



Certificate No:
TAE00004RA

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Li-Ion Battery System

with type designation(s)
Volvo/Akasol 9 AKM 144 CYC

Issued to
ZEM AS
Høvik, Norway

is found to comply with
DNV rules for classification – Ships, offshore units, and high speed and light craft

Application :

Product approved by this certificate is accepted for installation on all vessels classed by DNV.

Issued at **Høvik** on **2023-06-15**

[Redacted]
[Redacted]
[Redacted]

for **DNV**

[Redacted]
[Redacted]

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.



Name and place of manufacture

ZEM AS (Battery pack drainage modification)	Høvik, Norway
BorgWarner Akasol AG (Battery Pack)	Langen, Germany

Product description

The Volvo/Akasol 9 AKM 144 CYC is a liquid-cooled, high-energy, lithium-ion battery solution for safe and reliable use in battery powered vessels and hybrid solutions. 600 cells (20S30P) are mounted in one module with a monitoring unit (CSC). Nine of these modules are combined to one battery pack (battery system) with included Battery Management Unit (BMU) and a removable contactor box.

The Battery pack is drained in case of internal leakage of coolant. Controlling of the drainage system is performed by an external system.

Pack

Type: Volvo/Akasol 9 AKM 144 CYC
 Chemistry: Lithium ion NCA
 Number of cells per module: 600
 Number of modules per pack: 9
 Cell configuration: 9S 1P 20S30P
 Max Voltage: 756 V
 Min Voltage: 560 V
 Energy: 90 kWh
 IP degree 47*
 Cooling: Liquid cooled (Volvo coolant VCS 85108900, mixed with 50 % clean water)
 Max No. of packs in parallel: 12
 Max Energy in parallel configuration: 1080 kWh

Identification AKASYSTEM_9AKM 144 CYC +ZEM01
 BMU SW Version: PN3-RCBv4.1-SWP2.8.3

Application/Limitation

- When installed on a DNV classed ship or offshore unit, the DNV class rules for battery installation must be followed (DNV Pt.6 Ch.2 Sec.1)
- The Type Approval covers hardware and software listed under Product description
- The battery pack must be installed with a dedicated drainage system, ref ZEM document "9 AKM 144 CYC Supplement" rev 2.0.
- The battery pack shall only be connected to power network providing overvoltage II environment, ref ZEM document "9 AKM 144 CYC Supplement" rev 2.0
- The main power contactor inside the battery pack is only able to interrupt current above 50% of nominal current 5 times.

Product certification:

A DNV product certificate according to DNV Pt.6 Ch.2 Sec.1 is required for each delivery.

The following documents shall be submitted for approval:

- Reference to this type approval certificate
- Copy of the approved Safety description and Safety description supplement
- (E120) Technical specification of the battery system that is subject for product certification
- (I030) Project-specific Battery System Block Diagram
- (S010) Piping diagram of the drainage system
- (I020) Project-specific functional description
- Information on software versions applicable for the particular delivery
- (Z252) Test procedure at manufacturer

Location classes (DNV-CG-0339)

- Temperature Class B
- Humidity Class B
- Vibration Class A
- EMC Class A
- Enclosure IP47*

*Ingress protection is tested for IP 47 on a battery pack without the drainage hole.

Software update notification

When the type approved software is revised (affecting all future deliveries) DNV is to be informed by

forwarding updated software version documentation. If the changes are judged to affect functionality for which rule requirements apply a new functional type test may be required and the certificate may have to be renewed to identify the new software version

Type Approval documentation

Tests carried out

Tests according to DNV-CP-0418, DNV-CG-0339 and FAT Procedures.

Marking of product

The products to be marked with:
P112040200015

Periodical assessment

The scope of the periodical assessment is to verify that the conditions stipulated for the Type approval are complied with and that no alterations are made to the product design or choice of materials.

The main elements of the assessment are:

- Inspection on factory samples, selected at random from the production line (where practicable)
- Results from Routine Tests (RT) checked (if not available tests according to RT to be carried out)
- Review of type approval documentation
- Review of possible change in design, materials and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate

Periodical assessment is to be performed after 2 years and after 3.5 years. A renewal assessment will be performed at renewal of the certificate.

END OF CERTIFICATE