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Attn: Knut Høiland, VP

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Date:	Our reference:	Your reference:
2016-05-23	DNVGL Doc. No: LOC-PP158214-1111LMIZ-5	Project No. 39450-007-001-13-05

Letter of Compliance for the GMC Maritime ARCTIC SOLUTIONS AED4CG Cast-in-Place Anti-icing System with anti-icing performance requirements of DNVGL-OS-A201

Dear Mr. Høiland:

DNV GL accepts the GMC Maritime ARCTIC SOLUTIONS AED4CG Cast-in-Place Anti-icing System as compliant with relevant anti-icing performance requirements contained in DNVGL-OS-A201 for the winterization of offshore units as follows:

- DNV GL Offshore Class Notation **Winterized**
- Winterization qualifiers **Basic, Cold, and Polar**
- Winterization temperature (t_w) **$t_w \geq -25^\circ\text{C}$**
- Requirement references: DNVGL-OS-A201 *Winterization for Cold Climate Operations* (July 2015), §2.1.4 and §2.5.1

This approval is based on the test conducted at GMC Maritime AS on 2016-05-11 under witness by DNV GL (test report enclosed). The following parameters were used as the basis for the test procedure:

- Test air temperature: -25°C
- Test wind speed (laminar wind flow across the test object): none

Based on the satisfactory test results, DNV GL may also consider accepting the GMC Maritime ARCTIC SOLUTIONS AED4CG on a case-by-case basis for offshore winterization applications where the winterization temperature (t_w) is colder than -25°C .

This Letter of Compliance is valid only for the GMC Maritime ARCTIC SOLUTIONS AED4CG Cast-in-Place Anti-icing System for the winterization of offshore units to the requirements contained in DNVGL-OS-A201. It is not valid for the winterization of ships to the requirements contained in DNV GL Rules for Classification of Ships (DNVGL-RU-SHIP Part 6, Chapter 6, Section 3).

Sincerely
for DNV GL AS



Espen Wetterhus
Head of Section




Hoshyar Kasiri
Principal Surveyor

Encl: GMC Maritime AS, Test report GMC Arctic Solutions AED4CG Offshore, Doc no. 39450-007-001-13-05-RA-002, dated 2016-05-11

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Main body of the document containing several paragraphs of text. The text is extremely faint and largely illegible. It appears to be a formal report or document with multiple sections.



01	11.05.2016	Tested with DNV witnessing	ØAa			
Proj. rev.	Issue date	Reason for Issue	Made by	Chk'd by	Appr. by	
Purchase Order Number: NA		Equipment / Package Title: GMC Arctic Solutions AED4CG				
Tag No.(s):						
Client Logo:			For client use only: Status Code			
			1	2	3	4
			Date / Sign.			
Package Number: NA		Supplier Document Number: 39450-007-001-13-05-RA-002		Supplier rev.: 01		
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Contract Number: NA			SDDR or Doc Type Code:			
Document Title: Test report GMC Arctic Solutions AED4CG Offshore						
Client Document Number:				Page 1 of 6		



1 INFORMATION REGARDING THIS DOCUMENT

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3 INTRODUCTION

This test is performed to confirm that the tested equipment meets the requirements in **DNVGL-OS-A201 with design temperature (Tw) -25°C and 0ms wind.**

4 EQUIPMENT

Equipment used during the test

- Climate laboratory 0-50°C
- FLIR A315 thermo camera
- Squirrel SQ 2020 data logger
- 1pcs GMC Arctic Solutions AED4CG cast-in-place test plate

Details of the AED4CG test-object (Details presents the actual details for the AED4CG model)

- 1,1m x 1,1m heated surface
- 13,5m heating cable Bartec PSB33/m² = 16,3m heating cable for the test object
- C/C Distance: 74mm
- GH Gulv/Hesselberg Barrikade De-Ice epoxy compound

5 TEST DESCRIPTION

5.1 Preparation

The equipment is installed inside the test container and connected to the data logger.
The room is set to test temperature (with near the test object) and the equipment to be tested is given time to stabilize both power consumption and thermal distribution.

Actual test object as installed in the climate laboratory:



The inner square is the measuring area of 0,7m x 0,7m.
The center square is heated area of 1,1m x 1,1m
The tape used to mark up the squares is also used to set up the thermal camera.

To verify the ambient temperature near the test object, there is installed an ambient temp sensor:



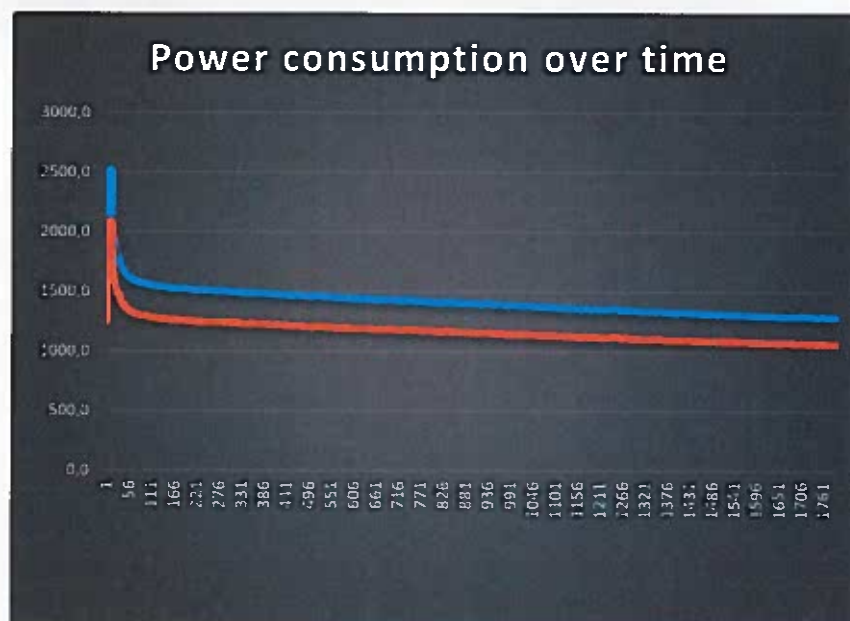


5.2 Test

- 1) The climate laboratory and the AED4CG floor is cooled down to -25°C to find the emissivity of the surface. The camera is adjusted to the correct settings for the test.
- 2) The power for the AED4CG is switched on, and the equipment is given approx.. 1 hour to reach a steady working temperature and power consumption. The surface temperature is measured with the FLIR A315 thermal camera.

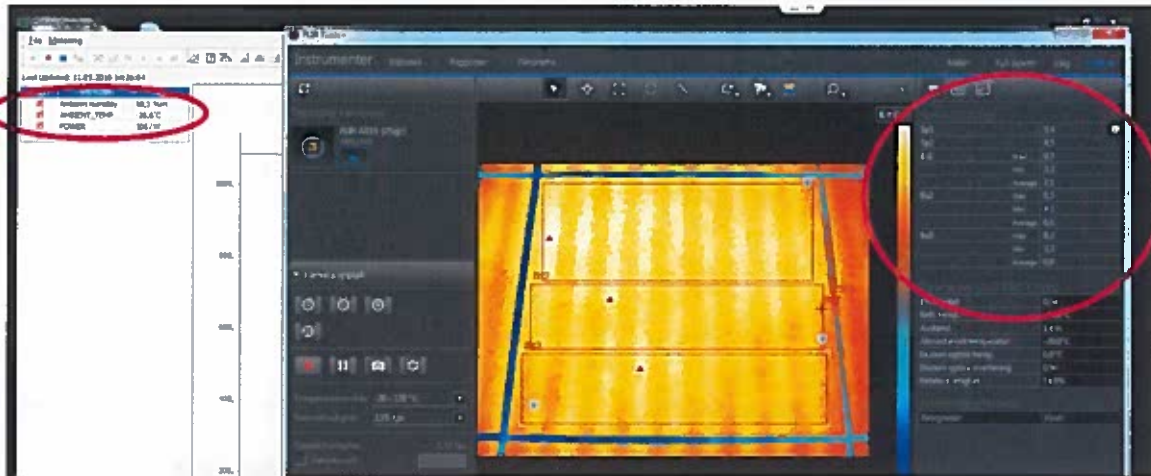
5.3 Recorded data

The data recorded during the test is listed below



The blue line is the actual measurement, and the orange line is scaled down to represent actual power consumption for 1M^2 .

The power consumption stabilizes at approx. 1000W for $1,1 \times 1,1 \text{ m}$ which gives approx.. 820W for 1M^2 at -26°C



Ambient temp = Temperature near the test object (see picture in chapter 5.1)
Bx1 = Measuring area
Bx2 = Measuring area
Bx3 = Measuring area
SPx = Calibration points – not relevant for test result

6 WITNESSING

The test is witnessed by:

DNVGL	Steven Sawhill
DNVGL	Hoshyar Kasiri
GMC Maritime AS	Øystein Aasheim

7 CONCLUSION

The AED4CG tested maintained an average and minimum temperature above 3°C when the ambient temperature was -26,6°C, where the lowest measured temperature was 3,3°C and the highest was 9,7°C.

The test confirmed that the GMC AED4CG met the DNVGL-OS-A201 requirement for a tw of -25°C or warmer.

Barrikade De Ice Flexible epoxy coating system

Product Description

Barrikade De Ice is a pigmented, seamless flooring system based on a solvent-free flexible elastomeric epoxy resin compound.

Barrikade De Ice has been designed to incorporate a heating system within the deck coating to keep areas free of ice. The screed underlayer encapsulates steel profiles and heating cables.

This flexible system offers many advantages over traditional rigid binders and coatings:

- improved impact resistance and protection
- crack bridging properties
- the ability to absorb stress within the surface layer preventing premature failure at the interface
- can be build up in considerable thickness to spread loads or absorb unevenness in the substrate.
- it may be applied to surfaces with movements such as sell and asphalt
- have good noise reduction factors

Areas of use

Barrikade De Ice has is suitable for escape ways and other areas that should be kept free of ice.

Properties

Chemical: Barrikade De Ice provides seamless and water tight finish with good chemical resistance to most chemicals such as alkalis, oils, fats, salt, but limited resistance to acid in high concentrations.

Mechanical: Barrikade De Ice has very good mechanical properties and is hard wearing. The system can be supplied with different grades of filler.

Thermal: Barrikade De Ice has very good resistance to thermal chock.

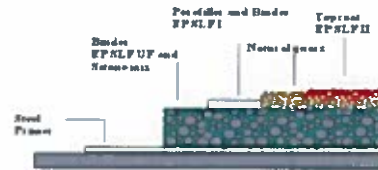
Surface treatment

Shot blasting

System build up

- 1 layer of Barrikade steel primer
- 30 mm screed with 1:5 mixture of Barrikade EP SLF UF and a special blend of quarz sand

- Porefilling with Barrikade EP SLF I approx. 1,6 kg/m²
- 1 layer of Barrikade EP-SLF I 1,8 kg/m² and graded quarts
- 1 layer of Barrikade EP-SLF II 1,3 kg/m² blended with aluminium oxide for anti skid



Technical data

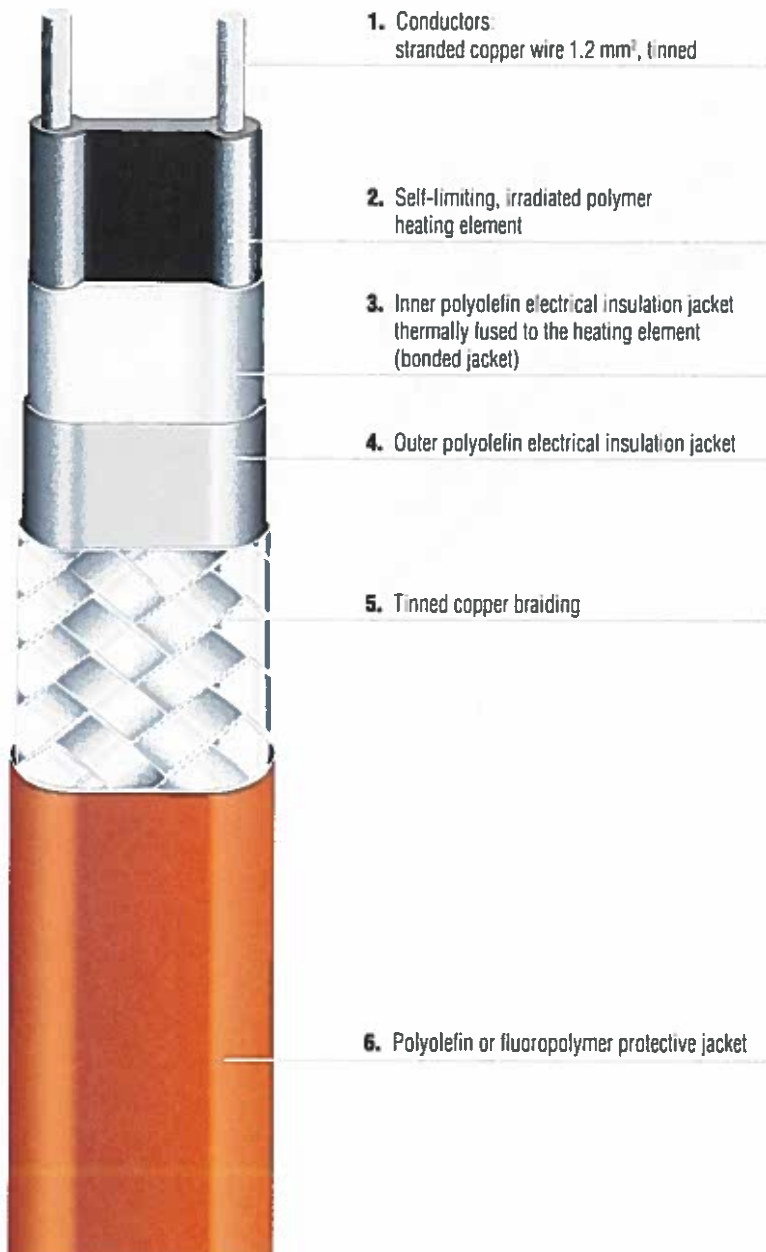
System weight	72.5 kg/m ²
Abrasion resistance, BS 8204:	0.31 class AR3
Impact resistance, ISO 6272:	Approved
Skid resistance, BS 8204-2:	72
For approved wet > 40 is required	
Adhesion, CEN TC 125/N 85:	
- concrete	100% concrete failure
- fully cured epoxy:	100 % concrete failure
- steel:	2,80 N/mm ²
Elongation:	SLF I, 50% SLF II, 26%
Maximum mechanical and chemical properties	After 7 days



Self-limiting parallel heating tape PSB

Features

- Self-limiting
- Can be used in explosive atmospheres without temperature limiter
- Can be cut at random length thanks to its parallel current supply
- Corrosion-proof and resistant to effects of chemicals thanks to its outer sheath
- Electrically and mechanically protected by a tinned copper braiding
- Simple installation thanks to its high flexibility and favourable dimensions



Description

A temperature-dependant resistive element between two parallel copper conductors regulates and limits the heat output of the heating tape according to the ambient temperature. If the ambient temperature rises, the power output of the heating tape is reduced. This self-limiting property prevents overheating even when the tapes are crossed. A temperature limiter is not necessary (also not in hazardous areas).

Thanks to the parallel design the heating tape can be cut and installed to any required length. The self-limiting heating tape is available with different power outputs and protective jackets. The protective outer jacket of either fluoropolymer or polyolefin protects the copper braiding from corrosion and chemical impact.

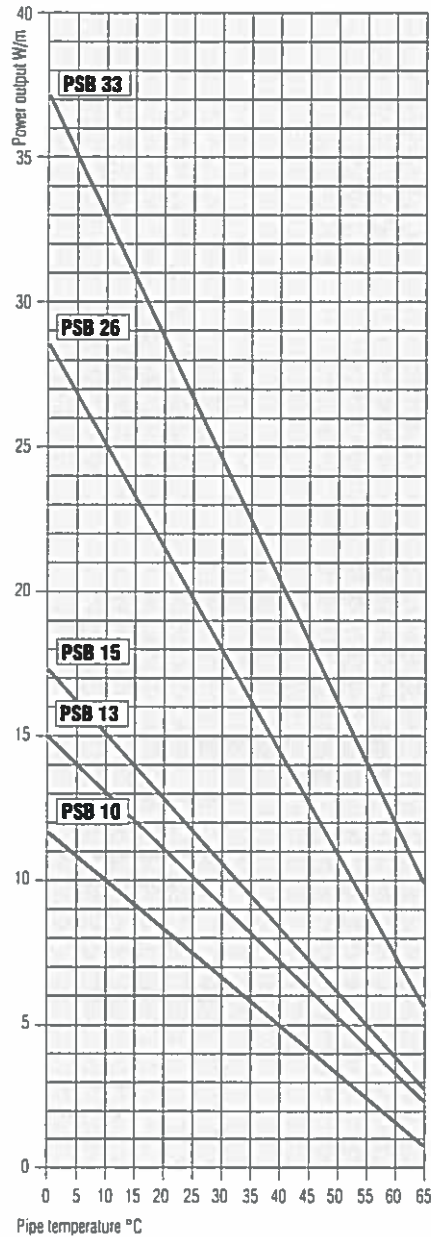
Two jackets under the protective braiding provide electrical insulation. The inner one of the two jackets is thermally fused to the heating element (bonded jacket).

The heating system must be designed to ensure that the maximum operating temperature of 65 °C will not be exceeded when it is energized.

When it is switched off, the heating tape can be exposed to a temperature of 85 °C, not more than 1,000 hours cumulated.



PSB characteristics



Power output on insulated steel pipes at 230 V under nominal conditions.

Areas of application

The PSB heating tape is suitable for electric trace heating for frost protection of pipelines and vessels.

While the polyolefin protective jacket is used where there are aqueous, inorganic chemicals, the fluoropolymer outer jacket is suitable for organic chemicals.

For questions regarding the chemical resistance please contact your BARTEC sales representative.

Explosion protection

Ex protection type

- ⊕ II 2G Ex e IIC T5, T6 Gb
- ⊕ II 2D Ex tb IIC T95 °C, T 80 °C Db

Certification

System

- KEMA 08 ATEX 0111 X
- IECEx KEM 09.0084X
- TC RU C-DE.ГБ06.В.00230
- CSA 1862457

Heating tape

- KEMA 02 ATEX 2326 U
- IECEx KEM 07.0047 U



Technical data

Nominal voltage AC 208 V to 254 V, AC 110 V to 120 V

Power setting at +10 °C					
Power output	PSB 10	PSB 13	PSB 15	PSB 26	PSB 33
at AC 230 V	10 W/m	13 W/m	15 W/m	25 W/m	33 W/m
at AC 120 V	10.6 W/m	13.7 W/m	15.8 W/m	25.8 W/m	33.6 W/m

Max. exposure temperature
 switched on +65 °C
 switched off +85 °C

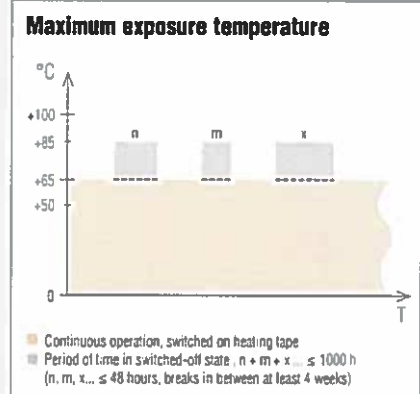
Min. installation temperature -55 °C

Min. start-up temperature -40 °C

Max. braid resistance < 18.2 Ohm/km

Dimensions
 with braiding and Fluoropolymer jacket 11.6 x 5.6 mm
 with braiding and Polyolefin jacket 11.8 x 5.8 mm

Min. bending radius 25 mm



Max. length of heating circuit at 254 V (for automatic circuit-breakers with C characteristic)					
Circuit breaker size	PSB 10	PSB 13	PSB 15	PSB 26	PSB 33
16 A, start-up temperature +10 °C	205 m	169 m	145 m	88 m	70 m
16 A, start-up temperature -15 °C	139 m	111 m	93 m	58 m	49 m
16 A, start-up temperature -30 °C	120 m	94 m	77 m	45 m	43 m
20 A, start-up temperature +10 °C	205 m	179 m	162 m	117 m	90 m
20 A, start-up temperature -15 °C	186 m	149 m	125 m	75 m	64 m
20 A, start-up temperature -30 °C	150 m	124 m	106 m	64 m	52 m
25 A, start-up temperature +10 °C	205 m	179 m	162 m	120 m	98 m
25 A, start-up temperature -15 °C	190 m	160 m	142 m	95 m	80 m
25 A, start-up temperature -30 °C	170 m	150 m	135 m	82 m	65 m
32 A, start-up temperature +10 °C	205 m	179 m	162 m	126 m	108 m
32 A, start-up temperature -15 °C	195 m	174 m	160 m	117 m	95 m
32 A, start-up temperature -30 °C	195 m	174 m	160 m	100 m	82 m

Max. length of heating circuit at 120 V (for automatic circuit-breakers with C characteristic)					
Circuit breaker size	PSB 10	PSB 13	PSB 15	PSB 26	PSB 33
16 A, start-up temperature +10 °C	95 m	78 m	67 m	43 m	33 m
16 A, start-up temperature -15 °C	69 m	55 m	45 m	30 m	25 m
16 A, start-up temperature -30 °C	58 m	47 m	39 m	26 m	21 m
20 A, start-up temperature +10 °C	95 m	86 m	80 m	58 m	45 m
20 A, start-up temperature -15 °C	90 m	72 m	60 m	38 m	32 m
20 A, start-up temperature -30 °C	75 m	59 m	49 m	31 m	26 m
25 A, start-up temperature +10 °C	95 m	86 m	80 m	60 m	50 m
25 A, start-up temperature -15 °C	92 m	80 m	70 m	45 m	38 m
25 A, start-up temperature -30 °C	85 m	72 m	65 m	42 m	34 m
32 A, start-up temperature +10 °C	95 m	86 m	80 m	63 m	54 m
32 A, start-up temperature -15 °C	95 m	86 m	80 m	55 m	45 m
32 A, start-up temperature -30 °C	95 m	86 m	80 m	53 m	43 m



Selection chart PSB			
Description	Protective jacket	Type	➔ Order no.
PSB parallel heating tape AC 254 V - self-limiting - explosion protected - media protected	Fluoropolymer	PSB 10	07-5801-2105
		PSB 13	07-5801-2135
		PSB 15	07-5801-2155
		PSB 26	07-5801-2265
		PSB 33	07-5801-2335
	Polyolefin	PSB 10	07-5801-2106
		PSB 13	07-5801-2136
		PSB 15	07-5801-2156
		PSB 26	07-5801-2266
		PSB 33	07-5801-2336
PSB parallel heating tape AC 120 V - self-limiting - explosion protected - media protected	Fluoropolymer	PSB 10	07-5801-1105
		PSB 13	07-5801-1135
		PSB 15	07-5801-1155
		PSB 26	07-5801-1265
		PSB 33	07-5801-1335
	Polyolefin	PSB 10	07-5801-1106
		PSB 13	07-5801-1136
		PSB 15	07-5801-1156
		PSB 26	07-5801-1266
		PSB 33	07-5801-1336

Technical data subject to change without notice.