Klant: **Hakkers B.V.**
Betreft: **Kathodisch bescherming kade FMT, Quarleshaven te Vlissingen**
Chemetall Ref.: **300128868**

Anode berekening (zie ook bijlage anode berekening combiwand – project FMT kade Vlissingen)

Uitgangspunten ontwerp:

- Locatie kade: Vlissingen, Quarleshaven
- Lengte kade 315 m
- Lengte kopschermen +/- 17,5 m per stuk
- Combiwand, buispalen Ø1016 mm, tussenplanken 2 x PU20;
- Inheiniveau 24,0 m - NAP;
- Bovenzijde buispaal 3,9 m + NAP;
- Inheiniveau 19,7 m - NAP;
- Bovenzijde damwand 3,9 m + NAP;
- Levensduur KB: 10 jaar;
- Contractdiepte -14,4 m NAP;
- Constructiediepte -15 m NAP (max. baggerdiepte);
- Geen coating aanwezig;
- Talud achterzijde constructie tot -4 m NAP met hierop 1 m slib;
- Uitgangspunt is kathodische bescherming middels aluminium anodes.

Ontwerp parameters.

Toegepaste norm:	DNV-RP-B401 October 2010
Te beschermen oppervlak waterzijde:	9.192 m2
Te beschermen oppervlak landzijde:	2.790 m2
Oppervlakte conditie:	Blank staal
Ontwerp levensduur anoden:	10 jaar
Water weerstand:	22 ohm.cm
Beschermstroom:	DNV: initial=170 mA/m2, final=110mA/m2, mean= 80 mA/m2
Anode type:	DNV: Long slender met stand-off van 0,15 m.
Anode verbruiksfactor:	DNV: 0.9

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Anode materiaal:

Zn-In activated aluminium alloy

Analyse:

Si	0,10 % max.
Fe	0,10 % max.
Zn	2,00 - 5,0 % alloying element
Ti	0,01 - 0,05% alloying element
In	0,015 - 0,05% alloying element
Cu	0,005 % max.
Mn	0,10 % max.
Ni	0,02 % max.
Pb	0,01 % max.
Sn	0,02 % max.
Bi	0,02 % max.
Mg	0,01 % max.
Others each	0,02 % max.
Al	remainder (99,85% purity)

Performance Data - Seawater:

Capaciteit: 2.500 Ampere Hr/kg.
Potentiaal : - 1050 mV v.s.. Ag/AgCl ref. electrode
Efficiency: 95%.

Gekozen anode type:
Ampak F2-C stand-off 0,15 m. gewicht: 57,0 kg. netto (volgens tekening S10834)

Berekening anode stroom:
Toegepaste formule uit DNV-RP-B401 tabel 10-7 type Long slender stand-off L > 4r.
Anode stroom begin:2,85 Ampere
Anode stroom eind:1,85 Ampere

Berekening totaal benodigde stroom :
Toegepaste tabel 10.0 uit DNV-RP-B401
(final=110mA/m2, mean= 80 mA/m2)
Waterzijde: final=904 Ampere en mean 664 Ampere
Landzijde: final=200 Ampere en mean 152 Ampere

Berekening totaal anode gewicht:
Toegepaste formule uit DNV-RP-B401 volgens 7.7.1

Formule: anode materiaal benodigd: $= \frac{\text{beschermstroom (mean) x levensduur x uren in jaar (8766)}}{\text{aluminium capaciteit x verbruik fact.}}$

Waterzijde: 25.863 kg.
Landzijde: 5.914 kg.

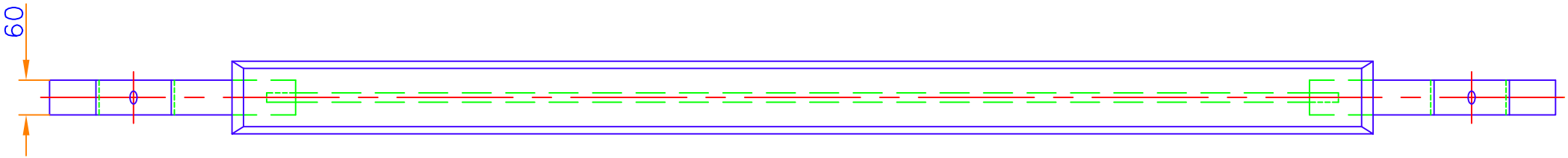
Bepaling aantal anoden:
Waterzijde:
25.863 kg./ 57 kg.= 454 stuks anode
Controle op levering benodigde eindstroom:
Totaal benodigde beschermstroom: 904 Ampere
Totaal beschikbare eindstroom: 454 stuks x 1,85 Amp.= 840 Ampere
Aantal anoden aanpassen naar 490 stuks (490x1,85=910 Ampere)
Totaal 490 stuks anode type Ampak F2-C stand-off 0,15 m.

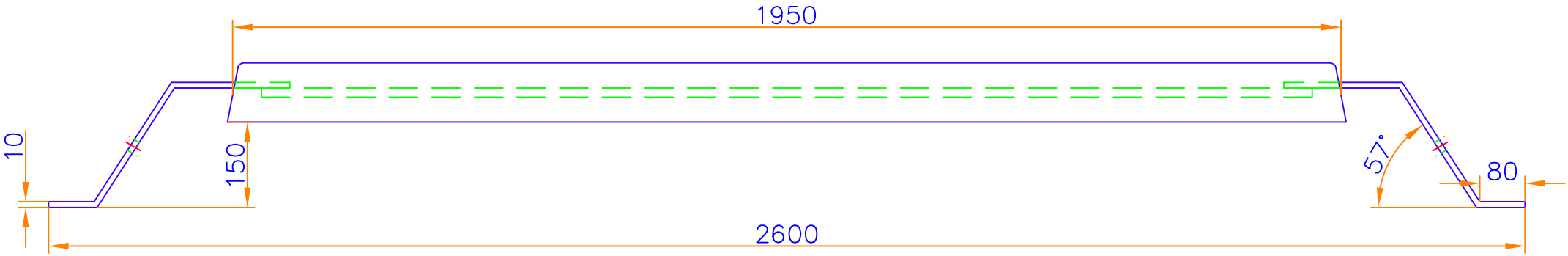
Landzijde:
5.914 kg./ 57 kg.= 104 stuks anode
Controle op levering benodigde eindstroom:
Totaal benodigde beschermstroom: 200 Ampere
Totaal beschikbare eindstroom: 104 stuks x 1,85 Amp.= 192 Ampere
Aantal anoden aanpassen naar 110 stuks (110x1,85=200 Ampere)
Totaal 110 stuks anode type Ampak F2-C stand-off 0,15 m.

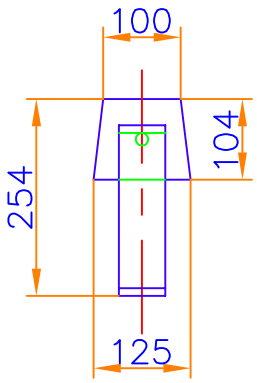
Anode berekeningen combi wand - project FMT kade Vlissingen

Anode characteristics			Project data	FMT Kade		(Waterzijde)			
Anode material	Aluminium		Lifetime	yrs	10				
Anode type	F2-C Stand off		Coating	µmm	>350				
Stated net anode weight	57	kg	Sea depth	m	14				
Capacity	2500	[A/hr]	Sea area						
Shape (1= Cyl. / 2=Non Cyl.)	2								
Anode body length	1,950	[m]	Coating type		geen				
Anode average width (or diameter)	0,108	[m]	Coating factor initial	%	100,0%				
Anode height	0,100	[m]	Coating factor yrly breakdown	%	0,0%				
Insert diameter	0,016	[m]	Coating factor calculated			100,0%	100%	100%	
					Mud	Initial	Mean	Final	
			Current densities	mA	20	170	80	110	
			Current calculation		**m²**	**A**	**A**	**A**	
			Area in mud	m²	1.192	24	24	24	
			Area scalding	m²	0	0	0	0	
			Area in water uncoated	m²	8.000	1.360	640	880	
			Area in water coated	m²	0	0	0	0	
When used in this project			Area splash zone uncoated	m²	0	0	0	0	
Utilisation	0,9		Area splash zone coated	m²	0	0	0	0	
Seawater resistance rho	22	Ohm.cm	Total area	m²	9.192				
Anode distance to object	0,15	[m]							
Driving voltage	0,250	[V]	Total required current	A		1.384	664	904	
Anode shape	long slender with stand off								
Correction factor distance	1,3								
Correction factor length (max)	90%								
			Required anode weight	kg			25.863		
			Required anode quantity	pcs			454		
			Anode check						
			Quantity anodes installed	pcs	490	108%	installed		
			Weight installed	kg	27.930	installed	7%	rest weight	
			Anode current initial	A		1.392			OK
Anode current at start	2,842	[A]	Anode current mean	A			1.392		OK
Anode current at end of life	1,753	[A]	Anode current final	A				910	OK
Anode current at end of design life	1,856	[A]							

Anode characteristics			Project data	FMT Kade		(Landzijde)			
Anode material	Aluminium		Lifetime	yrs	10				
Anode type	F2-C Stand off		Coating	µmm	>350				
Stated net anode weight	57	kg	Sea depth	m	3				
Capacity	2500	[A/hr]	Sea area						
Shape (1= Cyl. / 2=Non Cyl.)	2								
Anode body length	1,950	[m]	Coating type		geen				
Anode average width (or diameter)	0,108	[m]	Coating factor initial	%	100,0%				
Anode height	0,100	[m]	Coating factor yrly breakdown	%	0,0%				
Insert diameter	0,016	[m]	Coating factor calculated			100,0%	100%	100%	
					Mud	Initial	Mean	Final	
			Current densities	mA	20	170	80	110	
			Current calculation		**m²**	**A**	**A**	**A**	
			Area in mud	m²	1.190	24	24	24	
			Area scalding	m²	0	0	0	0	
			Area in water uncoated	m²	1.600	272	128	176	
			Area in water coated	m²	0	0	0	0	
When used in this project			Area splash zone uncoated	m²	0	0	0	0	
Utilisation	0,9		Area splash zone coated	m²	0	0	0	0	
Seawater resistance rho	22	Ohm.cm	Total area	m²	2.790				
Anode distance to object	0,15	[m]							
Driving voltage	0,250	[V]	Total required current	A		296	152	200	
Anode shape	long slender with stand off								
Correction factor distance	1,3								
Correction factor length (max)	90%								
			Required anode weight	kg			5.914		
			Required anode quantity	pcs			104		
			Anode check						
			Quantity anodes installed	pcs	110	106%	installed		
			Weight installed	kg	6.270	installed	6%	rest weight	
			Anode current initial	A		313			OK
Anode current at start	2,842	[A]	Anode current mean	A			313		OK
Anode current at end of life	1,753	[A]	Anode current final	A				200	OK
Anode current at end of design life	1,819	[A]							







ALUMINIUM ANODE:
Nett weight: 57,0 Kg
Gross weight: 65,2 Kg

Chemetall

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AMPAK
cathodic protection

scale: n.t.s.	Art.:
drawn: Ted Goossens	Dwg.: S 10834
date: 01-10-2014	Dim.: A-4

Anode type F2-C SO 150mm.