No.	Net Weight (Kg)	Nominal Weight (Kg)	Size (mm)				
			A	B	C	D	E
KZB-M006-093	8.1	9.3	50	50	500	700	9T × 25
KZB-M060-100	8.8	10.0	51	53	500	700	9T × 25
KZB-M061-102	9.0	10.2	50	55	500	700	9T × 25
KZB-M024-132	12.0	13.2	60	60	500	700	9T × 25
KZB-M062-137	12.5	13.7	60	62	500	700	9T × 25
KZB-M058-155	14.3	15.5	65	65	500	700	9T × 25
KZB-M004-179	16.7	17.9	70	70	500	700	9T × 25
KZB-M063-191	17.9	19.1	70	75	500	700	9T × 25
KZB-M064-189	17.7	18.9	72	72	500	700	9T × 25
KZB-M065-199	18.7	19.9	74	74	500	700	9T × 25
KZB-M066-232	22.0	23.2	80	80	500	700	9T × 25
KZB-M067-247	23.5	24.7	80	85	500	700	9T × 25
KZB-M068-277	26.5	27.7	85	90	500	700	9T × 25
KZB-M069-293	28.1	29.3	90	90	500	700	9T × 25
KZB-M005-361	34.9	36.1	100	100	500	700	9T × 25

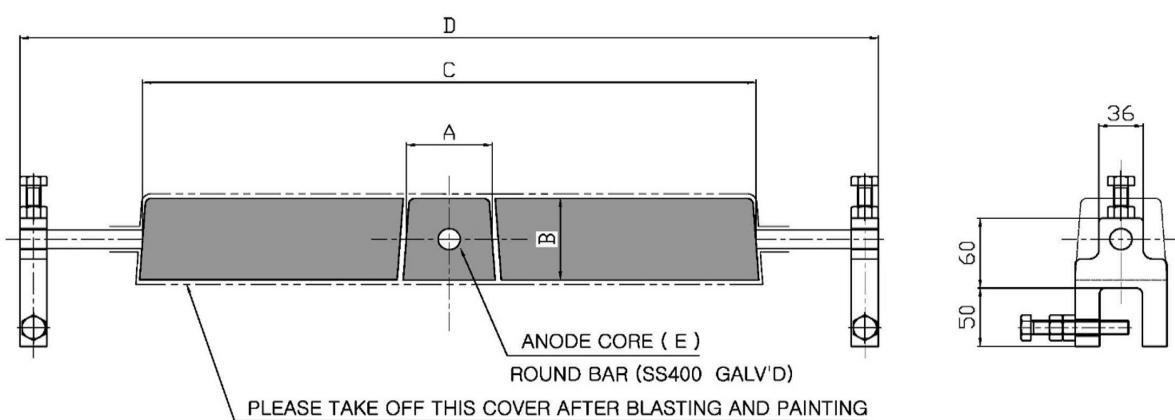


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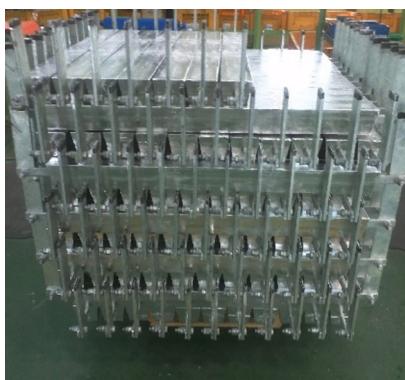
## ZN ANODE | STAND OFF TYPE

### CLAMP TYPE

Item No.	Net Weight ( Kg )	Nominal Weight ( Kg )	Size ( mm )				
			A	B	C	D	E
KZC-M006-091	8.4	9.1	50	50	500	700	φ13
KZC-M061-100	9.3	10.0	50	55	500	700	φ13
KZC-M024-132	12.1	13.2	60	60	500	700	φ16
KZC-M058-154	14.3	15.4	65	65	500	700	φ16
KZC-M004-179	16.8	17.9	70	70	500	700	φ16
KZC-M065-199	18.8	19.9	74	74	500	700	φ16
KZC-M066-232	22.1	23.2	80	80	500	700	φ16
KZC-M069-293	28.2	29.3	90	90	500	700	φ16
KZC-M005-361	35.0	36.1	100	100	500	700	φ16



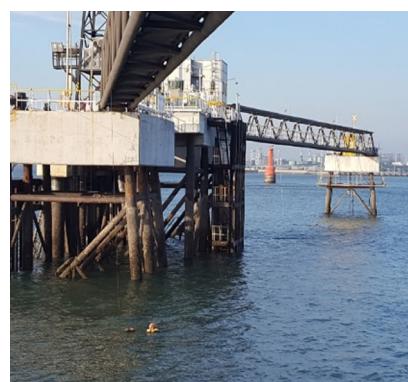
■ Other dimensions are also available on your request



## ZN ANODE | FLUSH MOUNT TYPE

Item No.	Nominal Weight (Kg)	Size ( mm )					TYPE
		H	W	L	Hole Distance		
KZB-M070-015	1.5	25	70	150	75	Bolt	
KZB-M071-024	2.4	20	100	200	110	Bolt	
KZB-M016-036	3.6	30	100	200	110	Bolt	
KZB-M072-048	4.8	40	100	200	110	Bolt	
KZB-M008-083	8.3	30	150	300	160	Bolt	
KZB-M022-112	11.2	40	150	300	160	Bolt	
KZB-M026-151	15.1	40	200	300	160	Bolt	
KZB-M019-192	19.2	50	200	300	160	Bolt	
KZB-M027-250	25.0	65	200	300	160	Bolt	
KZB-M017-298	29.8	75	200	300	160	Bolt	
KZB-M050-325	32.5	90	200	300	160	Bolt	
KZB-M013-235	23.5	60	150	400	180	Bolt	
KZB-M018-340	34.0	70	180	400	180	Bolt	
KZB-M059-324	32.4	65	200	460	260	Bolt	
KZW-M076-042	4.2	30	100	200	3t × 30	Weld	
KZW-M077-065	6.5	20	150	300	3t × 30	Weld	
KZW-M078-095	9.5	30	150	300	4.5t × 32	Weld	
KZW-M073-128	12.8	40	150	300	4.5t × 32	Weld	
KZW-M074-209	20.9	57	75	800	4.5t × 32	Weld	

■ Other dimensions are also available on your request





**FOS INTERNATIONAL INC.**  
**FORCE OF SOLUTION**  
**DEVELOPMENT OF OVERSEAS & LOCAL SALES**  
VIETNAM / MYANMAR / INDONESIA / CHINA

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