WE ARE SERVING THE INDUSTRY WITH

ALUShip Connect

PROBABLY THE LIGHTEST SHIPBOARD POWER CABLE SYSTEM IN THE WORLD

amokabel
CABLE FOR LIFE

mecatraction
mecatraction.com

TYPE APPROVED PRODUCT
DNV·GL
MARITIME

WE ARE A WORLD LEADING

MANUFACTURER

OF ENGINEERED WIRE AND CABLES

Amokabel is a Swedish cable manufacturer with a proud history in producing custom designed electrical cables with high quality, for demanding applications. We are a leading company in our industry when it comes to short lead-times, high service level and flexibility to meet our customer needs.
Focusing on environmentally friendly production to maintain a sustainable development, we are today self-sufficient on energy produced from 100 percent renewable sources.

We have been manufacturing cable in Alstermo since 1996. Since then, the plant has been expanded several times in order to meet the increased demand for our products. The factory area is today 32 000m².

HISTORY AND BACKGROUND

Traditionally, power cables for marine use have been made with copper, but **Amokabel** started a project in 2012 with the main purpose to replace copper with flexible aluminium. The reason behind it was that **Amokabel** saw number of benefits for the customers operational cost, to replace copper with flexible aluminium.

Installation: The reduced weight on ALUShip Connect reduces the installation time for the ship builders.
HSE: This light weight ALUShip Connect reduces the weight and handling for the workers. This helps to avoid accidents and injuries.
Operational cost: The benefits of implementing the ALUShip Connect are reduced fuel consumption, quicker installations and better price stability of aluminium compared with copper.
Environmental: Installing ALUShip Connect reduces fuel consumption and contributes to less CO_2 emissions.

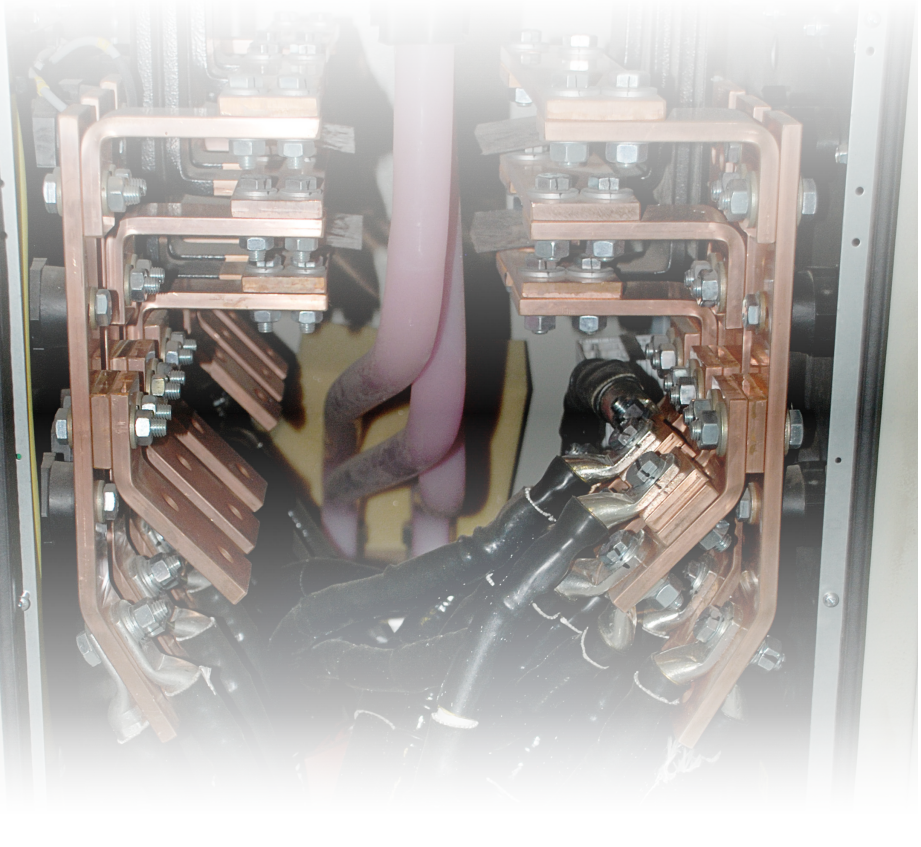
Summary:
All above gives substantially savings, both on our environment as well as our human resources, and at the same time give large-scale operational cost saving for the ship owner over the vessels life time.

TESTING AND EVALUATION

- In cooperation with our customer and DNV/GL it was decided to do a trial installation in a newly built vessel. The installation took place in March 2015.
- The cable we used was 3x150mm^2 1,8/3kV VFD class 5 aluminium.
- The survey confirmed perfect connection after more than 11 000 operating hours at sea.
- In March 2018 we inspected the ship outside Aberdeen after another 1000 operating hours. We performed a full effect test on a retractable azimut thruster, 880kW 690 Volt.
- During the full effect tests we performed thermographic monitoring in order to see any hotspots. After 3 years and 12 000 hours there was no change in temperature or behaviour in the system.

APPROVED CABLE RANGE

ALUShip Connect TEXILine Power ALUFLEX	connection system for flexible aluminum cable 0,6/1kV unscreened aluminum cable for marine and offshore applications			
Number of cores X conductor cross-section	Nominal outer diameter [mm]	Total weight [kg/km]	Conductor resistance [Ω/km]	Current rating of cables with aluminum conductors and temperature class 90°C at ambient 45°C [A]
1X95	19,1	430	0,320	223
1X120	21,7	550	0,253	258
1X150	24,0	670	0,206	296
3X95	39,8	1370	0,320	156
3X120	45,4	1750	0,253	180
3X150	51,3	2250	0,206	207
ALUShip Connect TEXILine Power EMC ALUFLEX	connection system for flexible aluminum cable 0,6/1kV EMC screened aluminum cable for marine and offshore applications			
Number of cores X conductor cross-section	Nominal outer diameter [mm]	Total weight [kg/km]	Conductor resistance [Ω/km]	Current rating of cables with aluminum conductors and temperature class 90°C at ambient 45°C [A]
1X95	20,3	500	0,320	223
1X120	22,9	640	0,253	258
1X150	25,4	790	0,206	296
3X95	41,6	1760	0,320	156
3X120	47,2	2360	0,253	180
3X150	52,9	3080	0,206	207

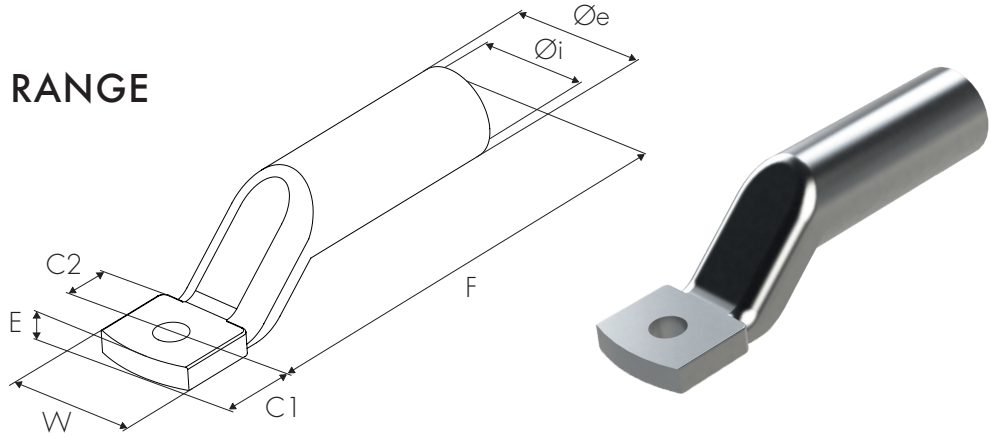


CRIMPING TECHNOLOGY

ALUShip Connect is developed to establish a reliable interface between the lugs and the flexible aluminium cable. This press technique has been used in the aviation industry for many years and the Al-cable has become a standard for transfering energy.

To obtain the best possible solution, we are using a Double B shape deep indent (DBI) compression die. We are using a copper lug, conductive grease and a mesh to avoid any type of oxidation. This build up ensures an optimal electrical connection between the lug and the Al-conductor as well as perfect water tightness.

TERMINAL RANGE



mm²	Part no.	ø mm	E	W	Øi	Øe	C1	C2	F
95	7340060532954	8	4,3	24,5	15,9	20,8	13,0	18,0	84,0
	7340060532961	10	4,3	24,5	15,9	20,8	13,0	18,0	84,0
	7340060532978	12	4,3	24,5	15,9	20,8	13,0	18,0	84,0
120	7340060532985	8	5,2	24,5	17,6	22,8	13,0	18,0	86,0
	7340060534170	10	5,2	24,5	17,6	22,8	13,0	18,0	86,0
	7340060534187	12	5,2	24,5	17,6	22,8	13,0	18,0	86,0
150	7340060534194	8	5,8	29,0	21,3	27,2	13,0	18,0	102,0
	7340060534200	10	5,8	29,0	21,3	27,2	13,0	18,0	102,0
	7340060534217	12	5,8	29,0	21,3	27,2	13,0	18,0	102,0
	7340060534224	14	5,8	29,0	21,3	27,2	15,5	20,5	104,5
	7340060534231	16	5,8	v 29,0	21,3	27,2	15,5	20,5	104,5

A PATENTED SOLUTION

The DBI crimping technique is a patented solution that combines a copper cable lug, an interface grid, conductive grease and with a specific crimping die. This combines a deep indent with two B crimp on each side.

This combination creates an optimum electrical contact between the DBI lug and the ALUFlex cable. The DBI crimping technique creates a perfect water tightness.

CONVENTIONAL CRIMPING PROCESS

1

Stripping of insulation.

2

Crimping the DBI lug.

3

Applying heat shrink tube.

CRIMPING DIES SET

Compatible with ASCH450 hydralic compression head.

TERMINAL TYPE	DIE SET
	Part No.
DBI 95	7340060532800
DBI 120	7340060532817
DBI 150	7340060532824

CRIMPING TOOLING

Hydralic compression head ASCH 450

Single action:

- Output force: 540kN under 850 bar
- Size: h260 x 135 x 115 mm
- Weight: 9,8 kg

Part No.
7340060532886

METALLIC CARRY CASE

For 1 crimping head and up to 4 diesets

Part No.
7340060532893

ASCH 450 Hydralic compression head kit

Kit composition:

- Hydralic compression head — PN: 7340060532886
- Metallic carry case — PN: 7340060532893

Part No.
7340060532909

Electro-hydralic pump ASHP 850

Single action. Wire remote control.
Operating energy: Li-ion battery or
110-230 VAC adapter EU plug (included).

- Nominal output pressure: 850 bar
- Flow rate:0,7-1 L/minute
- Oil tank: 0,65 L
- Size: h285 x 255 x 185 mm
- Weight: 6,5 kg

Part No.
7340060532916

Hydralic hose with push-pull couplers CEJN115

Part No.
7340060532947

METALLIC CARRY CASE

Part No.
7340060532923

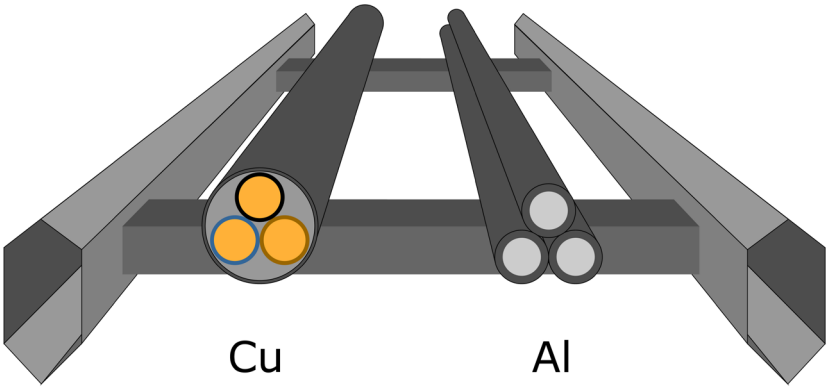
ASHP 850 Portable and compact electro-hydraulic pump kit

Kit composition:

- Electro-hydralic pump PN: 7340060532916
- Metallic carry case PN: 7340060532923
- Hydralic hose PN: 7340060532947

Part No.
7340060532930

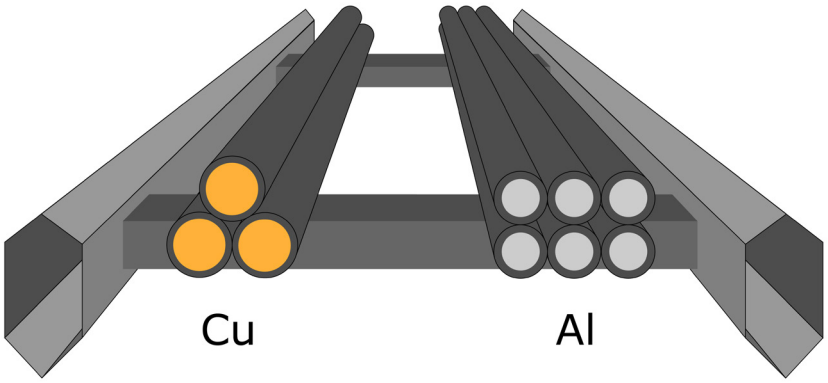
Comparison example for physical dimension and installation



Cable size	3x150mm² Cu
Installed width	48mm
Current carrying capacity	272A
Cable weight	5,4Kg/m

Cable size	3x1x150mm² AL
Installed width trefoil formation	48mm
Current carrying capacity	296A
Cable weight	2,0Kg/m

Cable size	3x1x120mm² AL
Installed width trefoil formation	43mm
Current carrying capacity	258A
Cable weight	1,65Kg/m



Cable size	3x185mm² Cu
Installed width	51mm
Current carrying capacity	444A
Cable weight	5,5Kg/m

Cable size	6x1x95mm² AL
Installed width flat formation	57mm
Current carrying capacity	446A
Cable weight	2,6Kg/m

Current carrying capacities per DNVGL-RU-SHIP Pt.4 Ch.8 10.7 Rating of cables

AluShip Connect	connection system for flexible aluminum cable 0,6/1kV
TEXILine Power ALUFLEX	unscreened aluminum cable for marine and offshore applications

Application:

TEXILine Power ALUFLEX, is a flexible aluminum DNV-approved cable for the marine market. TEXILine Power ALUFLEX has flexible aluminum conductors (class 5) which reduces the total weight of the cable to make the installation easier. TEXILine Power ALUFLEX is halogen free and flame retardant. With the low weight flexible conductor, it's suitable for use in narrow spaces and under the most challenging conditions in marine and offshore environments. The cable must be installed together with a special cable lug and crimping system to ensure a proper connection (TAE00002GJ). Lighter cables result in easier installation for the ship builder and lower material transport costs. A vessel with aluminum vs. copper cables, is lighter and more fuel efficient – resulting in lower operational costs.

Properties:

Max Conductor temperature	+90°C
Temperature range	-30 to +90°C
Voltage Rating Uo/U	0,6/1kV

Standards:

Conductor: ISO / IEC	6722-2 / 60228-2
Construction	IEC 60092-350
Flame retardant	IEC 60332-1-2
Flame retardant	IEC 60332-3-22
Halogen free	IEC 60754-1, -2
Smoke denisty	IEC 61034-1, -2
Test voltage	3,5kV
RoHS directive	Yes
Approval DNV	TAE00002V2

Construction	
Conductor	Flexible aluminum conductor, class 5
Insulation	XLPE
Single core identification	White
Multi core identification	Brown, Black, Grey
Filler (if three core)	Lapping helical tape (extruded inner covering on request)
Outer sheath	Halogen free, flame retardant SHF1 compound
Outer sheath color	Black (or customers choice)
Marking	AMOKABEL TEXILine Power ALUFLEX - size xxx mm2 - 0,6/1kV - IEC 60092-353 - IEC 60332-3-22 - DNV GL certificates TAE00002V2/TAE00002GJ
Bending radius, fixed installation / flexible	6 x Outer diameter / 8 x Outer diameter

Number of cores X conductor cross-section	Nominal outer diameter [mm]	Total weight [kg/km]	Current rating of cables with aluminum conductors and temperature class 90°C [A]	Conductor resistance [Ω/km]	Reactance in trefoil @ 60Hz [Ω/km]
1X50*	14,6	250	149	0,613	0,100**
1X70*	17,5	345	184	0,432	0,097**
1X95	19,1	430	223	0,320	0,096**
1X120	21,7	550	258	0,253	0,094**
1X150	24,0	670	296	0,206	0,093**
1X185*	26,0	815	337	0,164	0,093**
3X50*	30,4	804	104	0,613	0,085
3X70*	31,6	1115	128	0,432	0,084
3X95	39,8	1370	156	0,320	0,083
3X120	45,4	1750	180	0,253	0,082
3X150	51,3	2250	207	0,206	0,082
3X185*	55,4	2680	236	0,164	0,082

Values according to table 6 in DNVGL-RU-SHIP Pt.4 Ch.8 Edition July 2022

* = DNV-GL certificate pending
** = Three single core cables in trefoil

TYPE APPROVED PRODUCT DNV·GL MARITIME

AluShip Connect	connection system for flexible aluminum cable 0,6/1kV
TEXILine Power EMC ALUFLEX	EMC screened aluminum cable for marine and offshore applications

Application:

TEXILine Power EMC ALUFLEX, is a flexible aluminum DNV-approved cable for the marine market. TEXILine EMC ALUFLEX has a braided EMC screen with copper foil, flexible aluminum conductors (class 5) , which reduces the total weight of the cable. TEXILine Power EMC ALUFLEX is halogen free and flame retardant. With the low weight flexible conductor, it's suitable for use in narrow spaces and under the most challenging conditions in marine and offshore environments. The cable must be installed together with a special cable lug and crimping system to ensure a proper connection (TAE00002GJ). Lighter cables result in easier installation for the ship builder and lower material transport costs. A vessel with aluminum vs. copper cables, is lighter and more fuel efficient – resulting in lower operational costs.

Properties:

Max Conductor temperature	+90°C
Temperature range	-30 to +90°C
Voltage Rating Uo/U	0,6/1kV

Standards:

Conductor: ISO / IEC	6722-2 / 60228-2
Construction	IEC 60092-350
Flame retardant	IEC 60332-1-2
Flame retardant	IEC 60332-3-22
Halogen free	IEC 60754-1, -2
Smoke denisty	IEC 61034-1, -2
Test voltage	3,5kV
RoHS directive	Yes
Approval DNV	TAE00002GK

Construction	
Conductor	Flexible aluminum conductor, class 5
Insulation	XLPE
Single core identification	White
Multi core identification	Brown, Black, Grey
Filler (if three core)	Lapping helical tape (extruded inner covering on request)
EMC Screening	Bare copper wire with copper foil, 100% covering
Outer sheath	Halogen free, flame retardant SHF1 compound
Outer sheath color	Black (or customers choice)
Marking	AMOKABEL TEXILine Power EMC ALUFLEX - size xxx mm2 - 0,6/1kV - IEC 60092-353 - IEC 60332-3-22 - DNV GL certificates TAE00002GK/TAE00002GJ
Bending radius, fixed installation / flexible	6 x Outer diameter / 8 x Outer diameter

Number of cores X conductor cross-section	Nominal outer diameter [mm]	Total weight [kg/km]	Current rating of cables with aluminum conductors and temperature class 90°C [A]	Conductor resistance [Ω/km]	Reactance in trefoil @ 60Hz [Ω/km]
1X50	15,8	300	149	0,613	0,106**
1X70	18,9	417	184	0,432	0,103**
1X95	20,3	500	223	0,320	0,100**
1X120	22,9	640	258	0,253	0,098**
1X150	25,4	790	296	0,206	0,098**
1X185*	27,8	954	337	0,164	0,098**
3X50	31,6	975	104	0,613	0,085
3X70	38,4	1425	128	0,432	0,084
3X95	41,6	1760	156	0,320	0,083
3X120	47,2	2360	180	0,253	0,082
3X150	52,9	3080	207	0,206	0,082
3X185*	57,2	3759	236	0,164	0,082

Values according to table 6 in DNVGL-RU-SHIP Pt.4 Ch.8 Edition July 2022

* = DNV-GL certificate pending
** = Three single core cables in trefoil

AluShip Connect	connection system for flexible aluminum cable 1,8/3kV
TEXILine Power VFD EMC ALUFLEX	EMC screened aluminum cable 1,8/3kV for VFD marine and offshore applications

Application:

TEXILine Power VFD EMC ALUFLEX, is a flexible aluminum DNV-approved cable for the marine market. TEXILine VFD EMC ALUFLEX has a braided EMC screen with copper foil, thicker insulation for VFD applications and flexible aluminum conductors (class 5), which reduces the total weight of the cable. TEXILine Power VFD EMC ALUFLEX is halogen free and flame retardant. With the low weight flexible conductor, it's suitable for use in narrow spaces and under the most challenging conditions in marine and offshore environments. The cable must be installed together with a special cable lug and crimping system to ensure a proper connection (TAE00002GJ). Lighter cables result in easier installation for the ship builder and lower material transport costs. A vessel with aluminum vs. copper cables, is lighter and more fuel efficient – resulting in lower operational costs.

Properties:

Max Conductor temperature	+90°C
Temperature range	-30 to +90°C
Voltage Rating Uo/U	1,8/3kV

Standards:

Conductor: ISO / IEC	6722-2 / 60228-2
Construction	IEC 60092-350
Flame retardant	IEC 60332-1-2
Flame retardant	IEC 60332-3-22
Halogen free	IEC 60754-1, -2
Smoke denisty	IEC 61034-1, -2
Test voltage	6,5kV
RoHS directive	Yes
Approval DNV	TAE00002GK

Construction	
Conductor	Flexible aluminum conductor, class 5
Insulation	XLPE
Single core identification	White
Multi core identification	Brown, Black, Grey
Filler (if three core)	Lapping helical tape (extruded inner covering on request)
EMC Screening	Bare copper wire with copper foil, 100% covering
Outer sheath	Halogen free, flame retardant SHF1 compound
Outer sheath color	Black (or customers choice)
Marking	AMOKABEL TEXILine Power VFD EMC ALUFLEX - size xxx mm2 - 1,8/3kV - IEC 60092-353 - IEC 60332-3-22 - DNV GL certificates TAE00002GK/TAE00002GJ
Bending radius, fixed installation / flexible	6 x Outer diameter / 8 x Outer diameter

Number of cores X conductor cross-section	Nominal outer diameter [mm]	Total weight [kg/km]	Current rating of cables with aluminum conductors and temperature class 90°C [A]	Conductor resistance [Ω/km]	Reactance in trefoil @ 60Hz [Ω/km]
3X95	45,8	2030	156	0,320	0,091
3X120	50,9	2630	180	0,253	0,088
3X150	55,7	3370	207	0,206	0,087

Values according to table 6 in DNVGL-RU-SHIP Pt.4 Ch.8 Edition July 2022

COMPARISON TABLE WEIGHT AND CURRENT RATING

AluShip Connect connection system for flexible aluminum cable 0,6/1kV

TEXILine Power ALUFLEX Current rating comparacy table - DNV GL-RU-SHIP Pt.4 Ch.8 Edition July 2022

Number of cores X conductor cross-section	Nominal outer diameter [mm]	Copper weight [kg/m]	Aluminum weight [kg/m]	Current rating of cables with aluminum conductors and temperature class 90°C [A]	Current rating of cables with copper conductors and temperature class 90°C [A]	Conductor resistance aluminium [Ω/km]
1X50	14,6	0,42	0,13	149	196	0,613
1X70	17,5	0,61	0,18	184	242	0,432
1X95	19,1	0,83	0,24	223	293	0,320
1X120	21,7	1,00	0,32	258	339	0,253
1X150	24,0	1,28	0,41	296	389	0,206
1X185*	26,0	1,50	0,50	337	444	0,164
3X50	30,4	1,26	0,39	104	137	0,613
3X70	31,6	1,83	0,54	128	169	0,432
3X95	39,8	2,49	0,72	156	205	0,320
3X120	45,4	3,00	0,96	180	237	0,253
3X150	51,3	3,84	1,23	207	272	0,206
3X185*	55,4	4,50	1,50	236	311	0,164

TESTS ACCORDING TO STANDARD			
	RELEASE	GENERAL DESCRIPTION	LIMITATION
DNVGL-CP-0399	2016-03	Class Programme Electric cables	Same requirements as copper cables except for aluminium conductor
DNVGL-CP-0409	2018-01	Class Programme for terminal lugs for LV power cables with aluminium conductors	
IEC 60092-350	2014-08	General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications	Exception for aluminium conductor
IEC 60092-360	2014-04	Electrical installations in ships - Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables	
IEC 60092-353	2016-09	Electrical installations in ships - Part 353: Power cables for rated voltages 1 kV and 3 kV	
IEC 60228	2004-11	Conductors of insulated cables	For reference only
ISO 6722-2	2013-12	Road vehicles - 60V and 600V single core cables Part 2: Dimensions, test methods and requirements for aluminium conductor cables	(IEC 60228 does not define class 5 aluminium conductors)
IEC 60332-1-2	2015-07	Tests on electric cables under fire conditions. Tests for vertical flame propagation for a single insulated wire or cable.	
IEC 60332-3-22	2009-02	Tests on electric and optical fibre cables under fire conditions - Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A	Bunch test Category A
IEC 60754-1	2011-11	Tests on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid and gas content.	Low Halogen: <0,5% Halogen
IEC 60754-2	2011-11	Tests on gases evolved during combustion of materials from cables - Part 2: Determination of tacidity (by pH measurement) and conductivity.	Halogen free: pH > 4,3 Conductivity < 10µS/mm
IEC 61034-1/2	2013-07 2013-09	Measurement of smoke density of cables burning under defined conditions - Test apparatus, procedure and requirements.	Low smoke Light transmittance ≥ 60%
Internal test	2018	Flexibility test, Amo specification (general description)	
A60	2018	Fire test A60 Cable Sealing (general description)	

ALUShip Connect

TYPE APPROVAL CERTIFICATE

DNV·GL

Certificate No: TAE00002GK
Revision No: 1

This is to certify:
That the Electric Power Cable
with type designation(s)
Texiline Power EMC ALUFLEX 0,6/1 kV,
Texiline Power EMC VFD ALUFLEX 1,8/3 kV
Issued to
amo specialkabel AB
ALSTERMO, Sweden
is found to comply with
DNV GL rules for classification – Ships, offshore units, and high speed and light craft

Application :
Power cables with aluminum conductor.
Products approved by this certificate are accepted for installation on all vessels classed by DNV GL.

Type	Rated voltage (kV)	Temp. class (°C)
Texiline Power EMC ALUFLEX 0,6/1 kV	0,6/1	90
Texiline Power EMC VFD ALUFLEX 1,8/3 kV	1,8/3	90

Issued at Høvik on 2018-05-30
This Certificate is valid until 2023-05-29.
DNV GL local station: Malmö
Approval Engineer: Ivar Bull

for DNV GL
Andreas Kristoffersen
Head of Section

TYPE APPROVAL CERTIFICATE

DNV·GL

Certificate No: TAE00002GJ
Revision No: 1

for DNV GL
Andreas Kristoffersen
Head of Section

TYPE APPROVAL CERTIFICATE

DNV·GL

Certificate No: TAE00002GJ
Revision No: 1

for DNV GL
Andreas Kristoffersen
Head of Section

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