

BIBLOGRAPHY

DATE	REV.	DESCRIPTION	CHECK	APP.	APP.	REMARK
2021.06.03	A	Submitted to Buyer for Approval	K.Y.LEE	C.E.CHOI	S.K.LEE	

TOTAL (9) SHEETS WITH COVER

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APPROVED BY	S.K.LEE	DWT 6,800 CLASS	HULL NOS. SB646 / SB647	
APPROVED BY	C.E.CHOI	PRODUCT & CHEMILCAL TANKER	Hull Design Team (Painting Design)	
APPROVED BY			SCALE NONE	OWNER 성호해운
CHECKED BY	K.Y.LEE		DATE 2021.06.03	REV. NO. A
DRAWN BY	JooYoung Oh(오주영) (+82-51-419-5457)		CLASS KR	DWG' NO. 3P104001PB

	PROJECT NAME HULL NO. SB646/7	DWG. NO. 3P104001PB	DESIGNED : J. H. KIM	DATE : MAY 17,2021
			CHECKED : H. Y. JUNG	REV. NO.
			APPROVED : Y. I. SHIN	PAGE 2 OF 8

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HDM	PROJECT NAME HULL NO. SB646/7	DWG. NO. 3P104001PB	DESIGNED : J. H. KIM CHECKED : H. Y. JUNG APPROVED : Y. I. SHIN	DATE : MAY 17,2021 REV. NO. PAGE 3 OF 8
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1. SCOPE

The purpose of this document is to describe the requirements for design, fabrication and installation of sacrificial anodes used for the cathodic protection of sea chests

2. DESIGN BASE

2.1. Assumed electrolyte resistivity of seawater is 25 ohm - cm.

2.2. Anode utilization factor : 0.85 (for Sea Chests Anodes-Flush mounted type)

2.3. Protected potential : - 0.80 Volt or more negative with Ag/AgCl reference electrode.

2.4. Electrochemical characteristics

Alloy	Electrochemical Capacity(Ah/kg)	Closed Circuit Potential
Al-base	2,600	-1.11

2.5. Mean Current density (mA/m²) : 25 mA/m² for External hull

2.6. Design life (years) : 5 (years) for External hull

2.7. Ballast ratio (%) : 100 % for External hull

3. DETAIL OF ANODE

Anode Type	Approx. Dimension(mm)	Net Weight(Kg)	Gross Weight(Kg)
A-135N(Al-Anode) (Flush-mounted type)	90 x 200 x 300	13.2	13.7

4. ANODE OUTPUT CURRENT

The anode current output is calculated from Ohm's law ;

$$I = \frac{\Delta V}{R}$$

where; I = Anode output current(Amp.)

R = Anode resistance(ohm)

ΔV = Driving voltage between protected steel potential and anode closed circuit

$$(Al) = | (-1.11 V) - (-0.80 V) | = 0.31 V$$

4.1 Flush-mounted Type (for Sea Chests. anode : A - 135N)

Anode resistance 'R' is given by following formula;

$$R = \frac{\rho}{2S}, \quad S = \frac{a + b}{2} \quad * \text{A-135N : } 90 \times 200 \times 300 \\ \rho = 25 \text{ ohm-cm}, \quad a = 20 \text{ cm}, \quad b = 30 \text{ cm}$$

where, ρ = Assumed electrolyte resistivity of sea water (ohm-cm)

a = anode width (cm)

b = anode length (cm)

$$R = \frac{25 \text{ ohm-cm}}{2 \times \frac{(20 + 30)}{2} \text{ cm}} \quad \text{Therefore, } I = \frac{0.31 \text{ volts}}{0.5 \text{ ohm}} = \underline{\underline{0.620 A}}$$

$$= 0.5 \text{ ohm}$$

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5. ANODE MASS CALCULATION

$$\textcircled{1} \text{ Required Weight (kg)} = \frac{\text{Lifetime of Anode(Yr)} \times 8760(\text{Hr/Yr}) \times \text{Required Current(A)} \times \text{Ballast Ratio(%)}}{\text{Anode Material Current Capacity (A.Hr/Kg)} \times \text{Utilization Factor}}$$

$$\textcircled{2} \text{ Required Anode Quantity (pcs)} = \frac{\text{Required Weight (Kg)}}{\text{Individual Anode Net Weight (Kg/Pc)}} : \text{based on net weight}$$

$$= \frac{\text{Required Current (A)}}{\text{Individual Anode Output Current (A/Pc)}} : \text{based on output current}$$

* Required Current(A) = Estimated Protective Area(m^2) x Current Density(A/m^2)

* Actual Total Weight (kg) = Individual Anode Net Weight (kg/Pc) x Applied Anode Quantity (pcs)

* Actual Total Current (A) = Individual Anode Output Current (A/pc) x Applied Anode Quantity (cs)

* Quantity Check : Required Weight (kg) \leq Actual Total weight (kg) ---- O.K
 Required Current (A) \leq Actual Total Current (A) ---- O.K

6. ANODE QUANTITY CHECK PROCEDURE

6.1. ANODE TYPE A-135N

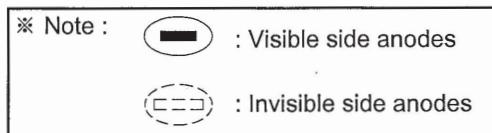
Compartments	Estimated Protective Area (m^2)	Required Weight (Kg)	Actual Total Weight (Kg)	Required Current (A)	Actual Total Current (A)	Applied Anode Q'ty (pcs)
HIGH SEA CHEST(P) (FR.27~FR.29)	17	7.9	13.2	0.4	0.6	1
LOW SEA CHEST(S) (FR.27~FR.29)	13	5.9	13.2	0.3	0.6	1
BALLAST PUMP ROOM SEA CHEST(P)(FR.32~FR.33)	10	5.9	13.2	0.3	0.6	1
Total net weight		39.6 kg	Total gross weight	41.1 kg	Total quantity	3 pcs

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7. ANODE INSTALLATION

The arrangement of the anodes shall be shown on this drawing in details. However, the actual location of the anodes may be adjusted during installation work considering its workability.

The drawings are symmetrical unless otherwise noted. Plan, section and elevation on drawings are expressed as "Looking down", "Looking forward" and "Looking port" respectively



8. ANODE MANUFACTURE

The anodes shall be manufactured in accordance with following chemical composition and manufacturer's standard.

Aluminum alloy anodes

Zn	2.5~5.75
Al	Remainder
In	0.015~0.040
Cd	Max.0.002
Si	Max.0.12
Fe	Max.0.09
Cu	Max.0.003

9. GUARANTEE

HDM will guarantee all defects arising from design and material for a period of one(1) year after ship's delivery to the Owner.

10. ANODES QUANTITY FOR BLOCK

10.1. ANODE TYPE A-135N

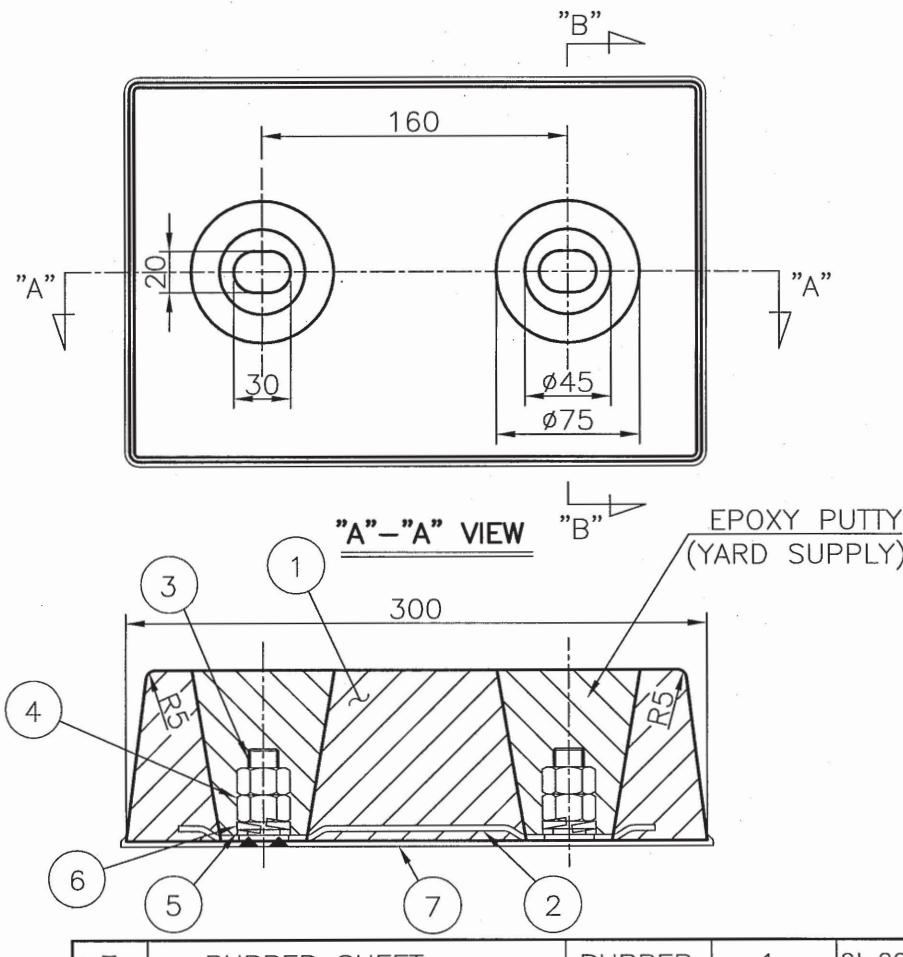
BLOCK NO.	Q'TY(PCS)			PAGE NO.	BLOCK NO.	Q'TY(PCS)			PAGE NO.
	P	C	S			P	C	S	
E11		3		8					
TOTAL Q'TY OF A-135N TYPE : 3 PCS									

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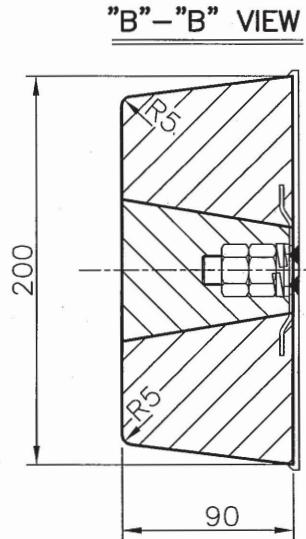
11. CERTIFICATE OF AI-ANODE

- a. Certificate No. : TAS00000AX
 - b. Type Designation : Al-Anode(HDM)
 - c. Manufactured : Haedong Metal Co., Ltd.
 - d. Application : The mean current capacity of the sacrificial anode material after 12 months free running testing is 2661 Ah/kg. The mean closed circuit potential is -1113 mV vs. Ag/AgCl seawater. The approval is given for use in seawater at temperatures below 30°C
 - e. Web Site
 - <https://approvalfinder.dnvgi.com/>
 - > TAS00000AX

12. DETAIL OF Al-ANODE FOR SEA CHESTS & ETC.



7	RUBBER SHEET	RUBBER	1	2tx206x306($\pm 5\%$)
6	SPRING WASHER	SUS304	2	M16
5	PLAIN WASHER	SUS304	2	M16
4	HEX NUT	SUS304	4	M16
3	STUD BOLT	SUS304	2	M16x50L
2	ANODE CORE	SS400	1	3tx160P(GALV'D)
1	Al - ANODE	Al-ALLOY	1	90tx200x300
NO.	DESCRIPTION	MAT'L	Q'TY	REMARK



PHYSICAL REQUIREMENTS	
SACRIFICIAL ANODE	REQUIREMENTS
TOLERANCE OF LENGTH	$\pm 3\%$ OR $\pm 25\text{mm}$, WHICHEVER IS SMALLER
TOLERANCE OF WIDTH	$\pm 5\%$
TOLERANCE OF DEPTH	$\pm 10\%$
TOLERANCE OF WEIGHT	$\pm 3\%$
NET WEIGHT	13.2 Kg(90x200x300)
GROSS WEIGHT	13.7 Kg(INCLUDE RUBBER)

COMPOSITION OF Al-ANODE		
ELEMENT	MINIMUM (Wt %)	MAXIMUM (Wt %)
ZINC	2.5	5.75
ALUMINIUM	REMAINDER	REMAINDER
INDIUM	0.015	0.040
CADMUM		0.002
SILICON		0.12
IRON		0.09
COPPER		0.003

*ANODE MATERIAL CURRENT CAPACITY : Min. 2,600 A.Hr/Kg

TITLE			
A-135N TYPE Al-ANODE(BOLTING TYPE)			
PROJECT NAME	HULL NO. SB646/7	DATE	MAY 17,2021
SCALE	N/S	REV. NO.	△
DESIGNED	J. H. KIM	CHECKED	H.Y. JUNG
APPROVED			Y. I. SHIN

 **HAEDONG METAL CO., LTD.**

※ Please contact us whenever you need an installment of new anodes or a replacement. We will provide you the design, inspection, supply services with the world best quality products.
(Tel. No.82-51-974-1051, Fax. No.82-51-831-3755, E-Mail : hdm@hdanode.com)



ARR'T OF ANODE FOR TYP. SECTION

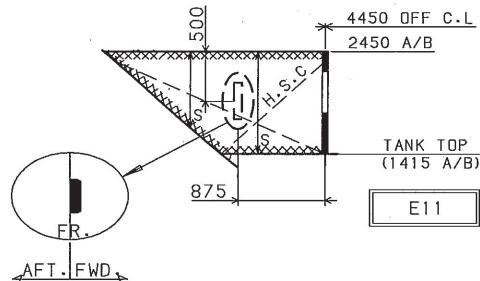
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HIGH SEA CHEST (P) (FR. 27~FR. 29)

TOTAL Q'TY : 1 PC

FR. 27 SEC.

Q'TY : 1 PC

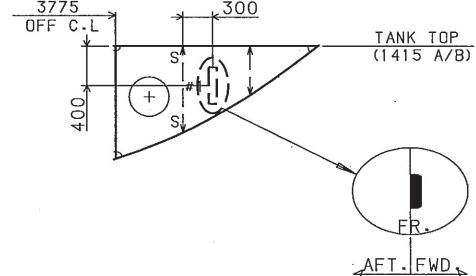


LOW SEA CHEST (S) (FR. 27~FR. 29)

TOTAL Q'TY : 1 PC

FR. 28 SEC.

Q'TY : 1 PC



Ⓐ Ⓛ : A - 135N TYPE AI-ANODES

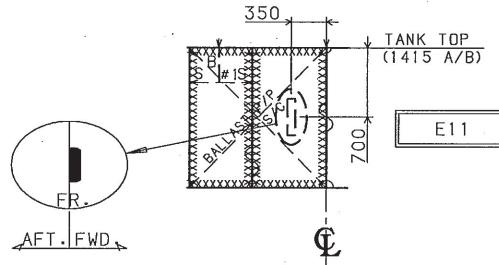
TOTAL Q'TY : 3 PCS

BALLAST SEA CHEST (P) (FR. 32~FR. 33)

TOTAL Q'TY : 1 PC

FR. 32 SEC.

Q'TY : 1 PC



TITLE ARRANGEMENT OF ANODES FOR
SEA CHESTS



HAEDONG METAL CO., LTD.