



PANELES SOLARES Q- CELL 360 Wp

CONTENIDO

- Certificado de distribuidor por parte del fabricante.
- Carta de garantía del fabricante.
- Términos de garantía.
- Certificado IEC 61215 e IEC 61730



Bogotá, 08 de abril de 2019

A QUIEN LE INTERESE

Referencia: Certificación de cliente

Estimados Señores:

Hanwha Q CELLS GmbH, fabricante TIER 1 de paneles solares líder del mercado, certifica por medio de la presente la colaboración con la empresa **COLENERGY SAS**, identificado con NIT N° **900.535.180-9**, ubicada en la dirección Carrera 28b No. 78-77, en la ciudad de Bogotá.

Llevamos relaciones comerciales activas con **COLENERGY** como cliente en Colombia desde el año 2018.

Sin tener otro particular, los saluda atentamente.

A handwritten signature in black ink, appearing to read "Marc Tremel", is positioned above a horizontal line.

Marc Tremel

Sales Manager Colombia
Hanwha Q CELLS GmbH
+57 320 857 5806
m.tremel@q-cells.com



Bogotá, 08 de abril de 2019

A QUIEN LE INTERESE

Referencia: Certificación de cliente

Estimados Señores:

Hanwha Q CELLS GmbH, fabricante TIER 1 de paneles solares líder del mercado, certifica por medio de la presente

QUE

Todos nuestros productos están cubiertos de una garantía de **DOCE (12) AÑOS** contra defectos, según consta en nuestros términos de garantía anexos a dicha carta.

Sin tener otro particular, los saluda atentamente.

A handwritten signature in black ink, appearing to read "Marc Tremel", is positioned above a horizontal line.

Marc Tremel
Sales Manager Colombia
Hanwha Q CELLS GmbH
+57 320 857 5806
m.tremel@q-cells.com

LIMITED WARRANTY FOR CRYSTALLINE PHOTOVOLTAIC MODULES FROM Q CELLS

Valid from January 1st, 2019

GENERAL TERMS

Provider of this Limited Warranty for PV Modules is Hanwha Q CELLS (Qidong) Co., Ltd. No.888 Linyang Road, Qidong 226200 Jiangsu, P.R. China ("Hanwha Q CELLS") and the warranty provided herein shall exclusively apply to the following photovoltaic modules of Hanwha Q CELLS (the "PV Modules"), which are sold and installed within Ascension Island, Albania, Algeria, Anguilla, Argentina, Aruba, Bahrain, Bangladesh, Bermuda, Bhutan, Bolivia, Bonaire, Bosnia and Herzegovina, Botswana, Brazil, British Indian Ocean Territory, British Virgin Islands, Brunei, Burkina Faso, Canada, Cambodia, Cameroon, Cayman Islands, China, Cook Islands, Columbia, Costa Rica, Curaçao, Chile, Dubai, Dominican Republic, Ecuador, El Salvador, Egypt, Falkland Islands, Fiji, French Polynesia, Gabon, Greenland, Guernsey, Guatemala, Guyana, Haiti, Honduras, Iceland, India, Indonesia, Iran, Iraq, Israel, Ivory Coast, Japan, Jersey, Jordan, Kazakhstan, Kosovo, Kuwait, Kenya, Laos, Lebanon, Macedonia, Madagascar, Malaysia, Maldives, Mauritania, Mauritius Island, Mexico, Montenegro, Montserrat, Morocco, Myanmar, Nauru, Nepal, New Caledonia, Nicaragua, Nigeria, Northern Cyprus, Oman, Pakistan, Palestine, Panama, Paraguay, Peru, Philippines, Puerto Rico, Qatar, Republic of Belarus, Republic of Rwanda, Russia, Saba and Sint Eustatius, Saint-Barthélemy, Saint Helena, Sri Lanka, Saint-Pierre und Miquelon, Samoa, Saudi Arabia, Senegal, Serbia, Singapore, Sint Maarten, Solomon Islands, South Africa, South Georgia and South Sandwich Islands, Sudan, Suriname, Switzerland, Taiwan, Tanzania, Thailand, Togo, Tonga, Tristan da Cunha, Tunisia, Turks- und Caicos Islands, United States of America, Ukraine, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Wallis and Futuna, Yemen with the following nomenclature (Module Type):

- Q.PEAK-G5, Q.PEAK-G5.1, Q.PEAK-G5.2
- Q.PEAK L-G5, Q.PEAK L-G5.1, Q.PEAK L-G5.2,
- Q.PEAK-G5.0.G, Q.PEAK L-G5.0.G,
- Q.PEAK S-G5.1, Q.PEAK XS-G5.1, Q.PEAK BLK-G5.1

This Limited Warranty for PV Modules takes effect from January 1st 2019 and shall remain valid until a new version of warranty applying to same territory is released.

CHAPTER I: TWELVE YEARS LIMITED PRODUCT WARRANTY

Subject to Chapters III and IV hereof, Hanwha Q CELLS warrants to the original buyer (the "Buyer") that the PV Modules shall be free from any defect in materials and workmanship that has an effect on module functionality under normal application, installation, use and service conditions as specified in Hanwha Q CELLS standard product documentation as updated from time to time (the "Product Documentation"). If, during a period of twelve (12) years from the date of dispatch of the PV Modules to the Buyer from Hanwha Q CELLS factory plus six (6) calendar months or the date of receipt of the PV Modules of the Buyer, whichever date is earlier (the "Warranty Start Date"), the PV Modules fail to conform to the warranty under this Chapter I (the "Twelve Years Limited Product Warranty"), then Hanwha Q CELLS will, at its sole discretion, either repair or replace the defective PV Modules, or refund the residual value¹ of the PV Modules at the time of Hanwha Q CELLS confirmation of the Buyer's claim.

For the avoidance of doubt, any cosmetic changes, or other changes in the PV Modules appearance, which include but not limited to any color change, abrasion, scratching, oxidation, mold and mechanical wear-out, or any other change attributable to or caused by the normal wear and tear over time, or localized impact, that occurs after the Warranty Start Date, shall be exempt from the Twelve Years Limited Product Warranty. The Buyer will be entitled to make claims under the Twelve Years Limited Product Warranty only if the Buyer has provided documented evidence sufficient to prove that the malfunctioning or non-conformity of the PV Modules results exclusively from the defect of the PV Modules and is covered by the Twelve Years Limited Product Warranty.

The Twelve Years Limited Product Warranty shall only cover the claims received by Hanwha Q CELLS before the end of the twelve years warranty period starting from the Warranty Start Date.

The remedies set forth in this Chapter I shall be the Buyer's sole and exclusive remedies under the Twelve Years Limited Product Warranty. The Twelve Years Limited Product Warranty does not warrant a specific power output of the PV Modules, which shall be exclusively covered under Chapter II hereinafter (the "Guaranteed Peak Power Output Limited Warranty").

¹ For the purpose of calculating the residual value, the formula shall be: the spot price of a comparable PV Module $\times (1 - a/12)$. In the above formula, "a" stands for the actual use life of the PV Modules starting from the Warranty Start Date.

CHAPTER II: GUARANTEED PEAK POWER OUTPUT LIMITED WARRANTY

Provided that the PV Modules are used under normal application, installation, use and service conditions as specified in Hanwha Q CELLS Product Documentation and subject to Chapters III and IV hereof, the following Guaranteed Peak Power Output Limited Warranty is provided by Hanwha Q CELLS.

1. First Year Guaranteed Peak Power Output Limited Warranty – Hanwha Q CELLS warrants the power output of the PV Modules as stated below for a period of the first year from the Warranty Start Date. If the minimum “Peak Power Output at STC”² for typical mono PV Modules reduces to less than ninety-eight percent (98%) of the labeled power output classification as specified in Hanwha Q CELLS Product Documentation. Hanwha Q CELLS will, at its sole discretion, either a) provide additional PV Modules to the Buyer, or b) repair these underpowered PV Modules, in either case, to restore the actual power output to the guaranteed level as specified in this Section 1., or c) otherwise provide monetary compensation which shall be calculated by multiplying (x) the difference between the actual peak power output of the PV Modules and the guaranteed peak power output as specified in this Section 1. by (y) the then current per watt market price of the comparable PV Modules in a similar market.
2. Second Year to Twenty-fourth Year Guaranteed Peak Power Output Limited Warranty – Hanwha Q CELLS warrants that, for a period from the second year to the twenty-fourth year, the maximum annual power decline of the typical mono PV Modules will not be more than zero point six percent (0.6%). If there is any decline exceeding the limitation specified hereinabove, Hanwha Q CELLS will, at its sole discretion, either a) provide additional PV Modules to the Buyer, or b) repair the underpowered PV Modules, in either case, to restore the actual power output to the guaranteed level as specified in this Section 2., or c) otherwise provide monetary compensation which shall be calculated by multiplying (x) the difference between the actual peak power output of the PV Modules and the guaranteed peak power output as specified in this Section 2. by (y) the then current per watt market price of the comparable PV Modules in a similar market.
3. 25 Years Guaranteed Peak Power Output Limited Warranty – Hanwha Q CELLS warrants the power output of the PV Modules as stated below for a period of twenty-five (25) years from the Warranty Start Date. If the minimum “Peak Power Output at STC”² for the typical mono PV

Modules reduces to less than eighty-three point six percent (83.6%) of the labeled power output classification as specified in Hanwha Q CELLS Product Documentation. Hanwha Q CELLS will, at its sole discretion, either a) provide additional PV Modules to the Buyer, or b) repair the underpowered PV Modules, in either case, to restore the power output to the guaranteed level as specified in this Section 3., or c) otherwise provide monetary compensation which shall be calculated by multiplying (x) the difference between the actual power output of the PV Modules and the guaranteed power output as specified in this Section 3. by (y) the then current per watt market price of the comparable PV Modules in a similar market.

4. For purpose of this Chapter II, labeled power output classification in Hanwha Q CELLS Product Documentation is the power in Watt peak that a PV Module generates in its maximum power point under STC. The actual power output of the PV Modules shall be determined for verification under STC only. The actual power output measurement shall be either carried out by a Hanwha Q CELLS entity or by a Hanwha Q CELLS recognized third party testing institute. Testing equipment tolerances will be applied to all actual power output measurements.
5. The Guaranteed Peak Power Output Limited Warranty shall only cover the claims received by Hanwha Q CELLS before the end of the respective warranty period in this Chapter II starting from the Warranty Start Date.
6. The remedies set forth in this Chapter II shall be the Buyer's sole and exclusive remedies under the Guaranteed Peak Power Output Limited Warranty.

CHAPTER III: EXCLUSIONS AND LIMITATIONS

The exclusions and limitations listed below shall apply to all the warranties set forth in above Chapters I and II.

- a. The “Twelve Years Limited Product Warranty” and the “Guaranteed Peak Power Output Limited Warranty” do not apply when:
 - i. The PV Modules are improperly installed, wired, maintained, or are subjected to inadequate system design, auxiliary instrument, device of the photovoltaic power system;
 - ii. The PV Modules are subjected to inappropriate handling, including but not limited to handling during transportation or storage, abuse, neglect, vandalism, vermin or accident;

² “Peak Power at STC” is the power in Watt peak that a PV module generates in its Maximum Power Point. “STC” are as follows (a) light spectrum of AM 1.5, (b) an irradiation of 1,000 W per m² and (c) a cell temperature of 25 degree centigrade at right angle irradiation. The measurements are carried out in accordance with IEC 60904 as tested at the connectors or junction box terminals – as applicable – per calibration and testing standards of Hanwha Q CELLS valid at the date of manufacture of the PV Modules. Hanwha Q CELLS calibration standards shall be compliant with the standards applied by international institutions accredited for this purpose.

- iii. The PV Modules are moved from its original installation location, uninstalled, reinstalled or otherwise altered;
- iv. The PV Modules are installed in an environment which exceeds "Operating Conditions" as defined in product specifications and installation manual, installed in a mobile or marine environment, subjected to improper voltage or power surges, abnormal environmental conditions (such as acid rain, salt damage or other corrosive chemical), or affected by dust, powders, assembled mass(es) or other pollutant(s) that is generated or resulted from an industrial setting and cannot be cleared through ordinary methods generally adopted by the PV Modules industry;
- v. The PV Modules are subjected to inappropriate maintenance, including maintenance by an unauthorized service technician or in non-conformance with Hanwha Q CELLS installation manual;
- vi. The PV Modules are subjected to external accidents or forces such as animals, fire, explosion, and civil disorder;
- vii. The PV Modules are subjected to other unforeseen circumstances or causes outside Hanwha Q CELLS reasonable control, including but not limited to, electrical surges, lightning, earthquakes, typhoons, hurricanes, tornadoes, volcanic action, floods, tsunamis, snow damage, heavy hail, etc;
- viii. The manufacture of the PV Modules is in accordance to the design, technical drawings, formulae or other specifications furnished by the Buyer; or
- ix. Any warranty claim, in any event, is not submitted to Hanwha Q CELLS within the applicable warranty period.

b. The Buyer shall carry the burden of proof to prove that it is eligible for coverage and that none of the exclusions and limitations listed in this Chapter III shall apply.

CHAPTER IV: GENERAL TERMS AND CONDITIONS

The General Terms and Conditions listed below shall apply to all the warranties set forth in above Chapters I and II.

1. Disclaimers and Limitation of Liability

a. DISCLAIMERS

HANWHA Q CELLS PROVIDES ALL DOCUMENTS AND INFORMATION ON AN „AS IS“ BASIS. THE WARRANTIES PROVIDED HEREIN ARE IN LIEU OF AND EXCLUDE ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, USE OR APPLICATION, UNLESS I) SUCH OTHER WARRANTIES ARE

EXPRESSLY AGREED TO IN WRITING BY HANWHA Q CELLS UNDER THE RELEVANT SALES AGREEMENT EXECUTED BETWEEN HANWHA Q CELLS AND THE BUYER OR II) OTHER STATUTORY WARRANTY WHICH IS EXPRESSLY PROVIDED IN ANY APPLICABLE MANDATORY LAWS. HANWHA Q CELLS DOES NOT WARRANT THAT THE OPERATION OF THE PV MODULES WILL ACHIEVE THE RESULTS INTENDED BY THE BUYER. IN THE EVENT THAT ANY PROVISION HEREOF (OR ANY PART THEREIN) SHOULD FOR ANY REASON BE HELD INEFFECTIVE UNDER APPLICABLE LAW, THE REMAINDER OF THE PROVISION SHALL REMAIN IN FULL FORCE AND EFFECT.

THE WARRANTIES PROVIDED HEREIN ARE IN LIEU OF AND EXCLUDE ALL OTHER OBLIGATIONS ON THE PART OF HANWHA Q CELLS IN RELATION TO THE DEFECT OF THE PV MODULES UNLESS SUCH OTHER OBLIGATIONS ARE EXPRESSLY AGREED TO IN WRITING BY HANWHA Q CELLS UNDER THE RELEVANT SALES AGREEMENT.

b. LIMITATION OF LIABILITY

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, HANWHA Q CELLS HEREBY DISCLAIMS, AND SHALL HAVE NO RESPONSIBILITY OR LIABILITY WHATSOEVER FOR DAMAGE TO PROPERTY, OR FOR OTHER LOSS FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR RELATED TO THE PERFORMANCE OR NONPERFORMANCE OF THE RELEVANT SALES AGREEMENT, ANY OF THE PV MODULES OR THEIR USE. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, UNDER NO CIRCUMSTANCES SHALL HANWHA Q CELLS BE LIABLE TO THE BUYER, FOR ANY LOST PROFITS, LOSS OF USE, LOSS OF DATA OR EQUIPMENT DOWNTIME, OR FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND, HOWSOEVER ARISING, RELATED TO THE PV MODULES, WHETHER OR NOT HANWHA Q CELLS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, HANWHA Q CELLS AGGREGATE LIABILITY, IF ANY, FOR DAMAGES OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE RECEIVED BY HANWHA Q CELLS FROM THE BUYER. HANWHA Q CELLS LIABILITY FOR FRAUDULENT OR WILFUL INTENT, GROSS NEGLIGENCE OR PERSONAL INJURY, IN EACH CASE, UNDER APPLICABLE MANDATORY LIABILITY LAW SHALL REMAIN UNAFFECTED.

THE BUYER ACKNOWLEDGES THAT THE FOREGOING LIMITATIONS ON LIABILITY UNDER THIS PARAGRAPH b) ARE AN ESSENTIAL ELEMENT OF THE RELEVANT SALES AGREEMENT BETWEEN THE PARTIES AND THAT IN THE ABSENCE OF SUCH LIMITATIONS THE PURCHASE PRICE OF THE PV MODULES WOULD BE SUBSTANTIALLY HIGHER. SOME JURISDICTIONS LIMIT OR DO NOT PERMIT DISCLAIMERS OF LIABILITY, SO THIS PROVISION MAY NOT APPLY TO THE BUYER IN SAID JURISDICTION. SOME JURISDICTIONS DO NOT

ALLOW LIMITATIONS OR THE EXCLUSION OF DAMAGES SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO THE BUYER IN SAID JURISDICTION. THE BUYER MAY HAVE SPECIFIC LEGAL RIGHTS OUTSIDE THIS LIMITED WARRANTY FOR PV MODULES, AND MAY ALSO HAVE OTHER MANDATORY RIGHTS THAT VARY FROM JURISDICTION TO JURISDICTION, WHICH SHALL REMAIN UNAFFECTED.

c. THE WARRANTY PROVIDED UNDER CHAPTER I “TWELVE YEARS LIMITED PRODUCT WARRANTY” AND CHAPTER II “GUARANTEED PEAK POWER OUTPUT LIMITED WARRANTY” COVERS ONLY THE TRANSPORTATION COST FOR RE-SHIPMENT OF ANY REPAIRED OR REPLACED PV MODULES TO THE DESTINATION PORT SET FORTH IN THE RELEVANT SALES AGREEMENT, AND COVER NEITHER CUSTOMS CLEARANCE, TAXES, ANY OTHER COSTS RELATED TO INSTALLATION, REMOVAL, OR REINSTALLATION OF THE PV MODULES, NOR ANY TRANSPORTATION CHARGES FOR THE RETURN OF PV MODULES TO HANWHA Q CELLS.

d. WARRANTY CLAIMS WILL BE HONORED ONLY IF THE PV MODULES CAN BE IDENTIFIED AS BEING MANUFACTURED BY HANWHA Q CELLS, AS INDICATED BY THE INFORMATION ON THE LABELS OF THE PV MODULES.

2. Assignment of the Limited Warranty for PV Modules

a. This Limited Warranty for PV Modules in its entirety, extends only to the Buyer, and is transferrable in its entirety to any other person to whom title to the PV Modules has been transferred provided that a) a prior written notice of such transfer has been received by Hanwha Q CELLS, and b) the PV Modules remain installed in their original installation location³.

3. Obtaining Warranty Performance/Claim Procedure

a. The Buyer shall notify Hanwha Q CELLS promptly (in no event later than thirty (30) days) from discovery of any breach of the Limited Warranty for PV Modules within applicable warranty period. The notice shall be in writing and shall include the description of the claim, corresponding PV Modules serial number(s), proof of purchase such as the commercial invoice and sufficient evidences proving such breach of the Limited Warranty for PV Modules.

b. The return of any PV Modules will not be accepted unless prior written authorization has been given by Hanwha Q CELLS.

c. Any replaced PV Modules shall become the property of Hanwha Q CELLS unless otherwise notified by it. Hanwha Q CELLS shall be entitled to deliver other comparable PV Modules (different in size, color, shape and/or power output

performance) in situations where it deems fit. The repair or replacement of the PV Modules or the delivery with additional PV Modules shall not extend the applicable original warranty period of the “Twelve Years Limited Product Warranty” and the “Guaranteed Peak Power Output Limited Warranty”.

4. Disputes

a. Any dispute arising from or in connection with the claim(s) under this Limited Warranty for PV Modules shall be submitted to binding arbitration and subject to the choice of law as provided in the relevant sales agreement executed between Hanwha Q CELLS and the Buyer. Notwithstanding the above, Technical Related Disputes (as defined below) shall be first submitted to non-binding expert’s evaluation as provided below.

b. For purpose of clarification, in this Limited Warranty for PV Modules, the term “Technical Related Disputes” shall mean disputes regarding the function or malfunction of the PV Modules or other related products. The Technical Related Disputes shall be evaluated by an expert appointed by one of the following test institutions listed in paragraph (c) below. The appointed expert shall provide its expert opinion regarding the function of the PV Modules, and the causes of the malfunction (if applicable). The expert shall also provide a suggestion for the adequate resolution of the dispute including monetary compensation if needed. The specific institution which will appoint the expert shall be the institution in paragraph (c) below whose physical location is the closest in distance to the location of the PV Modules in dispute.

c. Fraunhofer ISE in Freiburg, the Federal Republic of Germany or other TÜV areas

d. The expert’s opinion shall be non binding on either party to this Limited Warranty for PV Modules, but may be used as admissible evidence if the dispute is to be resolved through arbitration, court proceeding or any other form of dispute resolution that the parties may agree upon. For the avoidance of doubt, both parties reserve the right to submit the case to arbitration pursuant to paragraph a) above and to present alternative expert opinion(s) to the arbitration tribunal.

e. The parties shall cooperate to fully accommodate the appointed expert and shall provide the expert the necessary assistance to promptly complete its tasks. The parties shall bear the fees to be paid to the expert according to their degree of responsibility for any claim under this Limited Warranty for PV Modules.

³ This Limited Warranty for PV Modules applies only to PV-Modules that have been installed for the first time and remains in all countries except for 1) countries of the European Union, 2) Australia

ZEICHENGENEHMIGUNG MARKS APPROVAL

Hanwha Q.CELLS GmbH
Sonnenallee 17 - 21
06766 Bitterfeld-Wolfen

ist berechtigt, für ihr Produkt /
is authorized to use for their product

Terrestrische Photovoltaik-Module mit Silizium-Solarzellen
Crystalline silicon terrestrial photovoltaic modules

die hier abgebildeten markenrechtlich geschützten Zeichen
für die ab Blatt 2 aufgeführten Typen zu benutzen /
the legally protected Marks as shown below for the types referred to on page 2 ff.



Geprüft und zertifiziert nach /
Tested and certified according to

DIN EN IEC 61730-1 (VDE 0126-30-1):2018-10; EN IEC 61730-1:2018+AC:2018
DIN EN IEC 61730-2 (VDE 0126-30-2):2018-10; EN IEC 61730-2:2018+AC:2018
EN 61215-1:2016
EN 61215-1-1:2016
EN 61215-2:2017
IEC 61215-1:2016
IEC 61215-1-1:2016
IEC 61215-2:2016
IEC 61730-1:2016
IEC 61730-2:2016

Aktenzeichen: 5008771-3972-0001 / 257651

File ref.:

Ausweis-Nr. 40048195

Blatt 1

Certificate No.

Page

Weitere Bedingungen siehe Rückseite und Folgeblätter /
further conditions see overleaf and following pages

Offenbach, 2018-05-17

(letzte Änderung / updated 2018-12-18)

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Zertifizierungsstelle / Certification

J. Richter

VDE Zertifikate sind nur gültig bei Veröffentlichung unter:
VDE certificates are valid only when published on:

<http://www.vde.com/zertifikat>
<http://www.vde.com/certificate>

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Hanwha Q.CELLS GmbH, Sonnenallee 17 - 21, 06766 Bitterfeld-Wolfen

Aktenzeichen / *File ref.*
5008771-3972-0001 / 257651 / IC6 / FB

letzte Änderung / *updated* Datum / *Date*
2018-12-18 2018-05-17

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40048195.
This supplement is only valid in conjunction with page 1 of the Certificate No. 40048195.

Terrestrische Photovoltaik-Module mit Silizium-Solarzellen *Crystalline silicon terrestrial photovoltaic modules*

Typ(en) / *Type(s)*

- A) Q.PLUS L-G4.2 XXX
- A) Q.PEAK L-G4.2 XXX
- A) Q.PEAK L-G4.5 XXX
- A) B.LINE PEAK L-G4.5 XXX
- B) Q.PLUS L-G4.1 XXX
- B) Q.PEAK L-G4.1 XXX
- B) Q.PEAK L-G4.4 XXX
- B) B.LINE PEAK L-G4.4 XXX
- C) Q.PLUS-G4.2 XXX
- C) Q.PEAK-G4.2 XXX
- D) Q.PLUS-GY.Y XXX
- D) Q.PEAK-G4.1 XXX
- D) Q.PEAK BLK-G4.1 XXX
- D) Q.PLUS BFR-G4.1 XXX
- D) Q.PEAK-G4.4 XXX
- D) B.LINE PEAK-G4.4 XXX
- E) Q.PEAK DUO L-G5.2 XXX
- F) Q.PEAK DUO L-GY XXX
- G) Q.PEAK DUO-GY XXX
- G) Q.PEAK DUO BLK-GY XXX

Weitere Angaben

siehe Anlage 100 vom 18.12.2018
siehe Anlage 600 - 606 vom 18.12.2018
see annex 100 dated 2018-12-18
see annexes 600 - 606 dated 2018-12-18

Further information

Fortsetzung siehe Blatt 3 /
continued on page 3

VDE Prüf- und Zertifizierungsinstitut Zeichengenehmigung

Ausweis-Nr. / Blatt /
Certificate No. Page
40048195 3

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Hanwha Q.CELLS GmbH, Sonnenallee 17 - 21, 06766 Bitterfeld-Wolfen

Aktenzeichen / *File ref.*
5008771-3972-0001 / 257651 / IC6 / FB

letzte Änderung / *updated*
2018-12-18

Datum / *Date*
2018-05-17

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40048195.
This supplement is only valid in conjunction with page 1 of the Certificate No. 40048195.

Dieser Zeichengenehmigungs-Ausweis bildet eine Grundlage für die EG-Konformitätserklärung und CE-Kennzeichnung durch den Hersteller oder dessen Bevollmächtigten und bescheinigt die Konformität mit den grundlegenden Schutzanforderungen der **EG-Niederspannungsrichtlinie 2014/35/EU**.

*This Marks Approval is a basis for the EC Declaration of Conformity and the CE Marking by the manufacturer or his agent and proves the conformity with the essential safety requirements of the **EC Low-Voltage Directive 2014/35/EU**.*

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Fachgebiet IC6
Section IC6

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Hanwha Q.CELLS GmbH, Sonnenallee 17 - 21, 06766 Bitterfeld-Wolfen

Aktenzeichen / *File ref.*
5008771-3972-0001 / 257651 / IC6 / FB

letzte Änderung / *updated* Datum / *Date*
2018-12-18 2018-05-17

Dieses Beiblatt ist Bestandteil des Zeichengenehmigungsausweises Nr. 40048195.
This supplement is part of the Certificate No. 40048195.

Terrestrische Photovoltaik-Module mit Silizium-Solarzellen *Crystalline silicon terrestrial photovoltaic modules*

Fertigungsstätte(n) *Place(s) of manufacture*

Referenz/*Reference*
30018653 Hanwha Q CELLS (Qidong) Co., Ltd.
No. 888 Linyang Road
226200 QIDONG CITY
Jiangsu
CHINA

Referenz/*Reference*
30023330 Hanwha Q CELLS & Advanced
Materials Corporation
1329 Daegeum-ro, Geumwang-eup
27632 EUMSEONG-GUN
Chungcheongbuk-do
SOUTH KOREA

Referenz/*Reference*
30023399 Hanwha Q CELLS Malaysia Sdn. Bhd.
Lot 1, Jalan SP 2, Seksyen 2
Selangor Science Park 2
63300 CYBERJAYA
Selangor
MALAYSIA

Referenz/*Reference*
30024481 Hanwha Q CELLS & Advanced
Materials Corporation
202 Sansusandan2-ro, Iwol-myun
27816 JINCHEON-GUN
Chungcheongbuk-do
SOUTH KOREA

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Fachgebiet IC6
Section IC6

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
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Aktenzeichen / *File ref.*
5008771-3972-0001 / 257651 / IC6 / FB

letzte Änderung / *updated*
2018-12-18

Datum / *Date*
2018-05-17

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40048195.
This supplement is only valid in conjunction with page 1 of the Certificate No. 40048195.

Genehmigung zum Benutzen des auf Seite 1 abgebildeten markenrechtlich geschützten Zeichens des VDE:

Grundlage für die Benutzung sind die Allgemeinen Geschäftsbedingungen (AGB) der VDE Prüf- und Zertifizierungsinstitut GmbH (www.vde.com\AGB-Institut). Das Recht zur Benutzung erstreckt sich nur auf die bezeichnete Firma mit den genannten Fertigungsstätten und die oben aufgeführten Produkte mit den zugeordneten Bezeichnungen. Die Fertigungsstätte muss so eingerichtet sein, dass eine gleichmäßige Herstellung der geprüften und zertifizierten Ausführung gewährleistet ist.

Die Genehmigung ist so lange gültig wie die VDE-Bestimmungen gelten, die der Zertifizierung zugrunde gelegen haben, sofern sie nicht auf Grund anderer Bedingungen aus der VDE Prüf- und Zertifizierungsordnung (PM102) zurückgezogen werden muss.

Der Gültigkeitszeitraum einer VDE-GS-Zeichengenehmigung kann auf Antrag verlängert werden. Bei gesetzlichen und / oder normativen Änderungen kann die VDE-GS-Zeichengenehmigung ihre Gültigkeit zu einem früheren als dem angegebenen Datum verlieren.

Produkte, die das Biozid Dimethylfumarat (DMF) enthalten, dürfen gemäß der Kommissionsentscheidung 2009/251/EG nicht mehr in den Verkehr gebracht oder auf dem Markt bereitgestellt werden.

Der VDE-Zeichengenehmigungsausweis wird ausschließlich auf der ersten Seite unterzeichnet.

Approval to use the legally protected Mark of the VDE as shown on the first page:

Basis for the use are the general terms and conditions of the VDE Testing and Certification Institute (www.vde.com\terms-institute). The right to use the mark is granted only to the mentioned company with the named places of manufacture and the listed products with the related type references. The place of manufacture shall be equipped in a way that a constant manufacturing of the certified construction is assured.

The approval is valid as long as the VDE specifications are in force, on which the certification is based on, unless it is withdrawn according to the VDE Testing and Certification Procedure (PM102E).

The validity period of a VDE-GS-Mark Approval may be prolonged on request. In case of changes in legal and / or normative requirements, the validity period of a VDE-GS-Mark Approval may be shortened.

Products containing the biocide dimethylfumarate (DMF) may not be marketed or made available on the EC market according to the Commission Decision 2009/251/EC.

The approval is solely signed on the first page.

SGS-CSTC Standards Technical
Services Co., Ltd. To:

Applicant's name:

Hanwha Q CELLS(Qidong) Co., Ltd.

No.888 Linyang Road, 226200 Qidong
City, Jiangsu Province, P.R.China

SGS-CSTC Standards Technical
Services (Shanghai) Co., Ltd.

No.588 West Jindu Road, Songjiang
District, Shanghai, China

Project Status Notification

Dear Katherine KONG

We hereby inform you about the current status of your project as following:

Client : **Hanwha Q CELLS (Qidong) Co., Ltd.**

Project no. : SHES1809010529PV

Product : Photovoltaic (PV) Modules

Model no. :
Q.POWER-G5 xxx(xxx=260-280W, in steps of 5W)
Q.POWER-G5.0.G xxx(xxx=260-280W, in steps of 5W)
Q.POWER L-G5 xxx(xxx=315-335W, in steps of 5W)
Q.POWER L-G5.0.G xxx(xxx=315-335W, in steps of 5W)
Q.PEAK-G5 xxx(xxx=295-310W, in steps of 5W)
Q.PEAK-G5.0.G xxx(xxx=295-310W, in steps of 5W)
Q.PEAK L-G5 xxx(xxx=355-370W, in steps of 5W)
Q.PEAK L-G5.0.G xxx(xxx=355-370W, in steps of 5W)

Maximum system voltage: DC 1000/1500V

Service applied : COLOMBIA RETIE

Test standard :
IEC 61215-1:2016
IEC 61215-2:2016
IEC 61730-1:2016
IEC 61730-2:2016

Resolution 90708 of August 30,2013, article 20 "requirements for products",
Paragraph 20.22 "Photovoltaic solar panels" and modifications



Este documento se emite por la Compañía bajo sus Condiciones Generales de Servicio, a las que se puede acceder en http://www.sgs.com/terms_and_conditions.htm. La responsabilidad de SGS Colombia S.A.S queda limitada en los términos establecidos en las citadas condiciones Generales que resultan de aplicación a la prestación de sus servicios.

Se advierte al poseedor de este documento que la información en él recogida refleja los resultados obtenidos por la Compañía en el momento de su intervención, habiendo sido llevada a cabo exclusivamente dentro de los límites establecidos tanto en el contrato como en las Condiciones Generales de Servicio. La compañía responde únicamente frente a su cliente, sin que pueda derivarse responsabilidad de ningún tipo de SGS Colombia S.A.S frente a terceros ante los que se presente el certificado o reporte derivado de su intervención. El presente documento no podrá ser alterado ni modificado, ni en su contenido ni en su apariencia. En caso de modificación del mismo, SGS Colombia S.A.S se reserva las acciones legales que estime oportunas para la defensa de sus legítimos intereses.

SGS-CSTC Standards Technical
Services Co., Ltd. To:

Applicant's name:

Hanwha Q CELLS(Qidong) Co., Ltd.

No.888 Linyang Road, 226200 Qidong
City, Jiangsu Province, P.R.China

SGS-CSTC Standards Technical
Services (Shanghai) Co., Ltd.

No.588 West Jindu Road, Songjiang
District, Shanghai, China

Project status

(as of the date this notification
is issued)

- ☒ Factory Inspection completed
 - ☒ Pass
 - ☐ Fail
- ☒ Testing completed – positive result:
 - ☐ Preparing the technical report / documentation
 - ☒ Applying for the certificate
- ☐ Test completed – negative result:
 - ☐ Testing failed
 - ☐ Documentation not complete

Kind regards



Signature




Este documento se emite por la Compañía bajo sus Condiciones Generales de Servicio, a las que se puede acceder en http://www.sgs.com/terms_and_conditions.htm. La responsabilidad de SGS Colombia S.A.S queda limitada en los términos establecidos en las citadas condiciones Generales que resultan de aplicación a la prestación de sus servicios.

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ORIGINAL

1. Exporter HANWHA Q CELLS (QIDONG) CO LIMITED NO 888 LINYANG ROAD QIDONG CITY JIANGSU PROVINCE PR CHINA 226200		Certificate No. C183211Q16820440	
2. Consignee COL ENERGY SAS CRA 28B NRO 78-77 BOGOTA, COLOMBIA NIT: 900.535.180-9 TEL: +57 1 6603788 ATN: CAMILO CAÑILDE, ON		CERTIFICATE OF ORIGIN OF THE PEOPLE'S REPUBLIC OF CHINA	
3. Means of transport and route FROM SHANGHAI PORT IN CHINA TO BUENAVENTURA PORT IN COLOMBIA BY SEA			
4. Country / region of destination COLOMBIA		5. For certifying authority use only ISSUED RETROSPECTIVELY Verification: www.chinaorigin.gov.cn	
6. Marks and numbers N/M	7. Number and kind of packages; description of goods TWENTY TWO (22) PALLETS OF SOLAR MODULES *** **	8. H.S.Code 8541	9. Quantity 660PCS
			10. Number and date of invoices - 1300022938 NOV. 17, 2018
11. Declaration by the exporter The undersigned hereby declares that the above details and statements are correct, that all the goods were produced in China and that they comply with the Rules of Origin of the People's Republic of China. <div style="border: 1px solid black; padding: 5px; display: inline-block;"> 韩华新能源(启东)有限公司 Hanwha Q CELLS (Qidong) Co., Ltd </div> Nanjing, China, NOV. 19, 2018		12. Certification It is hereby certified that the declaration by the exporter is correct. <div style="text-align: center;">  南京 中华人民共和国 海关 </div> <div style="text-align: right;">  NOV. 19, 2018 </div>	
Place and date, signature and stamp of authorized signatory		Place and date, signature and stamp of certifying authority	

185495480



中国太平
CHINA TAIPING

总公司地址：深圳市福田区益田路6001号太平金融大厦33楼
33F, Taiping Finance Tower No.6001, Yitian Road, Futian District,
Shenzhen, P.R. CHINA
电话 Tel: (86-755) 28598888 传真 Fax: (86-755) 82960909
邮编 Post Code: 518026 网址 Website: www.cntaiping.com
全国统一客服热线: 95589

太平财产保险有限公司

TAIPING GENERAL INSURANCE CO., LTD.

货物运输保险单

CARGO TRANSPORTATION INSURANCE POLICY

鉴于本保险单承保表中列明的被保险人向太平财产保险有限公司（以下简称“本公司”）缴付了本保单承保表中列明的保险费，本公司同意按本保险单的规定负责赔偿被保险人招致的损失、损坏、责任或费用。

WE, TAIPING GENERAL INSURANCE CO., LTD. (HEREINAFTER CALLED "THE COMPANY"), HEREBY AGREE, IN CONSIDERATION OF THE PAYMENT TO US BY OR ON BEHALF OF THE INSURED OF THE PREMIUM AS ARRANGED, TO INSURE AGAINST LOSS, DAMAGE, LIABILITY OR EXPENSE IN THE MANNER HEREINAFTER PROVIDED.

保单号码 POLICY NO.	66102060620180000340		承保表 SCHEDULE	No. 1800 00036253	
被保险人 INSURED	Hanwha Q Cells Hong Kong Limited				
运输工具 CONVEYANCE	EVER LOVELY V. 92020E		起运日期 DATE OF DEPARTURE	AS PER B/L	
航程 VOYAGE	From SHANGHAI (CHINA) To BUENAVENTURA (COLOMBIA).				
保险金额 AMOUNT INSURED	美元 陆万玖仟贰佰陆拾元肆角整 US DOLLAR SIXTY NINE THOUSAND TWO HUNDRED SIXTY AND FORTY CENTS ONLY (USD\$9,260.40)				
保费 PREMIUM	按约定 As Arranged	提单号 B/L NO.	YMLUC236009794	信用证号码 L/C NO.	SO VALUED 定值
保险标的物 SUBJECT-MATTER INSURED SOLAR MODULES 660PCS					
发票号码 INVOICE NO.: HSOL-1300022938					
承保条件及条款 TERMS AND CONDITIONS Covering Marine Risks as per Institute Cargo Clauses (A) dated 1/1/82 (Warehouse to Warehouse Clause is Included)					
特别约定 SPECIAL CLAUSES					
<p>所保险货物如发生保险单下可能引起索赔的损失，应立即通知本公司或下述代理人查勘。如有索赔，应向本公司提交正本单（本保险单共有3份正本）及相关资料文件。如一份正本已用于索赔，其余正本自动失效。</p> <p>In the event of loss or damage which may involve a claim under this policy, no claim shall be paid unless immediate notice of such loss or damage has been given to and a Survey Report obtained from The Company or Agents specified below. If any one of the original policy which has been issued in 3 original(s) together with the relevant documents shall be surrendered to The Company. If one original has been used for claim purposes, the other originals shall be invalidating automatically.</p> <p>本保险单依照所附重要条款及损失通知条款约束。</p> <p>THIS INSURANCE IS SUBJECT TO THE IMPORTANT CLAUSE AND THE NOTICE OF LOSS CLAUSES PRINTED OVERLEAF.</p>					
免赔条件 Deductible Deductible: CNY10000.00 for any one accident.					
检验人 SURVEY AGENT MARCONSULT SAS (WEOG SURVEY AGENT) CALLE 94 A NO 11A-27 OFFICE 204 CHICO, BOGOTA TELEPHONE: (571) 622 0316 & 473 1866 FACSIMILE: (571) 622 0386 A.O.H. (571) 313 870 6335 E-MAIL: LLOYDSAGENTS@MARCONSULT.COOL.COM			理赔人 SETTLING AGENT DOLPHIN CLAIMS SERVICES (SINGAPORE) PTE LTD (AS AGENTS FOR DOLPHIN MARITIME & AVIATION SVCS LTD & DOLPHIN CLAIMS SVCS (S'PORE) PTE. LTD) 101 CECIL STREET, #17-08, TONG ENG BUILDING, SINGAPORE 069533TEH CHONG WYNE DAVID LANDAU+65 62221849+65 62221849+65 62211849CLAIMS@DOLPHIN-CLAIMS.COM SGWYNE@DOLPHIN-CLAIMS.COM SGWWW.DOLPHIN-MARITIME.COM; +44 (0) 2089548800, ALICE@DOLPHIN-MARITIME.COM		
赔款支付地 CLAIMS, IF ANY, PAYABLE AT/IN		BUENAVENTURA		预约保单号码 WOC NO.	

出单员 USER 613148

核保员 UNDERWRITER 610088

签发地点 ISSUE PLACE 启东市汇龙镇长江中路533号

签发日期 ISSUE DATE 2018/11/14

销售代理：中介机构业务—保险经纪业务，经办员：联系方式：中介机构名称：江苏保险经纪股份有限公司无锡分公司，中介机构地址：中介机构联系方式：A18011224

太平财产保险有限公司江苏分公司
TAIPING GENERAL INSURANCE CO., LTD. JIANGSU BRANCH
Taiping General Insurance Co., Ltd. Jiangsu Branch

授权人签字 AUTHORIZED SIGNATURE



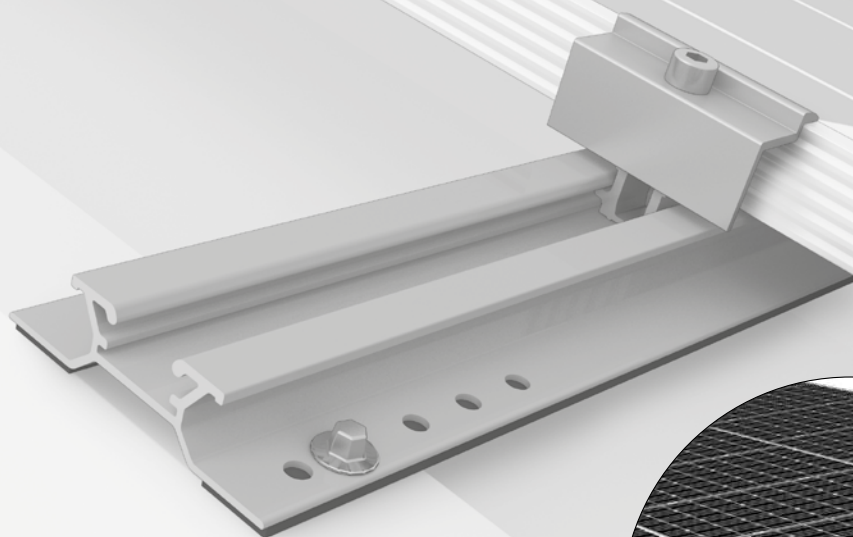
ESTRUCTURA DE MONTAJE PANELES

CONTENIDO

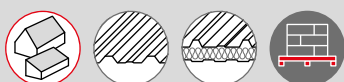
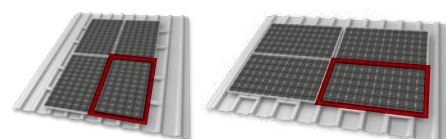
- Ficha técnica.



Sistema MiniRail

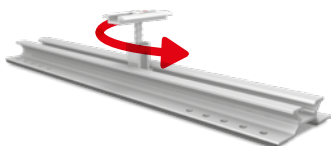


- ▶ Sistema innovador de guía corta, que está optimizado estáticamente y se monta de modo rápido y sencillo
- ▶ Posibilidad de fijación y orientación universales de los módulos
- ▶ Elevación de 5° con MiniFive: Mayor rendimiento gracias a ventilación posterior perfeccionada e inclinación de módulo optimizada
- ▶ Elevada seguridad de planificación, optimizada para almacenamiento y transporte



El sistema MiniRail permite el montaje de Portrait y Landscape como montaje modular gracias a la pinza de módulos universal giratoria.

Componentes



Kit de MiniRail

Montaje de Landscape y Portrait con MiniClamp MC/EC



MiniClamp MC/EC 30-50 mm

- ▶ Pinza universal para módulos
- ▶ La pinza es giratoria



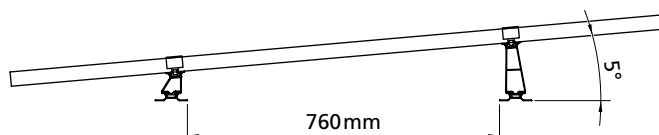
Tornillos para chapa fina

- ▶ Incluidos en el kit de MiniRail
- ▶ Con discos obturadores



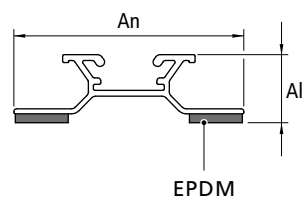
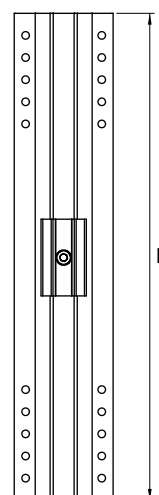
MiniFive Front y End

- ▶ Elevación simple por un lado mediante elementos extensibles de soporte de módulos
- ▶ Ventilación posterior perfeccionada y mayor rendimiento
- ▶ Optimización de la inclinación de módulos



Datos técnicos

	Sistema MiniRail
Campo de aplicación	Tejados con chapa trapezoidal o paneles sandwich; Inclinación de tejado: 5-75°
Tipo de fijación / anclaje al techo	Atornillamiento en la cubierta del tejado con tornillos para chapa fina autoterrajadores
Requisitos	<ul style="list-style-type: none"> ▶ Grosores de chapa: $\geq 0,5$ mm (acero y aluminio) ▶ Paneles sandwich: Necesaria autorización del fabricante ▶ Anchura del acanalado: como mínimo 22 mm * ▶ Separación de molduras: 101 - 350 mm en función de la anchura del acanalado ▶ Soporte plano alrededor de orificio de perforación: $\varnothing \geq 20$ mm ▶ Módulos de altura de bastidor: 30-50 mm
Orientación de módulos	Vertical u horizontal
Material	Aluminio (EN AW-6063 T66/ EN AW-6082 T6); EPDM
Medidas de MiniRail An x Al x L [mm]	78,2 x 23 x 385
Elevación con MiniFive	aprox. 5°



* La dimensión mínima específica del proyecto para la anchura de molduras se emite en el informe de Base On.



CONTROLADOR DE CARGA

CONTENIDO

- Certificado de conformidad con la norma directiva de baja tensión



EU Declaration of Conformity (DoC)



Name of manufacturer: Studer Innotec SA
Address of manufacturer: Rue des Casernes 57, CH – 1950 Sion
Type of product: Remote Control Module / (+) Programmation Module
Series name: **RCC**
Product reference: RCC-03
Serial numbers: From ERCN00001 to ERCN29999
From FRCN00001 to FRCN29999

The products with the serial numbers mentioned above are in conformity with the following EU directives and harmonised standards:

Safety: **Low Voltage Directive (LVD) 2014/35/EU**
- EN 62368-1:2014/AC:2015

EMC: **EMC Directive 2014/30/EU**
- EN 61000-6-1:2007
- EN 61000-6-2:2005/AC:2005
- EN 61000-6-4:2007/A1:2011

RoHS: **RoHS Directive 2011/65/EU**

Place and date: Sion, 15.10.2018
Signatory: Loïc Viret (Managing Director)

Viret L.



EU Declaration of Conformity (DoC)

Name of manufacturer: Studer Innotec SA
Address of manufacturer: Rue des Casernes 57, CH – 1950 Sion
Type of product: Isolated MPPT Solar Charge Controller
Series name: **VarioString**
Product reference: VS-70
Serial numbers: From ESBN00001 to ESBN29999
From FSBN00001 to FSBN29999

The products with the serial numbers mentioned above are in conformity with the following EU directives and harmonised standards:

Safety: **Low Voltage Directive (LVD) 2014/35/EU**
- EN 62109-1:2010

EMC: **EMC Directive 2014/30/EU**
- EN 61000-6-1:2007
- EN 61000-6-2:2005/AC:2005
- EN 61000-6-4:2007/A1:2011

RoHS: **RoHS Directive 2011/65/EU**

Place and date: Sion, 15.10.2018
Signatory: Loïc Viret (Managing Director)

Viret L.



LIMITED FACTORY WARRANTY

Warranty Period

Studer Innotec SA (hereafter Studer Innotec) warrants its full range of products to be free from defects in workmanship and materials for the applicable Warranty Period:

- for the AJ, Compact, SI, VarioString, VarioTrack, Xtender, and all Studer-made accessories: 5 years starting on the earlier of (i) 6 months from shipment from Studer Innotec, and (ii) the final sale of the product.
- for all other products, including battery accessories such as the MBC, MDC, MDCI, MBI, MBR, MBW, SBM-02, etc.: 2 years starting on the earlier of (i) 6 months from shipment from Studer Innotec, and (ii) the final sale of the product.

Extended Warranty Period

For the AJ, VarioString, VarioTrack and Xtender products manufactured after 1 January 2018, an additional 5-year Extended Warranty Period (total 10-year Warranty) is granted for those products that are registered online with Studer Innotec within 90 days of their final sale. The date of product registration does not delay the start of the Warranty Period.

The Extended Warranty is subject to the following limitations:

- it does not cover defects due to failure of the following components that are subject to aging by harsh conditions: fans and capacitors.
- it does not cover the VarioString and VarioTrack products for non-solar PV applications.

Warranty eligibility

Only the original owner of the product at the place of its first installation is eligible to make a claim on the warranty. Resale or reinstallation of the product without authorization from Studer Innotec will result in loss of warranty.

Warranty coverage

During the Warranty and Extended Warranty Periods, Studer Innotec will, at its option, repair or replace the defective product free of charge. Studer Innotec shall not be liable for damages, whether direct, incidental, special, or consequential, caused by negligence or fault, even if having been advised of the probability of such damages.

Exclusions

This warranty will not apply where the product has been misused, neglected, improperly installed, or repaired by anyone other than Studer Innotec or one of its QSP. To qualify for the warranty, the product must not be disassembled, modified, or have suffered any physical damage internally or externally.

This warranty does not cover damages arising from improper use such as:

- Reverse of battery polarity.
- Inadequate installation of the product and/or of its accessories.
- Mechanical shock or deformation.
- Contact with liquid or oxidation by condensation.
- Use in an inappropriate environment with exposure to dust, corrosive vapour, humidity, high temperature, etc.
- Intrusion of insects, animals, or any living organism.

- Breakage or damage due to lightning or overvoltage due to any external cause.
- Damage to connection terminals and screws from misuse or incorrect tightening.
- Damage during transport.
- Force majeure.

Warranty service

Studer Innotec owns all parts removed from repaired products. Studer Innotec uses new or reconditioned parts made by various manufacturers in performing warranty repairs and building replacement products. If Studer Innotec or a QSP repairs or replaces a part of a product, its Warranty Period is: (i) the remaining time of the original Warranty Period or (ii) 6 months from the date of shipment from Studer Innotec or the QSP, whichever is longer.

Warranty procedure

If a product requires service, the product reseller should be contacted first. In the event the reseller cannot be contacted, or if they are not able to provide service, direct contact should be made with Studer Innotec.

If Studer or a QSP determine the product should be sent in for service, a Return Form for Service is required before the product will be accepted for service.

The warranty claimant must provide all necessary information to process the warranty claim including, when applicable, the purchase invoice, product serial number, date of installation, and Extended Warranty Certificate. The faulty product must be sent at the sender's expense back to a QSP or Studer Innotec.

CAUTION: transport must be organized in a way to avoid damage to the product.

Life Support Policy

As a general policy, Studer Innotec prohibits the use of any of its products in life support applications where failure or malfunction of the Studer Innotec product can be reasonably expected to cause failure of the life support device or to significantly affect its safety or effectiveness. Studer Innotec does not recommend the use of any of its products in direct patient care. Studer Innotec will not knowingly sell its products for use in such applications unless it receives written assurance, satisfactory to Studer Innotec, that the risks of injury or damage have been minimised, the customer assumes all such risks, and the liability of Studer Innotec is adequately protected under the circumstances.

Applicable law

Swiss law is exclusively applicable, and the jurisdiction is Sion, Switzerland.

Severability

If a part of the terms and conditions set out above is held invalid, void, or unenforceable due to any national or international legislation, it shall not affect other parts of the remaining terms and conditions.

Sion, 1 June 2018

Gama VarioString



Modelo	VS-70		VS-120			
Características eléctricas lado módulos FV	MPPT		MPPT 1	MPPT 2	1 + 2 en paralelo	1 + 2 en serie
Potencia solar máx. recomendada (@STC)	4200 W		3500 W	3500 W	7000 W	7000 W
Corriente máx.	13 A		13 A	13 A	26 A	13 A
Tensión máx. de circuito abierto (Voc)	600 V		600 V	600 V	600 V	900 V
Tensión mín. de funcionamiento	200 V		200 V	200 V	200 V	400 V
Tensión MPP recomendada	250-500 V		250-500 V	250-500 V	250-500 V	500-750 V
Características eléctricas lado baterías						
Corriente máx. de salida	70 A		60 A	60 A	120 A	
Tensión nominal de batería			48 V			
Rango de tensión de funcionamiento			38 - 68 V			
Posibilidad de puesta a tierra de batería			Bat +, Bat -			
Prestaciones del equipo						
Eficiencia de conversión máx.			> 98 %			
Eficiencia MPPT			> 99.8 %			
Autoconsumo en Stand-by (noche)	< 20 mA (1 W)		< 25 mA (1.25 W)			
Etapas de carga			4 etapas: Bulk, Absorción, Flotación, Ecuilización			
Valor de compensación por temperatura de batería (BTS-01)			-3mV / °C / célula de fábrica ajustable -8 to 0 mV / °C			
Protecciones electrónicas						
Inversión de polaridad lado FV			•			
Sobre temperatura			•			
Corriente inversa de noche			•			
Aislamiento Galvánico			•			
Posibilidad de puesta a tierra FV			FV+, FV -, ninguna			
Protección de fallo a tierra			Programmable			
Entorno						
Rango de temperatura de funcionamiento			-20 a 55°C			
Humedad	100 %		máx. 95 %, sin condensación			
Índice de protección IP	IP54		IP20			
Lugar de montaje			Interior			
Datos Generales						
Garantía			5 años			
Certificado ISO			9001:2008 / 14001:2004			
Peso	5.51 kg		7.5 kg			
Dimensiones A/a/l [mm]	120 / 220 / 350		133 / 322 / 466			
Conexiones para generador FV			SUNCLIX™ (Phoenix Contact Tool Free)			
Funcionamiento en paralelo (cadenas FV separadas)			Hasta 15 equipos			
Sección de cable máx. (batería)	35 mm²		70 mm²			
Prensa estopas (batería)	M 20 x 1,5		2xPG21			
Comunicación						
Cable de comunicación			Bus de comunicación Studer			
Control remoto y visualización			RCC-02/-03, Xcom-232i / Xcom-LAN / Xcom-GSM / Xcom-SMS			
Idiomas del menú			Inglés / Francés / Alemán / Español			
Data logging			Con RCC-02/-03 en tarjeta SD · un punto por minuto			
Conformidad con normas						
Declaración UE de conformidad			Directiva de Baja Tensión 2014/35/UE: - EN 62109-1:2010 Directiva de Compatibilidad Electromagnética (CEM) 2014/30/UE: - EN 61000-6-2:2005, EN 61000-6-4:2007/A1:2011			
Accesorios						
Control remoto RCC-02 o RCC-03	•		•			
Módulo Xcom-232i	•		•			
Sets de comunicación Xcom-LAN / Xcom-GSM / Xcom-SMS	•		•			
Controlador del estado de carga de batería BSP	•		•			
Módulo con 2 contactos auxiliares ARIM-02	•		•			
Sensor de temperatura de batería BTS-01 (3 m)	•		•			
Cable de comunicación CAB-RJ45-8-2	•		•			

Estos datos pueden cambiar sin preaviso



BATERIAS BAE

CONTENIDO

- Ficha técnica vida útil
- Ficha técnica.
- Certificación IEC 60896_ IEC 61427_ IEC 62485_ EN 50272
- Type test del fabricante.
- Certificación IEC_60068-2-6
- Certificación IEEE 344_ IEC 68
- Certificación de origen.
- Certificados ISO 9001, ISO 14001, ISO 50001, OHSAS 18001.
- Fabricación de los electrodos.
- Historia BAE baterías.
- Origen del fabricante.
- Plan de control de calidad.
- Política Ambiental.
- Relevancia ambiental.
- Certificación de calidad 1 / 2.
- Test de certificación.
- Autorización nuclear
- Declaración de conformidad EN 60529
- Reporte final IEEE 535 test OPzV cells
- certificación de conformidad IEC896-2

Temperature influence on float operation life, cycle life and capacity

The temperature is an important factor for the life time of lead-acid batteries. Increasing temperatures lead to decreasing life times. However, this is related to the internal battery temperature and not to the ambient temperature. The average ambient temperature can be used as an indicator whereas peak temperatures during short times normally do not have an impact on the internal battery temperature.

1. Service life in float operation

Aging in float operation can be determined using Arrhenius law, which describes the influence of the temperature on the rate constant of the chemical reaction.

As a rule of thumb, the aging process of lead-acid batteries at high temperatures can be estimated as follows: With a temperature of 10 K above the design temperature, the designed life time of the battery will be reduced to half of it. For instance, if a battery is designed for 20 years at 25 °C, the life time will decrease down to 10 years when the battery is permanently operated at 35 °C.

The real temperature behaviour is not linear. The following figure gives the life time at battery temperatures above the nominal temperature of 25 °C:

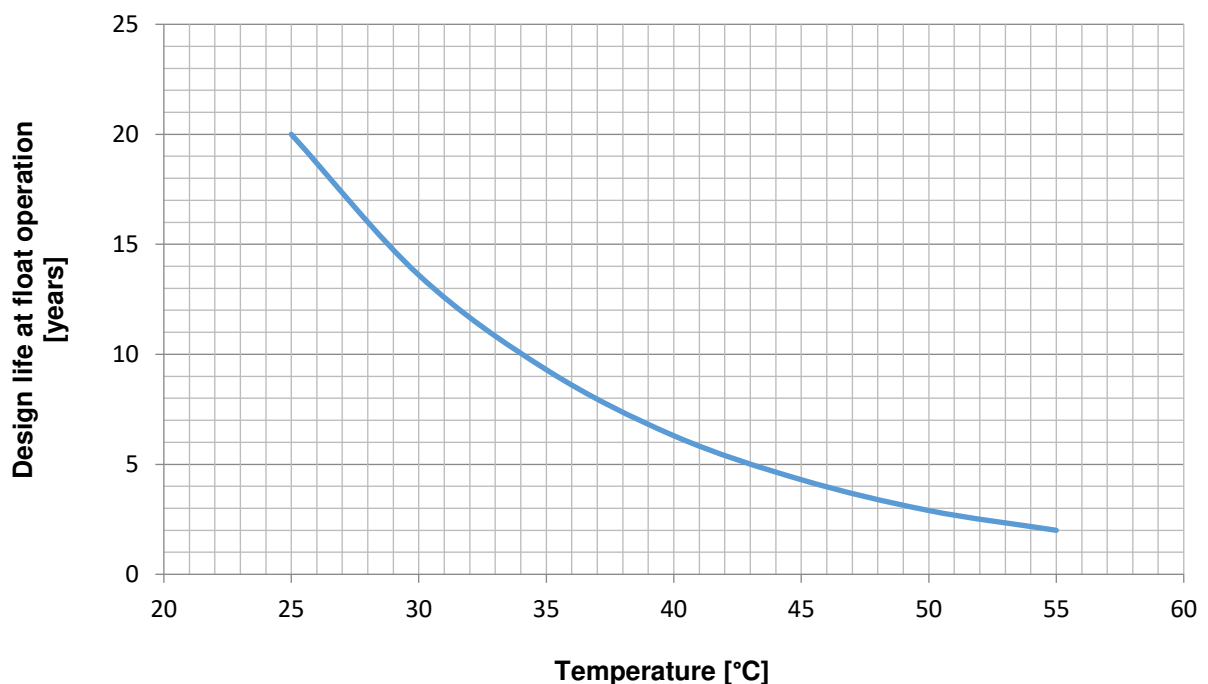


Fig. 1: Design life at different temperatures



2. Cycle life

The following graphic gives the number of cycles at different depth of discharges (DOD) for several battery temperatures:

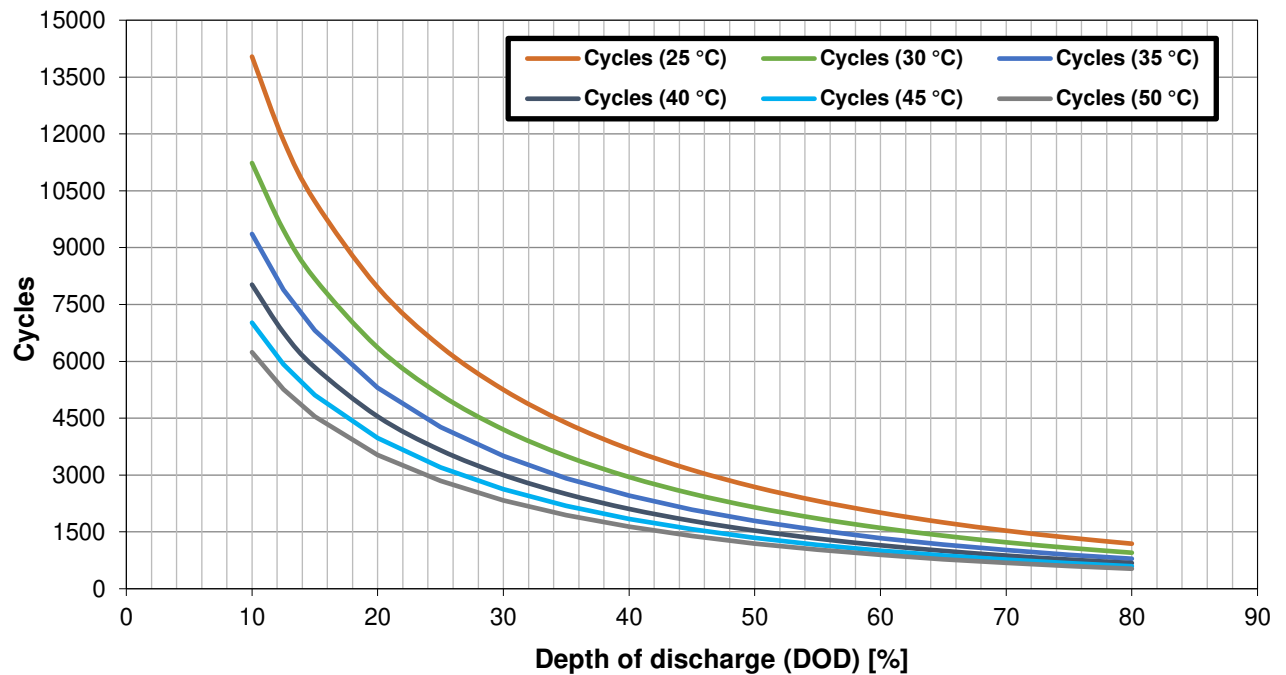


Fig. 2: Number of cycles at different temperatures for BAE OPzV / PVV cells

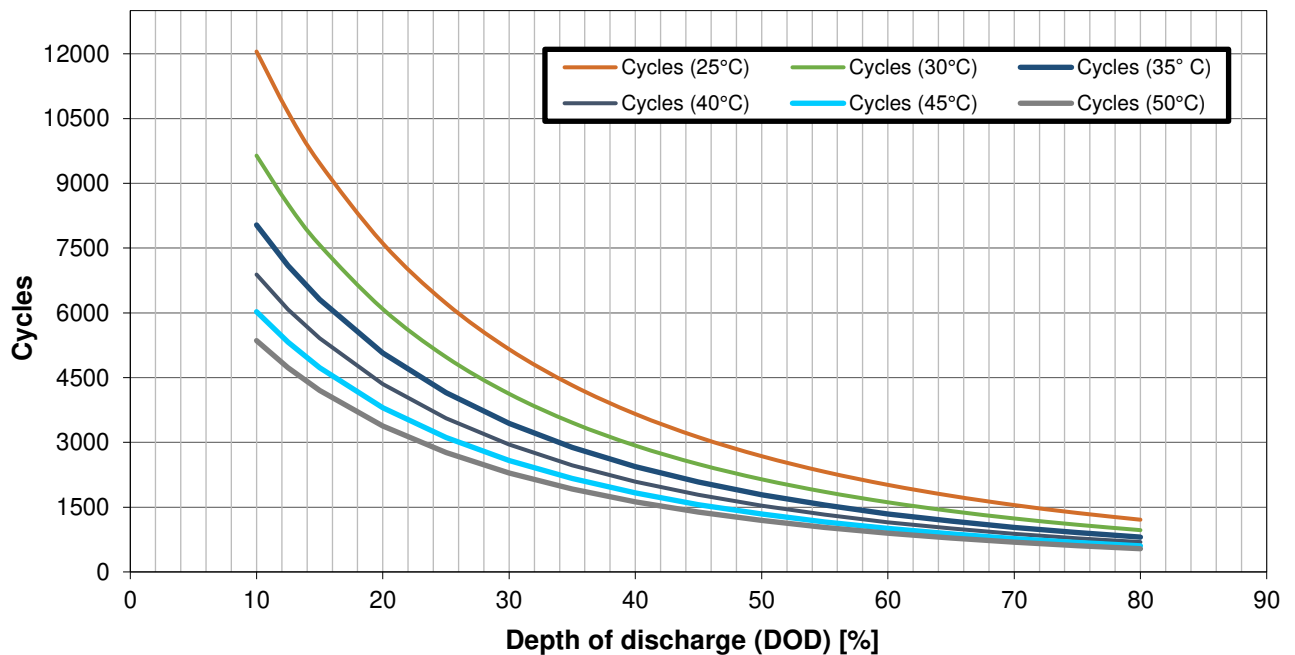


Fig. 3: Number of cycles at different temperatures for BAE OPzV / PVV blocks



3. Capacity

While discharging the battery the temperature has also an influence on the available capacity. At higher temperatures the measured capacity is higher than at lower temperatures. Furthermore, this effect depends on the discharge current as well. The higher the discharge current the higher the temperature influence on the available capacity. For an exact battery sizing these effects must be considered. The following graphic gives some correction factors for several discharge currents.

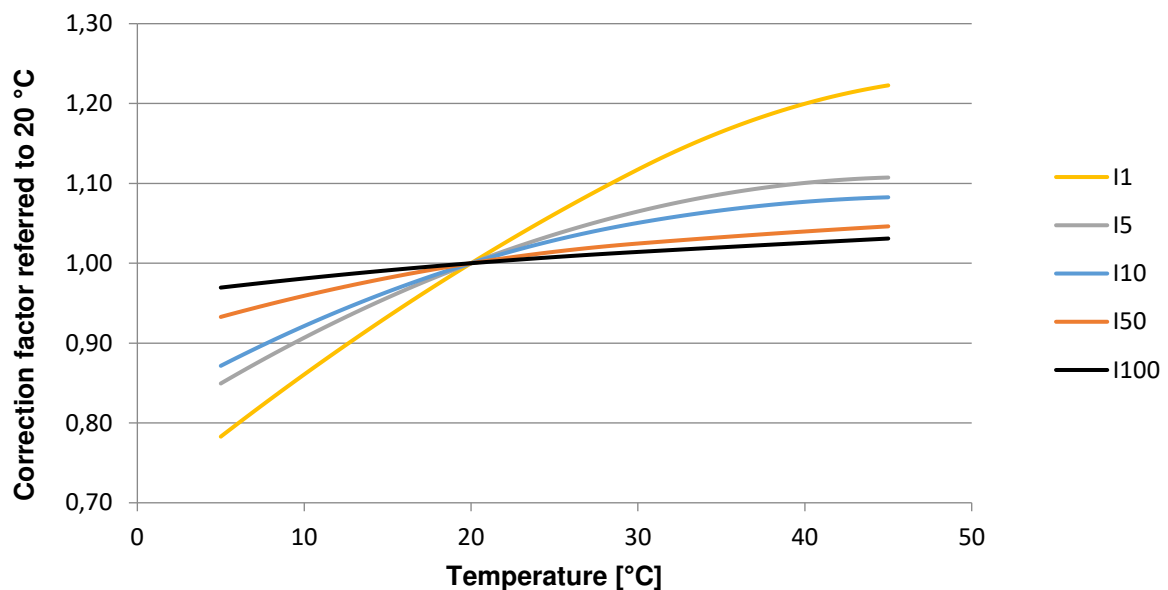


Fig. 4: Temperature correction factors for several discharge currents

Technical Specification for Valve Regulated Lead-Acid Batteries (VRLA-GEL)

1. Application

BAE SECURA PVV SOLAR batteries are the ideal solution for storage of regenerative energy in home systems and in the industrial sectors. Robustness and reliability are characteristic for BAE SECURA PVV SOLAR batteries. In addition, they do not require any refilling of water during the whole battery life time and are maintenance-free.

The special electrode design with tubular electrodes and the fixed gel electrolyte distinguish the BAE SECURA PVV SOLAR batteries and lead to high security and reliability as well as high cycle life time.



Similar to the illustration

2. Technical data (Reference temperature 20 °C)

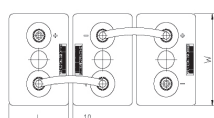
Type	C_{1h} Ah	C_{10h} Ah	C_{20h} Ah	C_{72h} Ah	C_{100h} Ah	C_{120h} Ah	C_{240h} Ah	R_i 1) mΩ	I_k 2) kA	Length (L) mm	Width (W) mm	Height (H) mm	Weight kg
U_e V/cell	1.67	1.80	1.80	1.80	1.80	1.80	1.80						
2 PVV 140	71	121	134	153	157	158	165	1.65	1.30	105	208	420	12.4
3 PVV 210	107	182	202	229	236	238	247	1.15	1.86	105	208	420	17.1
4 PVV 280	143	243	268	306	314	318	331	0.89	2.40	105	208	420	19.4
5 PVV 350	179	304	336	383	393	397	412	0.73	2.91	126	208	420	23.3
6 PVV 420	215	364	404	460	472	477	496	0.63	3.39	147	208	420	27.4
5 PVV 550	254	447	506	570	583	589	609	0.68	3.14	126	208	535	31.4
6 PVV 660	302	529	598	671	686	693	715	0.58	3.64	147	208	535	36.9
7 PVV 770	350	610	688	770	788	795	820	0.52	4.12	168	208	535	42.4
6 PVV 900	417	729	834	943	968	978	1,012	0.46	4.63	147	208	710	49.5
7 PVV 1050	492	858	980	1,116	1,140	1,154	1,195	0.36	5.81	215	193	710	60.4
8 PVV 1200	559	970	1,106	1,252	1,280	1,296	1,344	0.32	6.54	215	193	710	67.3
9 PVV 1350	616	1,090	1,252	1,418	1,450	1,464	1,524	0.34	6.29	215	235	710	75.5
10 PVV 1500	691	1,200	1,382	1,562	1,600	1,620	1,675	0.28	7.50	215	235	710	82.5
11 PVV 1650	748	1,320	1,512	1,713	1,750	1,764	1,836	0.28	7.56	215	277	710	90.8
12 PVV 1800	822	1,440	1,644	1,857	1,900	1,920	1,989	0.24	8.63	215	277	710	97.7
11 PVV 2090	839	1,570	1,772	2,023	2,070	2,088	2,169	0.27	7.86	215	277	855	108.2
12 PVV 2280	927	1,710	1,918	2,181	2,230	2,256	2,337	0.23	9.18	215	277	855	116.5
13 PVV 2470	1,040	1,890	2,120	2,426	2,490	2,508	2,592	0.18	11.91	215	400	815	131.4
14 PVV 2660	1,125	2,070	2,320	2,678	2,740	2,772	2,880	0.17	12.63	215	400	815	141.2
15 PVV 2850	1,191	2,170	2,420	2,772	2,840	2,868	2,976	0.16	13.25	215	400	815	147.9
16 PVV 3040	1,265	2,300	2,580	2,937	3,000	3,036	3,144	0.15	13.94	215	400	815	156.2
17 PVV 3230	1,358	2,480	2,780	3,182	3,260	3,300	3,408	0.14	15.32	215	490	815	173.6
18 PVV 3420	1,433	2,610	2,920	3,348	3,420	3,468	3,576	0.13	16.03	215	490	815	181.4
19 PVV 3610	1,507	2,740	3,080	3,506	3,590	3,624	3,744	0.12	16.70	215	490	815	189.6
20 PVV 3800	1,581	2,870	3,220	3,664	3,750	3,792	3,912	0.12	17.37	215	490	815	197.8
22 PVV 4180	1,740	3,210	3,600	4,118	4,220	4,272	4,416	0.11	18.43	215	580	815	219.1
24 PVV 4560	1,887	3,470	3,900	4,442	4,550	4,596	4,752	0.10	19.76	215	580	815	235.4
26 PVV 4940	2,014	3,650	4,060	4,608	4,710	4,764	4,920	0.10	21.02	215	580	815	248.4

1, 2) Internal resistance R_i and short circuit current I_k according to IEC 60896-21

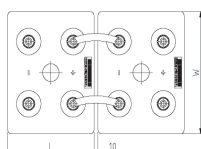
Height (H) is the maximum height between container bottom and top of the bolts in assembled condition.

All values published in the table correspond to 100 % discharge of current depending capacity without voltage drop of connectors. Please consider item 7.

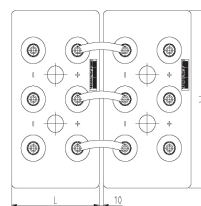
3. Terminal positions



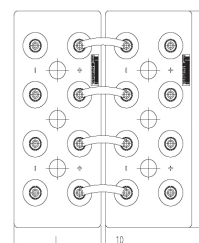
2 PVV 140 to 6 PVV 900



7 PVV 1050 to 12 PVV 2280



13 PVV 2470 to 16 PVV 3040



17 PVV 3230 to 26 PVV 4940

Terminals are designed as female poles with brass inlay M10 for flexible insulated copper cables with cross-section 25, 35, 50, 70, 95 or 120 mm² or insulated solid copper connectors with cross-section 90, 150 or 300 mm².

Technical Specification for BAE SECURA PVV SOLAR



4. Design

Positive electrode

Tubular-plate with woven polyester gauntlet and solid grids in a corrosion-resistant PbCaSn-alloy

Negative electrode

Grid-plate in PbCaSn-alloy with long-life expander material

Separation

Microporous separator

Electrolyte

Sulphuric acid with a density of 1.24 kg/l (20 °C), fixed as GEL by fumed silica

Container and lid

High impact ABS (Acrylonitrile butadiene styrene), grey coloured (colour may vary slightly from given image), UL-94 rating: HB, on request also in UL-94 rating: V-0

Valve

Valve with flame arrestor, opening pressure approx. 120 mbar

Pole bushing

100 % gas- and electrolyte-tight, sliding, plastic coated "Panzerpol"

Kind of protection

IP 25 regarding EN 60529, touch protected according to BGV A3

Horizontal operation

Please use BAE special type PVV "horizontal".

5. Installation

BAE SECURA PVV SOLAR batteries are designed for indoor applications. For outdoor applications please contact BAE.

6. Maintenance

Every 6 months

Check battery voltage, pilot cell voltages and temperatures

Every 12 months

Check connections, record battery voltage, cell voltages and temperatures

7. Operational data

Depth of discharge (DOD)

Max. 80 % ($U_e = 1.91$ V/cell for discharge times >10 h; 1.74 V/cell for 1 h), deep discharges of more than 80 % DOD have to be avoided
Unlimited, the minimal charge current has to be 1.5 A/100 Ah C₁₀

Initial charge current

(I or bulk phase)

Charge voltage at cyclic operation

Restricted from 2.30 V to 2.40 V per cell, operating instruction is to be observed
2.25 V/cell

Float voltage/non cyclic operation

Adjustment of charge voltage

No adjustment necessary if battery temperature is kept between 10 °C and 45 °C (50 °F and 113 °F) in the monthly average, $\Delta U/\Delta T = -0.003$ V/cell per K below 10 °C (50 °F)

Recharge to 100 %

Within a period of 1 up to 4 weeks

Battery temperature

-20 °C to 45 °C (-4 °F to 113 °F), recommended temperature range 10 °C to 30 °C (50 °F to 86 °F)

Self-discharge

Approx. 2 % per month at 20 °C (68 °F)

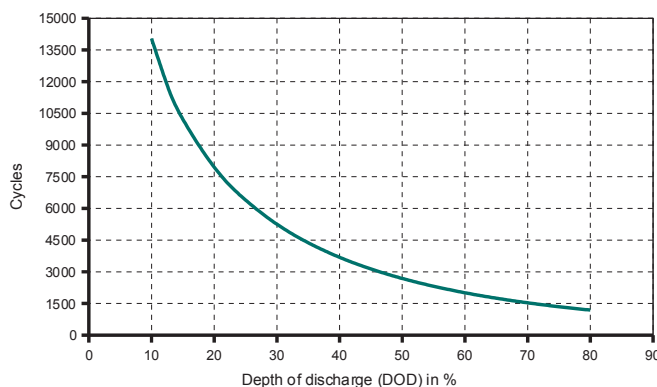
IEC 61427 cycles

>3,000 (A+B) at 40 °C (104 °F)

IEC 60896-21 cycles

>1,500 at 20 °C (68 °F)

8. Number of cycles as function of Depth of discharge



9. Transport

Batteries are not subject to ADR (road transport), if the conditions of Special Provisions 598 and 238 (Chapter 3.3) are observed.

BAE cells/batteries are conform to the IMDG-Code, therefore these products are no dangerous goods on sea transport.

10. Standards

Test standards

IEC 60896-21, IEC 61427

Safety standard, ventilation

IEC 62485-2

TYPE APPROVAL CERTIFICATE**DNV·GL**

This is to certify that the undernoted product(s) has/have been tested in accordance with the relevant requirements of the DNV GL Type Approval System.

Certificate No. **20 222 - 04 HH**

Company **BAE Batterien GmbH**

**Wilhelminenhofstraße 69
12459 Berlin, GERMANY**

Product Description **Lead Acid Accumulators, System "BAE SECURA OPzV" Block batteries / cells
Lead Acid Accumulators, System "BAE SECURA PVV solar" Block batteries / cells**

Type **OPzV in accordance with DIN 40744, 2015-09 / DIN 40742, 2015-09
PVV solar following DIN 40744, 2015-09 / DIN 40742, 2015-09
continued below**

Environmental Category **A**

Technical Data /
Range of Application **Lead Acid accumulators, System "BAE SECURA OPzV"
Cells / Block batteries: 100 Ah (C10) up to 3250 Ah (C10) / 50 Ah (C10) up to
900 Ah (C10)
In accordance with:
DIN 40742: 2015-09
DIN 40744: 2015-09
IEC 60896-21: 2004
IEC 60896-22: 2004
IEC 61427-1: 2013
IEC 61427-2: 2015
IEC 62485-2: 2010
EN 50272-2: 2001
BS 6290-4: 1997
DIN 43539-5: 1984-08**

continued on page 2

Test Standard **DNVGL-RU-0050, 01/2016
DNVGL-CG-0339, 11/2015
DNVGL-RU-SHIP-Pt4, Ch8, 11/2015**

Documents **Test report BAE Secura OPzV of 22.07.2016
Data sheet 4804068 12/2012 and 4804035 12/2012**

**Test report BAE Secura PVV of 05/2010
Data sheet 4805628 06/2016 and 4805578 06/2016**

Remarks **Product(s) approved by this certificate is/are accepted for installation on all
vessels classed by DNV GL.**

Valid until **2021-08-11**

Page **1 of 2**

File No. **I.M.01**

Hamburg, 2016-08-12

Type Approval Symbol



DNV GL

(Signature)
Arne Schaarmann

(Signature)
Maik Gagern

TYPE APPROVAL CERTIFICATE**DNV-GL**

This is to certify that the undernoted product(s) has/have been tested in accordance with the relevant requirements of the DNV GL Type Approval System.

Certificate No. **20 222 - 04 HH**

Technical data / Range of Application (continued from page 1)

Lead Acid Accumulators, System "BAE SECURA PVV solar"

Cells / Block batteries: 140 (C100) up to 4940 Ah (C100) / 70 up to 420 Ah (C100)

In accordance with:

IEC 60896-21: 2004

IEC 60896-22: 2004

IEC 61427: 2002-04

IEC 62485-2: 2010-06

EN 50272-2: 2001

BS 6290-4: 1997

DIN 43539-5: 1984-08

Following:

DIN 40742: 2015-09

DIN 40744: 2015-09

General application notes:

Valve Regulated Lead Acid accumulators (VRLA) with gelled electrolyte.

The single cells or block batteries can be combined to batteries with the desired voltage.

Application: In particular the batteries are suitable to supply stationary electrical installations and for storage of renewable solar energy. At sufficient capacity also suitable for electrical starting of combustion engines occasional.

For charging conditions manufacturer's instruction shall be considered.

Periodical assessment

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

The main elements of the survey are:

- **Inspection on factory samples, selected at random from the production line**
 - **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.**
- Survey to be performed at least every second year.**

Valid until **2021-08-11**

Page **2 of 2**

File No. **I.M.01**

Hamburg, 2016-08-12

Type Approval Symbol



DNV GL

i.A.

Arne Schaefermann

i.A. Maik Gagern

TEST REPORT

BAE *SECURA OPzV*

STATIONARY VALVE REGULATED LEAD-ACID CELLS AND BATTERIES
WITH POSITIVE TUBULAR PLATE

OPzV block batteries and cells according to DIN EN 40744 and DIN 40742



BAE Batterien GmbH, Wilhelminenhofstraße 69/70, D-12459 BERLIN

Phone: +49 30 / 5 30 01 - 661

Fax: +49 30 / 5 30 01 - 667

Table of contents:

	page
Test: Capacity test (block batteries).....	3
Test: Internal resistance and short circuit current (block batteries).....	5
Test: Charge retention (block batteries)	7
Test: Capacity test (50 Ah plate)	9
Test: Capacity test (70 Ah plate)	11
Test: Capacity test (100 Ah plate)	13
Test: Capacity test (125 Ah plate)	15
Test: Internal resistance and short circuit current (50 Ah plate)	17
Test: Internal resistance and short circuit current (70 Ah plate)	18
Test: Internal resistance and short circuit current (100 Ah plate)	19
Test: Internal resistance and short circuit current (125 Ah plate)	20
Test: Suitability for floating battery operation (cells)	21
Test: Endurance in cycles (cells).....	23
Test: Endurance in cycles (cells / German Railways).....	25
Test: Charge retention (cells).....	27
Test: Vibration (sinusoidal), bump (endurance in impacts), cells	29
Test: Vibration (sinusoidal), bump (endurance in impacts), block batteries ...	34
Test: Temperature dependency of the capacity (block batteries)	37
Test: Stability against cyclic over-discharge.....	40
Test: Stability of OPzV batteries against deep discharges	41
Test: Mechanical abuse test.....	44
Test: Low temperature service	47
Test: Test for gas emissions (block batteries)	49
Test: Test for gas emissions (cells)	52
Test: Tightness test	55
Test: Opening and closing pressure of the valve	57
Test: Material tests.....	59
Test: Ventilation test.....	60
Test: Spark test	61
Annex A	62

Type test of OPzV block batteries according to IEC 60896-21

Product group: Valve regulated lead acid batteries
Stationary block batteries with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Test: **Capacity test (block batteries)**

Test, chapter: Capacity test, IEC 60896-21, Chapter 6.11

Test laboratory: BAE Batterien GmbH

Test performance:

Capacity tests are carried out for time ranges given by IEC 60896-21 Chapter 6.11.10:

10 h, 5 h, 3 h, 1 h, $\frac{1}{2}$ h

Tubular plate size: OPzV 50 Ah

Test data: Test subject: 12V 2 OPzV 100

Capacity test	C ₁₀ discharge	C ₅ discharge	C ₃ discharge	C ₁ discharge
Discharge current ¹	10 A	17 A	25.3 A	53 A
Final voltage ¹	1.80 V	1.77 V	1.75 V	1.67 V
Nominal capacity ²	100 Ah	85 Ah	76 Ah	53 Ah
Measured capacity	111.6 Ah = 112 %	102.5 Ah = 121 %	93.3 Ah = 123 %	78.4 Ah = 148 %

Test temperature: 20 °C (mean value)

Summary of test results:

In all capacity tests the nominal capacity was exceeded. The measured C₁₀ capacity was in excess of the nominal capacity.

¹ The discharge current and the final voltage per cell are given by DIN EN 40 744.

² The calculation based on a multiplication of discharge time and discharge current.

Type test of OPzV block batteries according to IEC 60896-21

Exemplarily measurement curves are shown at page 4 (from Figure 1).

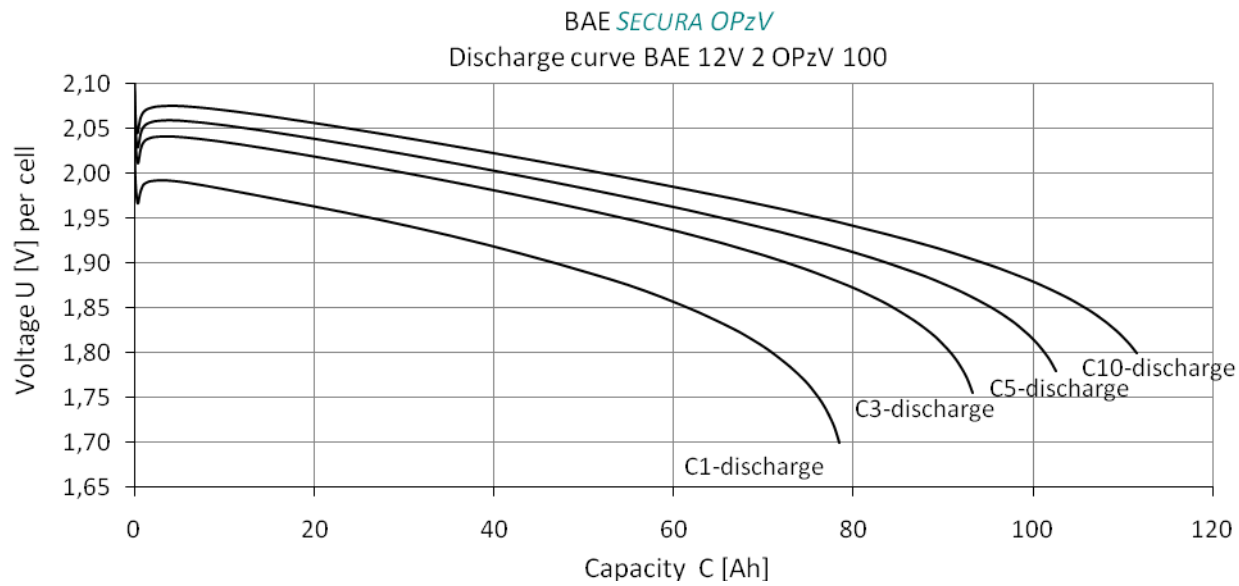


Figure 1 – Capacity test (example BAE block 12V 2 OPzV 100).

Type test of OPzV block batteries according to IEC 60896-21

Product group:	Valve regulated lead acid batteries Stationary block batteries with positive tubular plates BAE SECURA OPzV
Type designation:	12V 1 OPzV 50 - 12V 3 OPzV 150 6V 4 OPzV 200 - 6V 6 OPzV 300 2V 4 OPzV 600 - 2V 6 OPzV 900
Test:	Internal resistance and short circuit current (block batteries)
Test, chapter:	Test for short circuit current and internal resistance, IEC 60896-21 Chapter 6.3
Test laboratory:	BAE Batterien GmbH
Test temperature:	20 °C (mean value)

Test performance:

The test carried out on three 12V 2 OPzV 100 is in accordance with the above standard. This means the internal resistance and the short circuit current can be calculated from the current-voltage relationship given by two points in a discharge curve. The first point is obtained after 20 sec of discharge at a current $I_{\text{point}_1} = 4 I_{C10} \dots 6 I_{C10}$ (at this example the discharge current was 50 A), the voltage and the current shall be recorded. The discharge should be interrupted for 25 sec without recharge. After an open circuit stand of 2 min to 5 min, the second point can be determined. After 5 sec of discharge at the current of $I_{\text{point}_2} = 20 I_{C10} \dots 40 I_{C10}$ (at this example the discharge current was 350 A), voltage and the current shall be recorded.

The figures can be calculated from the following equations (see Figure 2 at page 6):

$$I_{sc} = \frac{U_1 I_2 - U_2 I_1}{U_1 - U_2} \quad [\text{A}] \quad [1]$$

$$R_i = \frac{U_1 - U_2}{I_2 - I_1} \quad [\Omega] \quad [2]$$

Results:

These are the results for the internal resistance [1] and short circuit current [2] for the positive tubular plate OPzV 50 Ah:

Internal resistance: $R_i = 4 \text{ m}\Omega$ per plate, per cell

Short circuit current: $I_{sc} = 520 \text{ A}$

Electrical test field OPzV/e Status: JULY-2016	Page 5 of 62	Research and Development
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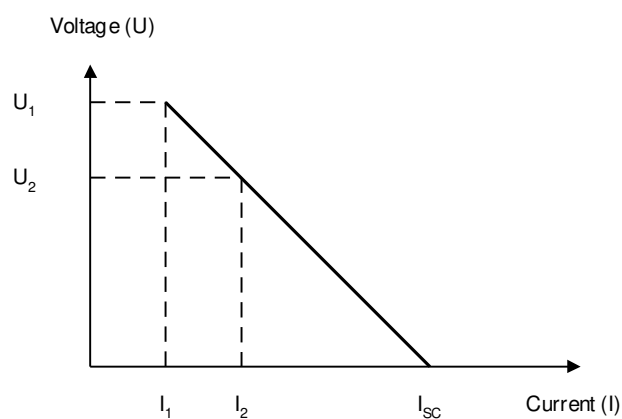


Figure 2 – Discharge characteristic $U = f(I)$.

Product group:	Valve regulated lead acid batteries Stationary block batteries with positive tubular plates BAE SECURA OPzV
Type designation:	12V 1 OPzV 50 - 12V 3 OPzV 150 6V 4 OPzV 200 - 6V 6 OPzV 300 2V 4 OPzV 600 - 2V 6 OPzV 900
Test:	Charge retention (block batteries)
Test, chapter:	IEC 60896-21 Chapter 6.12
Test laboratory:	BAE Batterien GmbH
Test temperature:	20 °C (mean value)
Test performance:	

The test carried out on two block batteries 12V 2 OPzV 100 is in accordance with the above standard. The block batteries were stored with open circuit for a period of 3 months. Before and after the test the capacity was measured (C₁₀ discharge). The mean test temperature was 20 °C.

Results:

The measured capacity after 3 months storage was 95.08% of the capacity at the beginning of the test. This corresponds to a self-discharge rate of 1.64% per month. This is clearly well below the stated value of 3% per month.

An example of the measurement is shown at page 8 (Figure 3).

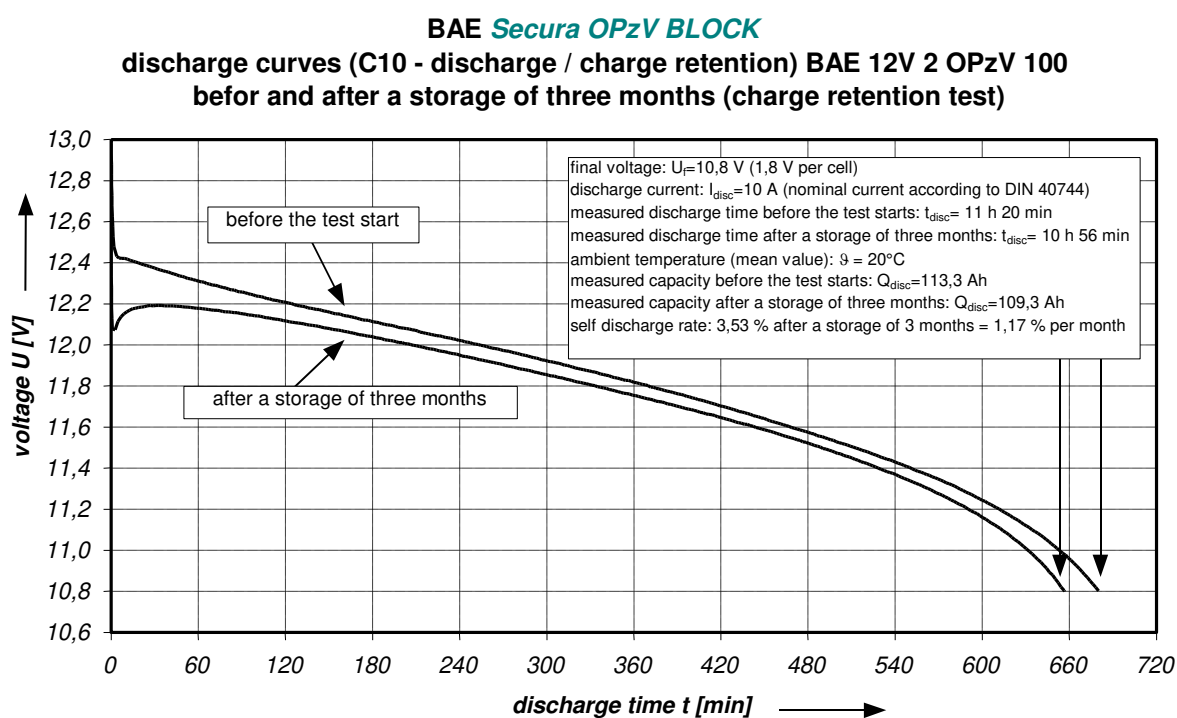


Figure 3 – Test of charge retention (self-discharge) on BAE 12V 2 OPzV 100 block battery.

Product group: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 2 OPzV 100 - 6 OPzV 300

Test: **Capacity test (50 Ah plate)**

Test, chapter: Capacity test, IEC 60896-21, Chapter 6.11

Test laboratory: BAE Batterien GmbH

Test performance:

Capacity tests are carried out for time ranges given by IEC 60896-21 Chapter 6.11.10:

10 h, 5 h, 3 h, 1 h, $\frac{1}{2}$ h

Tubular plate size: OPzV 50 Ah

Test data: Test subject: 6 cells 5 OPzV 250

Capacity test	C ₁₀ discharge	C ₅ discharge	C ₃ discharge	C ₁ discharge
Discharge current ³	25 A	43 A	62.67 A	133 A
Final voltage ³	1.80 V	1.77 V	1.75 V	1.67 V
Nominal capacity ⁴	250 Ah	215 Ah	188 Ah	133 Ah
Measured capacity	295.1 Ah = 118 %	260.8 Ah = 121 %	231.5 Ah = 123 %	181.3 Ah = 136 %

Test temperature: 20 °C (mean value)

Summary of test results:

In all capacity tests the nominal capacity was exceeded. The measured C₁₀-capacity was in excess of the nominal capacity.

Exemplarily measurement curves are shown at page 10 (Figure 4).

³ The discharge current and the final voltage per cell are given by DIN EN 40 742 chapter 4.

⁴ The calculation bases on a multiplication of discharge time and discharge current.

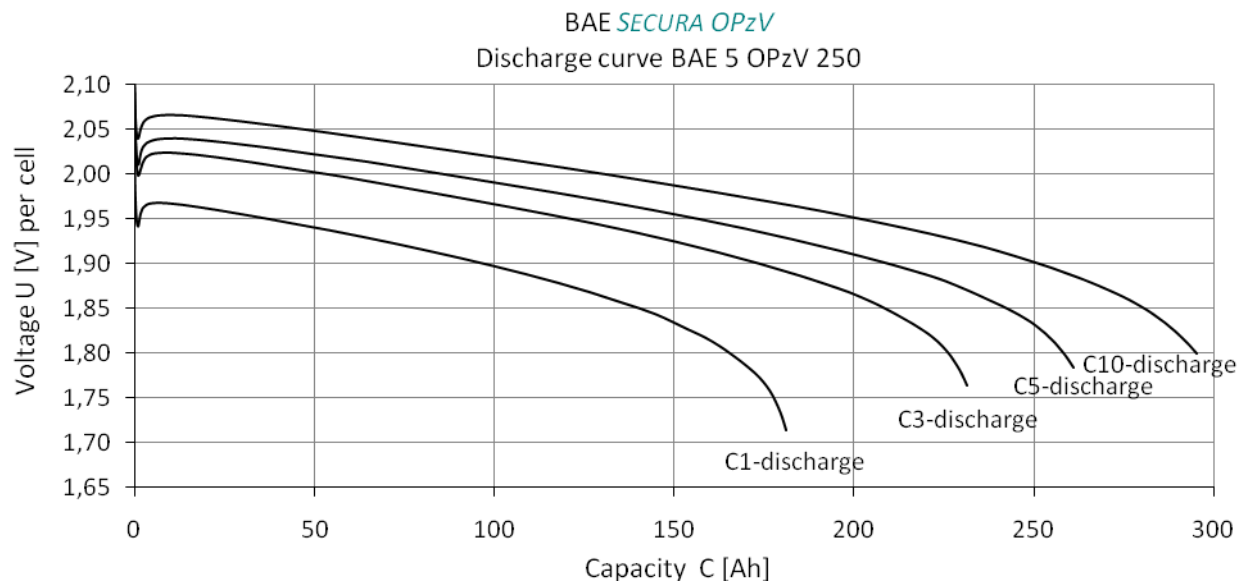


Figure 4 – Capacity test OPzV 50 plate (example BAE cells 5 OPzV 250).

Product group: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 5 OPzV 350 - 7 OPzV 490

Test: **Capacity test (70 Ah plate)**

Test, chapter: Capacity test, IEC 60896-21, Chapter 6.11

Test laboratory: BAE Batterien GmbH

Test performance:

Capacity tests are carried out for time ranges given by IEC 60896-21 Chapter 6.11.10:

10 h, 5 h, 3 h, 1 h, $\frac{1}{2}$ h

Tubular plate size: OPzV 70 Ah

Test data: Test subject: 6 cells 7 OPzV 490

Capacity test	C ₁₀ discharge	C ₅ discharge	C ₃ discharge	C ₁ discharge
Discharge current ³	49 A	84 A	122.67 A	259 A
Final voltage ³	1.80 V	1.77 V	1.75 V	1.67 V
Nominal capacity ⁴	490 Ah	420 Ah	368 Ah	259 Ah
Measured capacity	624.3 Ah = 127 %	554.1 Ah = 132 %	488.7 Ah = 133 %	379.5 Ah = 147 %

Test temperature: 20 °C (mean value)

Summary of test results:

In all capacity tests the nominal capacity was exceeded. The measured C₁₀-capacity was in excess of the nominal capacity.

Exemplarily measurement curves are shown at page 12 (Figure 5).

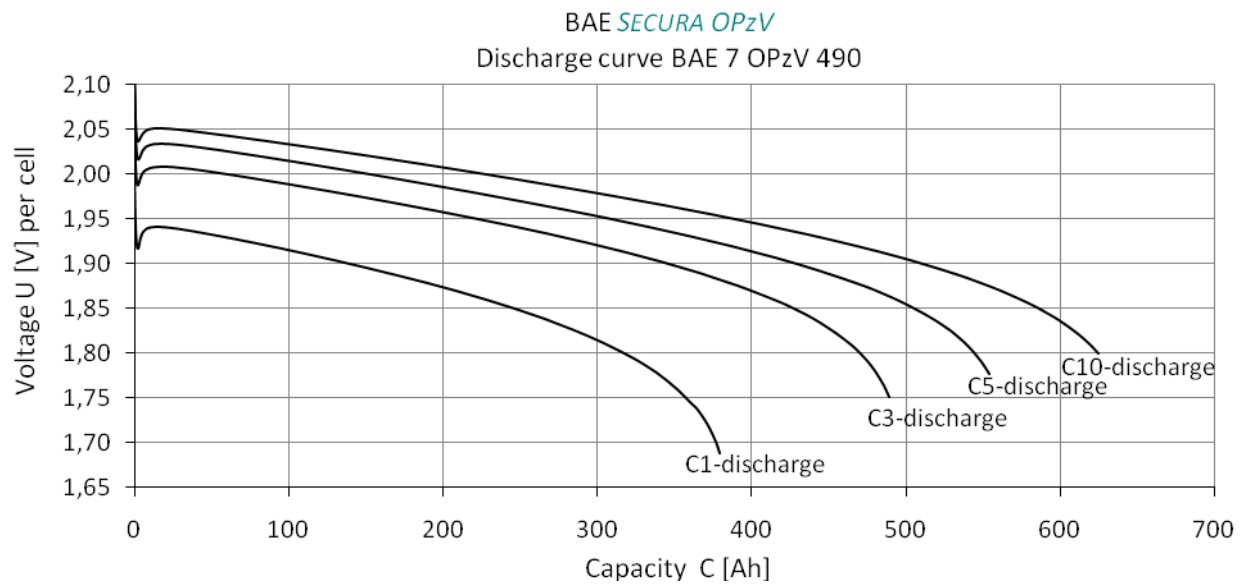


Figure 5 – Capacity test OPzV 70 plate (example BAE cells 7 OPzV 490).

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 6 OPzV 600 - 12 OPzV 1200

Test: **Capacity test (100 Ah plate)**

Test, chapter: Capacity test, IEC 60896-21, Chapter 6.11

Test laboratory: BAE Batterien GmbH

Test performance:

Capacity tests are carried out for time ranges given by IEC 60896-21 Chapter 6.11.10:

10 h, 5 h, 3 h, 1 h, $\frac{1}{2}$ h

Tubular plate size: OPzV 100 Ah

Test data: Test subject: 6 cells 6 OPzV 600

Capacity test	C ₁₀ discharge	C ₅ discharge	C ₃ discharge	C ₁ discharge
Discharge current ³	60 A	103.2 A	150 A	312 A
Final voltage ³	1.80 V	1.77 V	1.75 V	1.67 V
Nominal capacity ⁴	600 Ah	516 Ah	450 Ah	312 Ah
Measured capacity	727.9 Ah = 121 %	642.7 Ah = 125 %	578.0 Ah = 128 %	432.3 Ah = 139 %

Test temperature: 20 °C (mean value)

Summary of test results:

In all capacity tests the nominal capacity was exceeded. The measured C₁₀-capacity was in excess of the nominal capacity.

Exemplarily measurement curves are shown at page 14 (Figure 6).

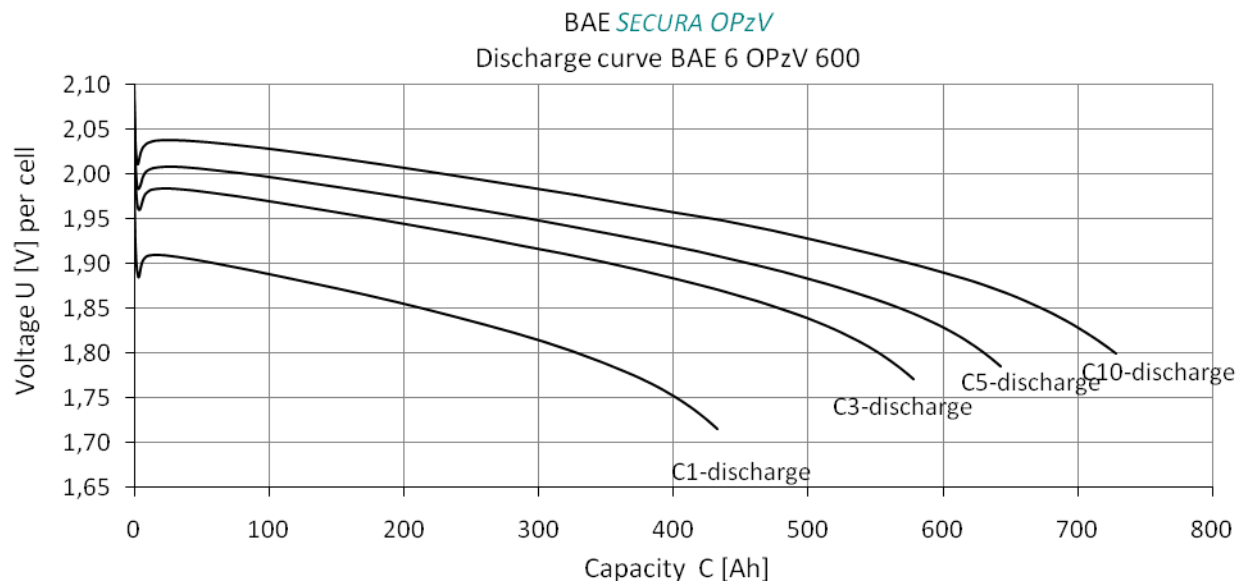


Figure 6 – Capacity test OPzV 100 plate (example BAE cells 6 OPzV 600).

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12 OPzV 1500 - 26 OPzV 3250

Test: **Capacity test (125 Ah plate)**

Test, chapter: Capacity test, IEC 60896-21, Chapter 6.11

Test laboratory: BAE Batterien GmbH

Test performance:

Capacity tests are carried out for time ranges given by IEC 60896-21 Chapter 6.11.10:

10 h, 5 h, 3 h, 1 h, $\frac{1}{2}$ h

Tubular plate size: OPzV 125 Ah

Test data: Test subject: 6 cells 12 OPzV 1500

Capacity test	C ₁₀ discharge	C ₅ discharge	C ₃ discharge	C ₁ discharge
Discharge current ³	150 A	252 A	372 A	744 A
Final voltage ³	1.80 V	1.77 V	1.75 V	1.67 V
Nominal capacity ⁴	1500 Ah	1260 Ah	1116 Ah	1067.4 Ah
Measured capacity	1682.3 Ah = 112 %	1539.0 Ah = 122 %	1387.6 Ah = 124 %	1067.4 Ah = 143 %

Test temperature: 20 °C (mean value)

Summary of test results:

In all capacity tests the nominal capacity was exceeded. The measured C₁₀-capacity was in excess of the nominal capacity.

Exemplarily measurement curves are shown at page 16 (Figure 7).

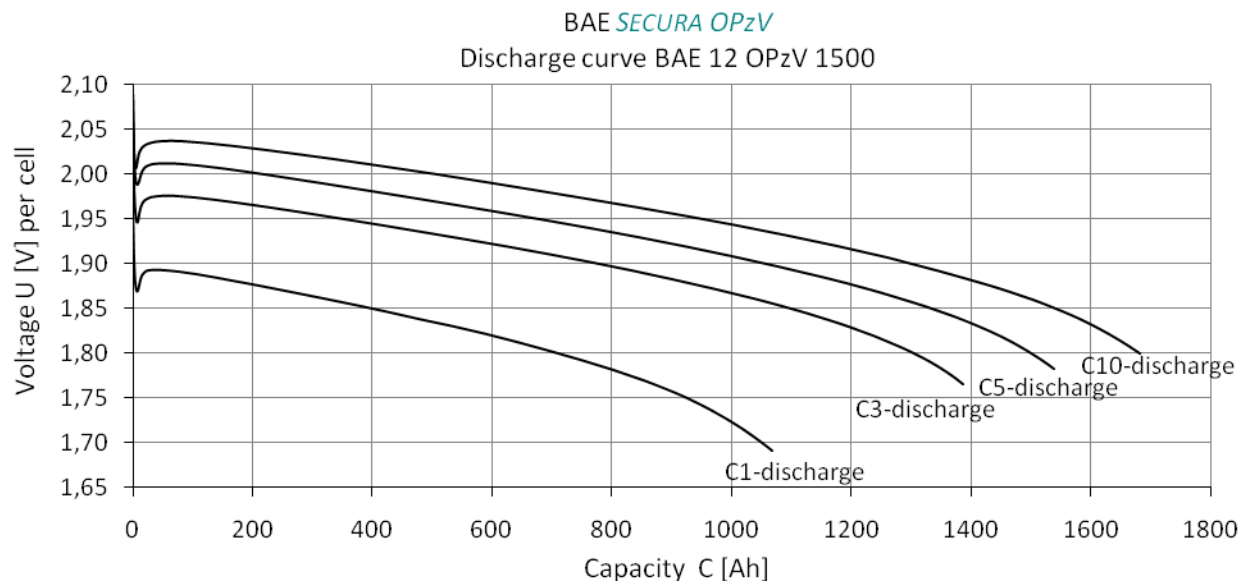


Figure 7 – Capacity test OPzV 125 plate (example BAE cells 12 OPzV 1500).

Product range:	Valve regulated lead acid batteries Stationary cells with positive tubular plates BAE SECURA OPzV
Type designation:	2 OPzV 100 - 6 OPzV 300
Test:	Internal resistance and short circuit current (50 Ah plate)
Test, chapter:	Test for short circuit current and internal resistance, IEC 60896-21 Chapter 6.3
Test laboratory:	BAE Batterien GmbH
Test temperature:	20 °C (mean value)

Test performance:

The test carried out on 6 units 6 OPzV 300 is in accordance with the above standard. This means the internal resistance and the short circuit current can be calculated from the current-voltage relationship given by two points in a discharge curve. The first point is obtained after 20 sec of discharge at a current $I_{\text{point}_1} = 4 I_{C10} \dots 6 I_{C10}$ (at this example the discharge current was 150 A), the voltage and the current shall be recorded. The discharge should be interrupted for 25 sec without recharge. After an open circuit stand of 2 min to 5 min, the second point can be determined.

After 5 sec of discharge at the current of $I_{\text{point}_2} = 20 I_{C10} \dots 40 I_{C10}$ (at this example the discharge current was 900 A), the voltage and the current shall be recorded.

The figures can be calculated from the equations [1] and [2] at page 5.

Results:

These are the results for the internal resistance [1] and short circuit current [2] for the positive tubular plate OPzV 50 Ah:

Internal resistance: $R_i = 4.8 \text{ m}\Omega$ per plate

Short circuit current: $I_{sc} = 430 \text{ A}$ per plate

Product range:	Valve regulated lead acid batteries Stationary cells with positive tubular plates BAE SECURA OPzV
Type designation:	5 OPzV 350 - 7 OPzV 490
Test:	Internal resistance and short circuit current (70 Ah plate)
Test, chapter:	Test for short circuit current and internal resistance, IEC 60896-21 Chapter 6.3
Test laboratory:	BAE Batterien GmbH
Test temperature:	20 °C (mean value)

Test performance:

The test carried out on 6 units 6 OPzV 420 is in accordance with the above standard. This means the internal resistance and the short circuit current can be calculated from the current-voltage relationship given by two points in a discharge curve. The first point is obtained after 20 sec of discharge at a current $I_{\text{point}_1} = 4 I_{C10} \dots 6 I_{C10}$ (at this example the discharge current was 210 A), the voltage and the current shall be recorded. The discharge should be interrupted for 25 sec without recharge. After an open circuit stand of 2 min to 5 min, the second point can be determined.

After 5 sec of discharge at the current of $I_{\text{point}_2} = 20 I_{C10} \dots 40 I_{C10}$ (at this example the discharge current was 1260 A), the voltage and the current shall be recorded.

The figures can be calculated from the equations [1] and [2] at page 5.

Results:

These are the results for the internal resistance [1] and short circuit current [2] for the positive tubular plate OPzV 70 Ah:

Internal resistance:	$R_i = 3.57 \text{ m}\Omega \text{ per plate}$
Short circuit current:	$I_{sc} = 577 \text{ A per plate}$

Product range:	Valve regulated lead acid batteries Stationary cells with positive tubular plates BAE SECURA OPzV
Type designation:	6 OPzV 600 - 12 OPzV 1200
Test:	Internal resistance and short circuit current (100 Ah plate)
Test, chapter:	Test for short circuit current and internal resistance, IEC 60896-21 Chapter 6.3
Test laboratory:	BAE Batterien GmbH
Test temperature:	20 °C (mean value)

Test performance:

The test carried out on 6 units 6 OPzV 600 is in accordance with the above standard. This means the internal resistance and the short circuit current can be calculated from the current-voltage relationship given by two points in a discharge curve. The first point is obtained after 20 sec of discharge at a current $I_{\text{point}_1} = 4 I_{C10} \dots 6 I_{C10}$ (at this example the discharge current was 350 A), the voltage and the current shall be recorded. The discharge should be interrupted for 25 sec without recharge. After an open circuit stand of 2 min to 5 min, the second point can be determined.

After 5 sec of discharge at the current of $I_{\text{point}_2} = 20 I_{C10} \dots 40 I_{C10}$ (at this example the discharge current was 1850 A), the voltage and the current shall be recorded.

The figures can be calculated from the equations [1] and [2] at page 5.

Results:

These are the results for the internal resistance [1] and short circuit current [2] for the positive tubular plate 100 Ah:

Internal resistance: $R_i = 2.70 \text{ m}\Omega$ per plate

Short circuit current: $I_{sc} = 763 \text{ A}$ per plate

Product range:	Valve regulated lead acid batteries Stationary cells with positive tubular plates BAE SECURA OPzV
Type designation:	12 OPzV 1500 - 26 OPzV 3250
Test:	Internal resistance and short circuit current (125 Ah plate)
Test, chapter:	Test for short circuit current and internal resistance, IEC 60896-21 Chapter 6.3
Test laboratory:	BAE Batterien GmbH
Test temperature:	20 °C (mean value)

Test performance:

The test carried out on 6 units 12 OPzV 1500 is in accordance with the above standard. This means the internal resistance and the short circuit current can be calculated from the current-voltage relationship given by two points in a discharge curve. The first point is obtained after 20 sec of discharge at a current $I_{\text{point}_1} = 4 I_{C10} \dots 6 I_{C10}$ (at this example the discharge current was 500 A), the voltage and the current shall be recorded. The discharge should be interrupted for 25 sec without recharge. After an open circuit stand of 2 min to 5 min, the second point can be determined.

After 5 sec of discharge at the current of $I_{\text{point}_2} = 20 I_{C10} \dots 40 I_{C10}$ (at this example the discharge current was 3000 A), the voltage and the current shall be recorded.

The figures can be calculated from the equations [1] and [2] at page 5.

Results:

These are the results for the internal resistance [1] and short circuit current [2] for the positive tubular plate 125 Ah:

Internal resistance: $R_i = 2.88 \text{ m}\Omega$ per plate

Short circuit current: $I_{sc} = 715 \text{ A}$ per plate

Suitability for floating battery operation (cells)

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Suitability for floating battery operation (cells)**

Test, chapter: Suitability for floating battery operation
IEC 896 - 2 Chapter 5.2

Test laboratory: BAE Batterien GmbH

Test temperature: 20 °C (mean value)

Test performance:

The test was carried out on 6 units 6 OPzV 300. The cells were tested for their suitability for float charge operation. The cells of the battery were connected to a power supply with a voltage of 13.38 V (2.23 V per cell). The float charge voltage was examined over a test period of 3 and 6 months. A 10 hour discharge (test of the nominal capacity) was carried out as a capacity trial before and after the test.

Results:

The following results were found:

Reference temperature: 20 °C

Voltage per cell (V):

Cell	1	2	3	4	5	6	Mean value
Test start	2.231	2.233	2.234	2.234	2.232	2.233	2.231 ± 0.001
After 3 months	2.235	2.241	2.240	2.234	2.236	2.237	2.230 ± 0.002
After 6 months	2.231	2.231	2.226	2.235	2.228	2.233	2.235 ± 0.005

The maximum difference from mean value given by BAE is +0.2 / -0.01 V.

The measured values demonstrate that the float voltage was distinct less than the limiting values given by the manufacturer.

Capacity test:

Capacity before the examination starts: 377.5 Ah = 125.6% of the nominal capacity.
Measured capacity after float charge over a period of 6 months: 389.5 Ah = 129.8% of the nominal capacity (see Figure 8).

The measured capacity C_{10} before and after float charge was in excess of the nominal capacity.

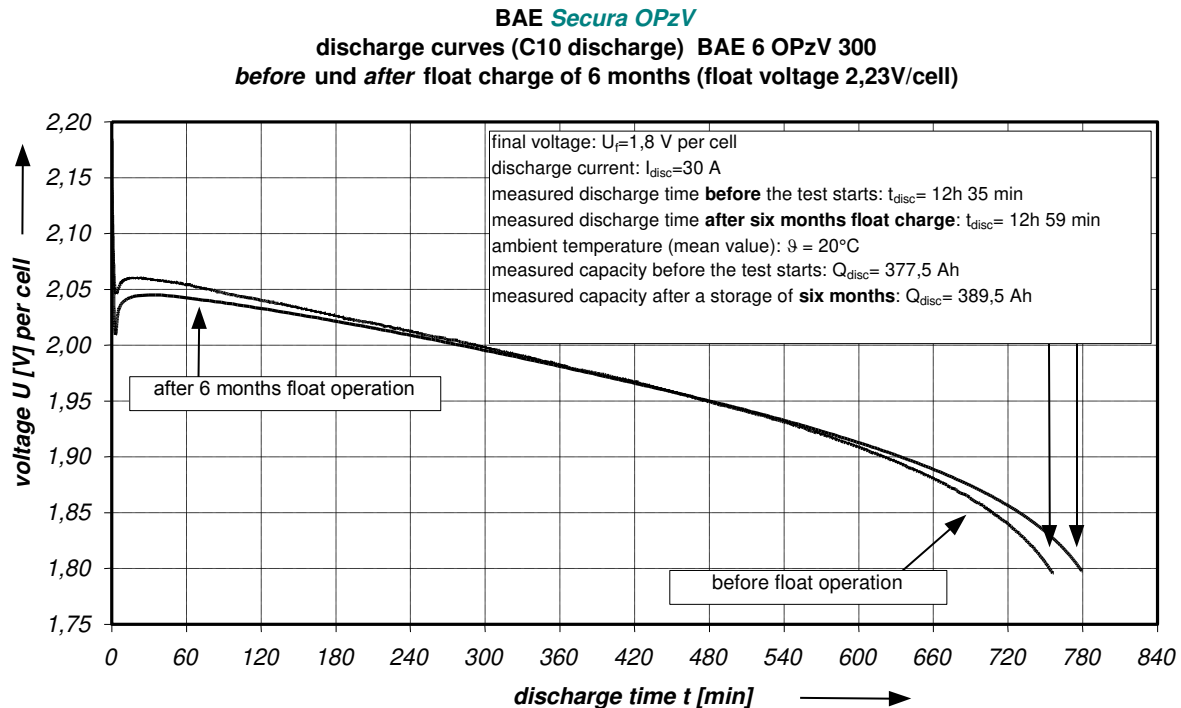


Figure 8 – Capacity test before and after a float charge of 6 months.

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Endurance in cycles (cells)**

Test, chapter: Endurance in cycles, IEC 896 - 2 Chapter 5.3

Test laboratory: BAE Batterien GmbH

Test temperature: 20 °C (mean value)

Test performance:

The test was carried out on 6 units 6 OPzV 420 in accordance with the above standard, i.e. 1 cycle per day. Each cycle comprises a discharge for 3 h at a discharge current of $I = 2.0 I_{C10}$ (84 A) and a charge for 21 h immediately following the discharge. The charge voltage should not extend 2.40 V per cell and the current at the beginning of the charge should be limited to $I_{\max} = 2.0 \times I_{C10}$ (84 A). The cycles should be continued until $C_a = 0.8 C_r$ (80 % of the nominal capacity).

Results:

After 1750 cycles and approx. 6 years under standard conditions (mean ambient temperature of the test field 20 °C) the C_{10} -capacity (measured nominal capacity) was in excess of 80% (80.8% C_{10}).

Capacity development and test measurements for this test are illustrated by Figure 9 (page 24).

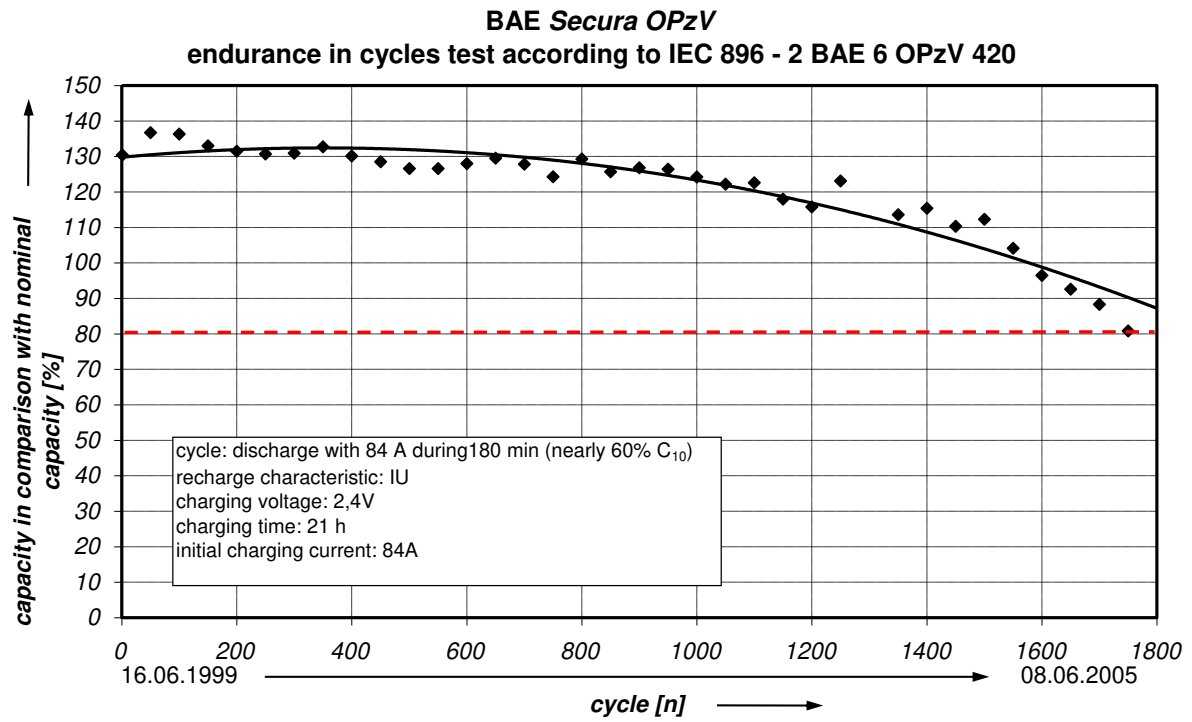


Figure 9 – Endurance in cycles (6 OPzV 420 cells).

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Endurance in cycles (cells / German Railways)**

Test, chapter: Endurance in cycles, demands given by German Railways

Test laboratory: BAE Batterien GmbH

Test temperature: 20 °C (mean value)

Test performance:

The test was carried out on 6 units 6 OPzV 600 in accordance with the demands given by German Railways, i.e. 1 cycle per day. Each cycle comprises a discharge for 144 min at a discharge current of $I = 2.5 I_{C10}$ (150 A) and a charge for **15 h** immediately following the discharge. The charge voltage should not extend 2.40 V per cell and the current at the beginning of the charge should be limited to $I_{max} = 2.0 \times I_{C10}$ (120 A). The cycles should be continued until $C_a = 0.8 C_r$ (80% of the nominal capacity).

Results:

After 2050 cycles and 5½ years under standard conditions (mean ambient temperature of the test field 20 °C) a C_{10} -capacity (measured nominal capacity) has reached the 80% value. This means the end of the test.

Capacity development and test measurements for this test are illustrated in Figure 10 (page 26).

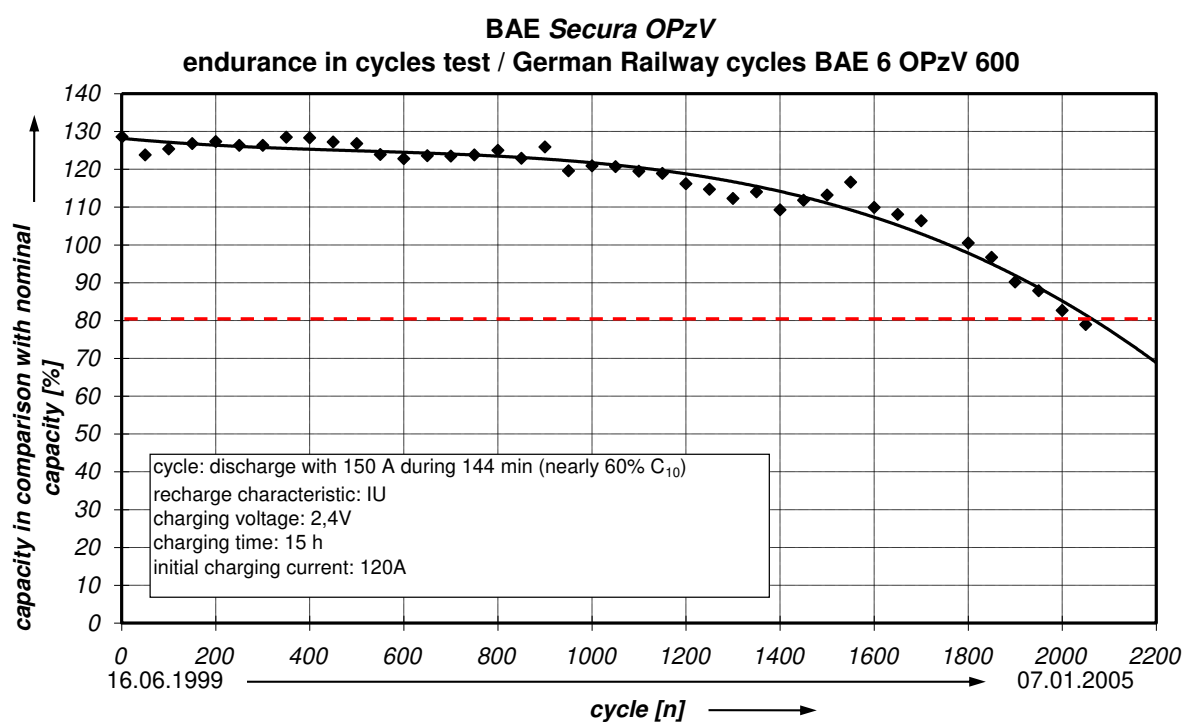


Figure 10 – Endurance in cycles (6 OPzV 600 cells).

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Charge retention (cells)**

Test, chapter: Charge retention, IEC 896 - 2 Chapter 5.4
(Draft: November 1992)

Test laboratory: BAE Batterien GmbH

Test temperature: 20 °C (mean value)

Test performance:

The test was carried out on 6 cells 12 OPzV 1500 in accordance with the above standard. The cells were stored with open circuit for a period of 3 months. Before and after the test the capacity was measured (C₁₀ discharge). The mean test temperature was 20 °C.

Results:

The measured capacity after 3 months of storage was 96.98 % of the capacity at the beginning of the test. This corresponds to a self-discharge rate of 1.04 % per month. This is clearly well below the stated value of 2 % per month. An exemplarily measurement is shown at page 28 (Figure 11).

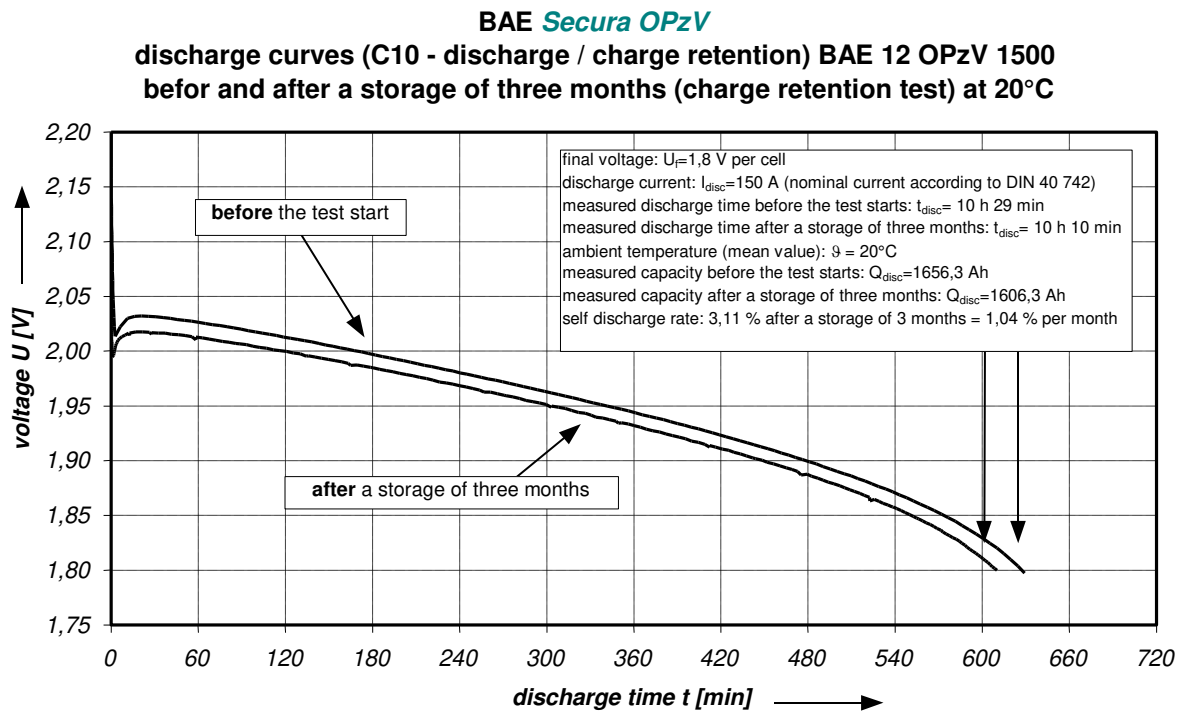


Figure 11 – Test of charge retention (self-discharge) on BAE 12 OPzV 1500 cells.

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Vibration (sinusoidal), bump (endurance in impacts), cells**

Test, chapter: Vibration (sinusoidal),
IEC 60068-2-6 Chapter 5.3.1 and Annex C

Bump (endurance in impacts),
IEC 60068-2-29 Chapter 5.1, 5.2 and Annex A

Test laboratory: AUCOTEAM GmbH Berlin

Test temperature: 20 °C (mean value)

Test performance:

The vibration test was carried out on a 2V 6 OPzV 300 single cell. The test subject was exposed to sinusoidal vibrations:

Frequency	3 Hz - 5 Hz	5 - 300 Hz
Acceleration	10 m/s ² (1 g)	20 m/s ²

Frequency sweeping: 1 octave/min

Number of axes: 3

Duration of the test: 90 min (30 min per axis)

The bump (endurance in impacts) test was carried out on a 2V OPzV 300 single cell. The test subject was exposed to impacts.

Impact form: half sinusoidal

Acceleration: 250 m/s²

Impact duration: 6 ms

Number of axes: 3 (with two directions)

Number of impacts: 6000 (1000 per axis and direction)

Before and after the vibration and bump test the capacity (10 h-discharge) of the test subject should be measured. Before, during and after the vibrations and bump test the example should be examined for fissures, deformations and other mechanical damages.

Electrical test field	Page 29 of 62	Research and Development
OPzV/e Status: JULY-2016		

Results:

After mechanical stress with impacts and vibration no mechanical defects or other changes were detected. The examination for mechanical stability found no reasons for complaints.

The measured capacity, before the vibration test are carried out, was 124.2 % (372.5 Ah compared with nominal capacity of 300 Ah at 10h-discharge). After the mechanical stress with sinusoidal vibrations the measured capacity was at 126.0 % (378.0 Ah).

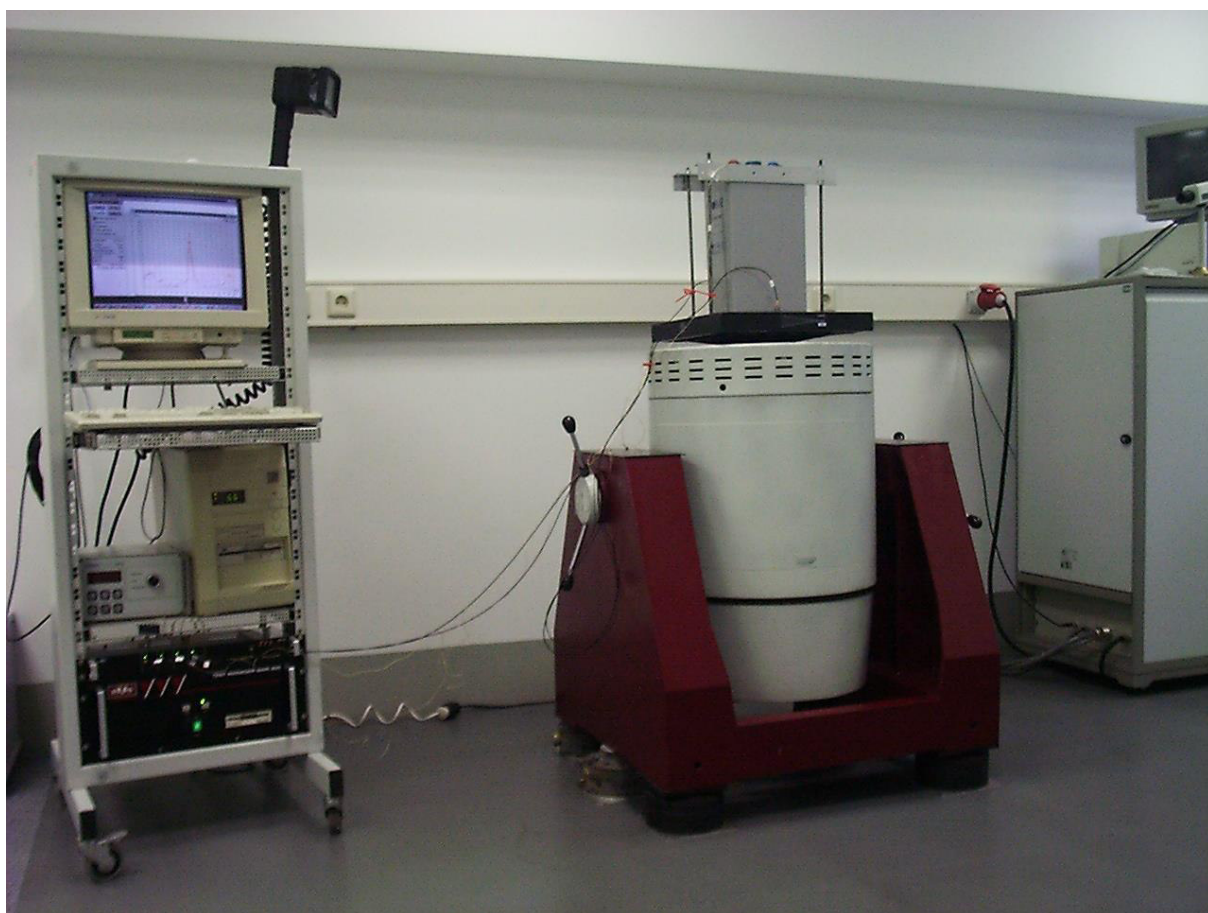


Figure 12 – *Test configuration of OPzV cell for mechanical stress.*

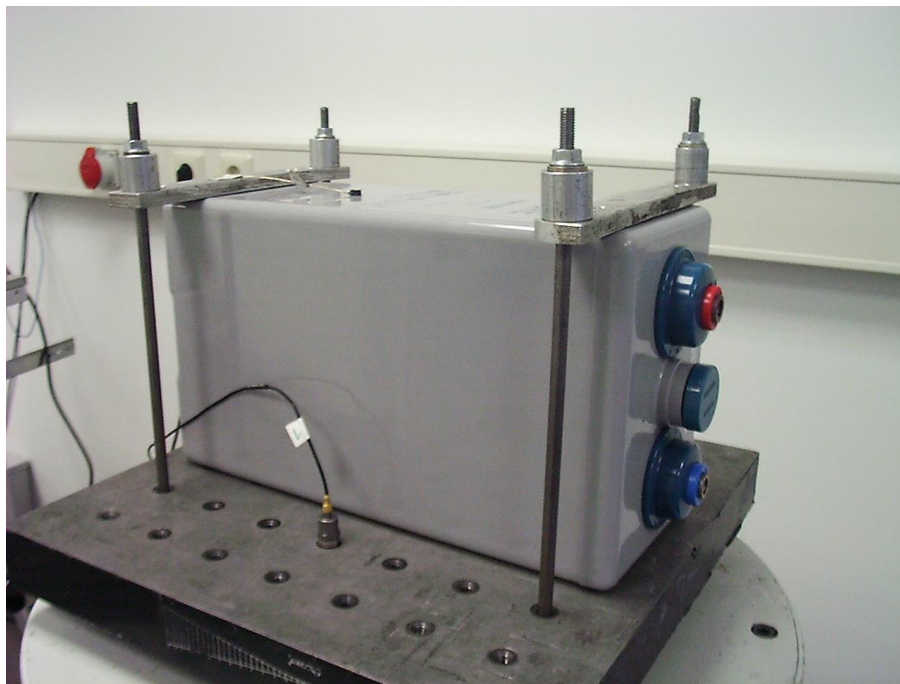


Figure 13 – *Mechanical test on 2 V 6 OPzV 300 – X axis.*



Figure 14 – *Mechanical test on 2 V 6 OPzV 300 – Z axis.*

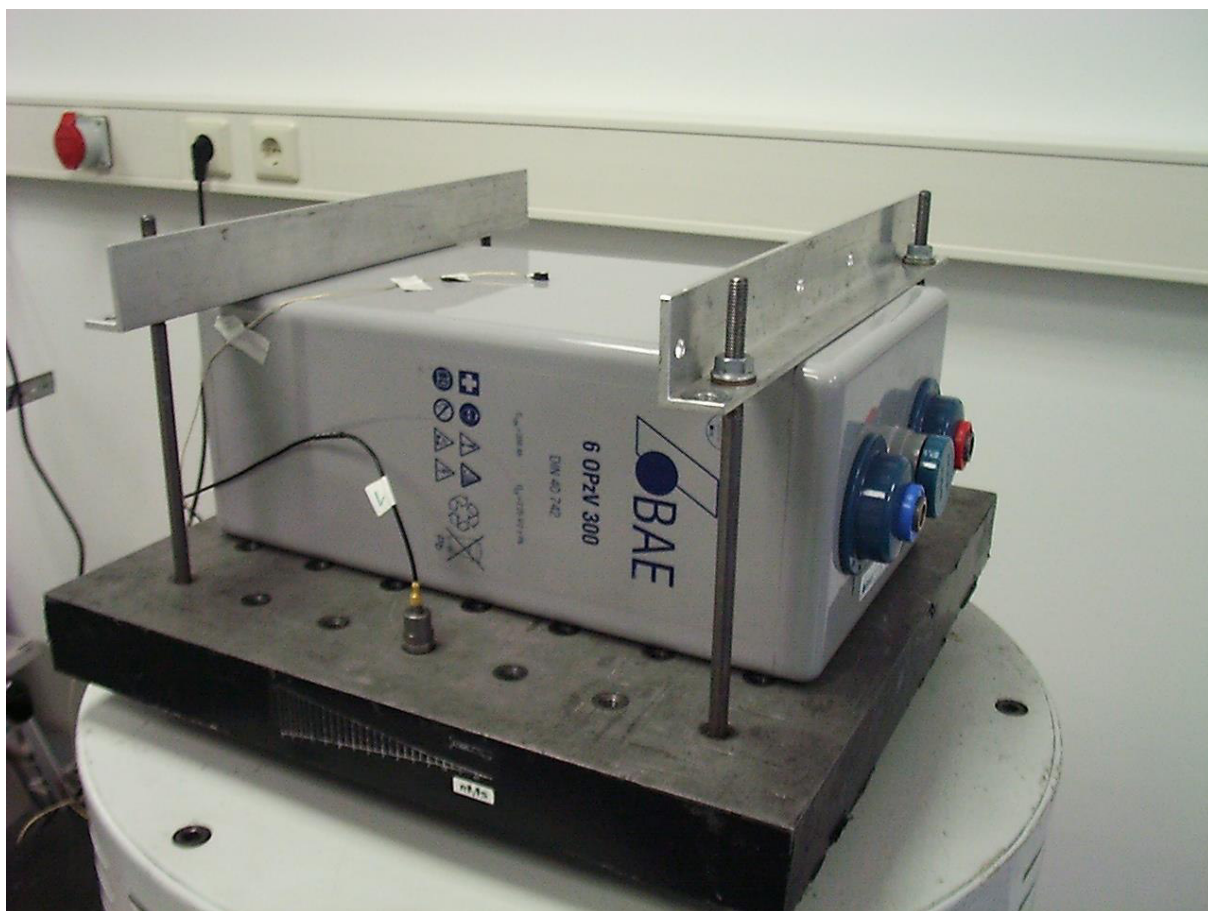


Figure 15 – Mechanical test on 2 V 6 OPzV 300 – Y axis.

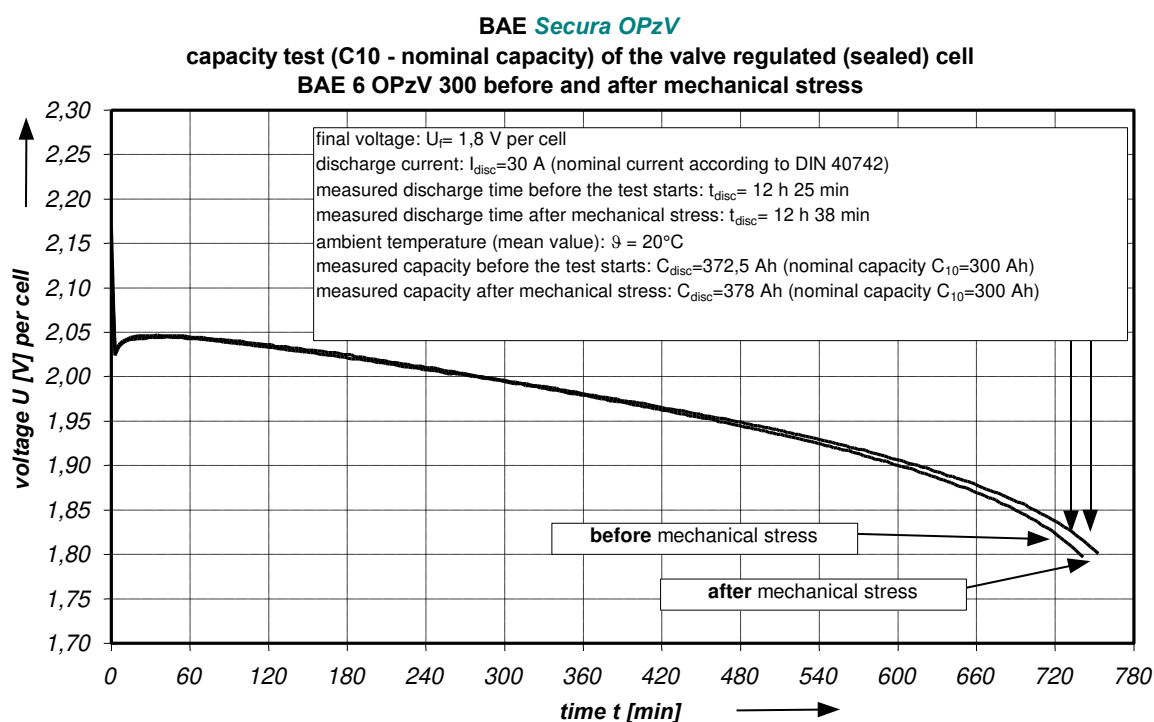


Figure 16 – Capacity of cell before and after mechanical test.

Product range:	Valve regulated lead acid batteries Stationary block batteries with positive tubular plates BAE SECURA OPzV
Type designation:	12V 1 OPzV 50 - 12V 3 OPzV 150 6V 4 OPzV 200 - 6V 6 OPzV 300 2V 4 OPzV 600 - 2V 6 OPzV 900
Test:	Vibration (sinusoidal), bump (endurance in impacts), block batteries
Test, chapter:	Vibration (sinusoidal), IEC 60068-2-6 Chapter 5.3.1 and Annex C Bump (endurance in impacts), IEC 60068-2-29 Chapter 5.1, 5.2 and Annex A
Test laboratory:	AUCOTEAM GmbH Berlin
Test temperature:	20 °C (mean value)

Test performance:

The vibration test was carried out on a 12V 2 OPzV 100 block battery. The test subject was exposed to sinusoidal vibrations:

Frequency	3 Hz - 5 Hz	5 - 300 Hz
Acceleration	10 m/s ² (1 g)	20 m/s ²

Frequency sweeping: 1 octave/min

Number of axes: 1

Duration of the test: 30 min

The bump (endurance in impacts) test was carried out on a 12V 2 OPzV 100 block battery. The test subject was exposed to impacts.

Impact form: half sinusoidal

Acceleration: 250 m/s²

Impact duration: 6 ms

Number of axes: 1 (with two directions)

Number of impacts: 2000 (1000 per axis and direction)

Before and after the vibration and bump test the capacity (10h-discharge) of the test subject should be measured. Before, during and after the vibrations and bump test the example should be examine for fissures, deformations and other mechanical damages.

Electrical test field	Page 34 of 62	Research and Development
OPzV/e Status: JULY-2016		

Results:

After mechanical stress with impacts and vibration no mechanical defects or other changes were detected. The examination for mechanical stability found no reasons for complaints.

The measured capacity, before the vibration tests are carried out, was 100.2 % (105.0 Ah compared with nominal capacity of 100 Ah at 10 h-discharges). After the mechanical stress with sinusoidal vibrations the measured capacity was at 106.2 % (106.2 Ah).

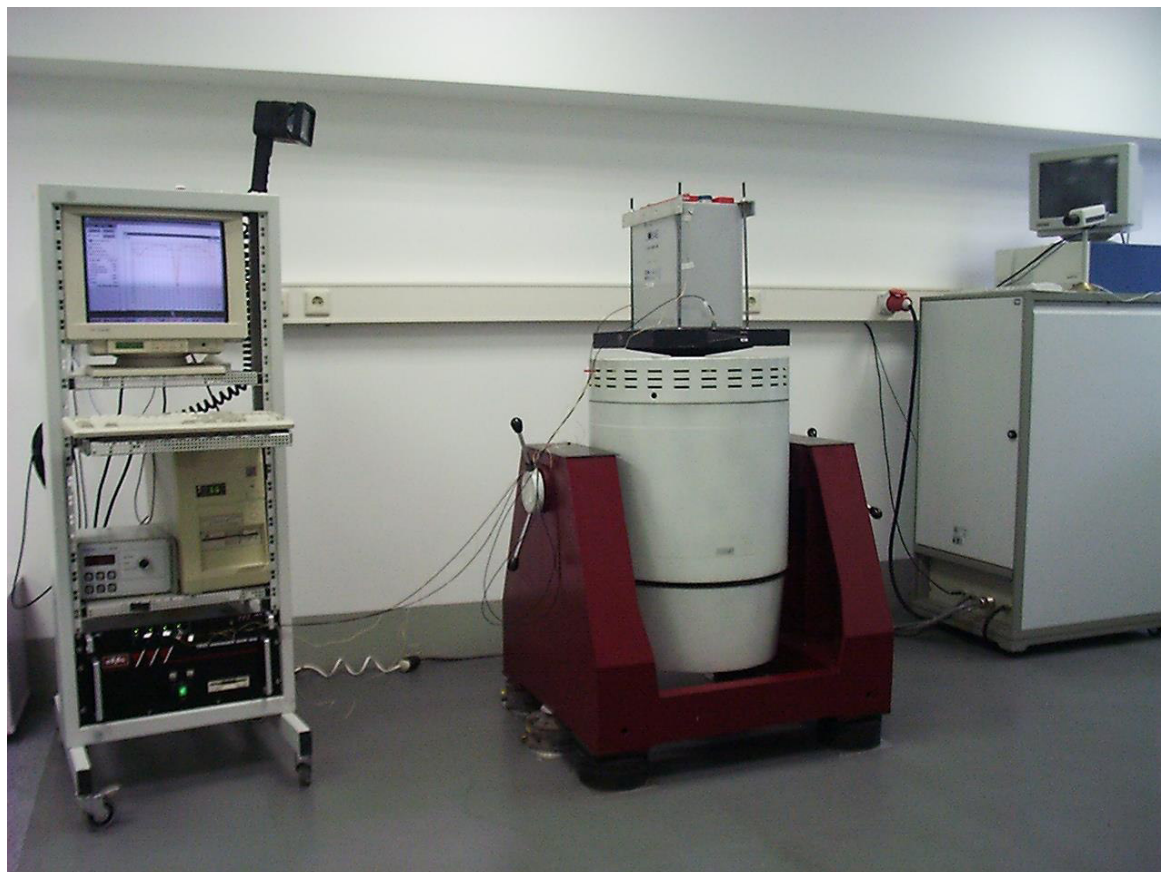


Figure 17 – *Test configuration of OPzV block battery for mechanical stress.*

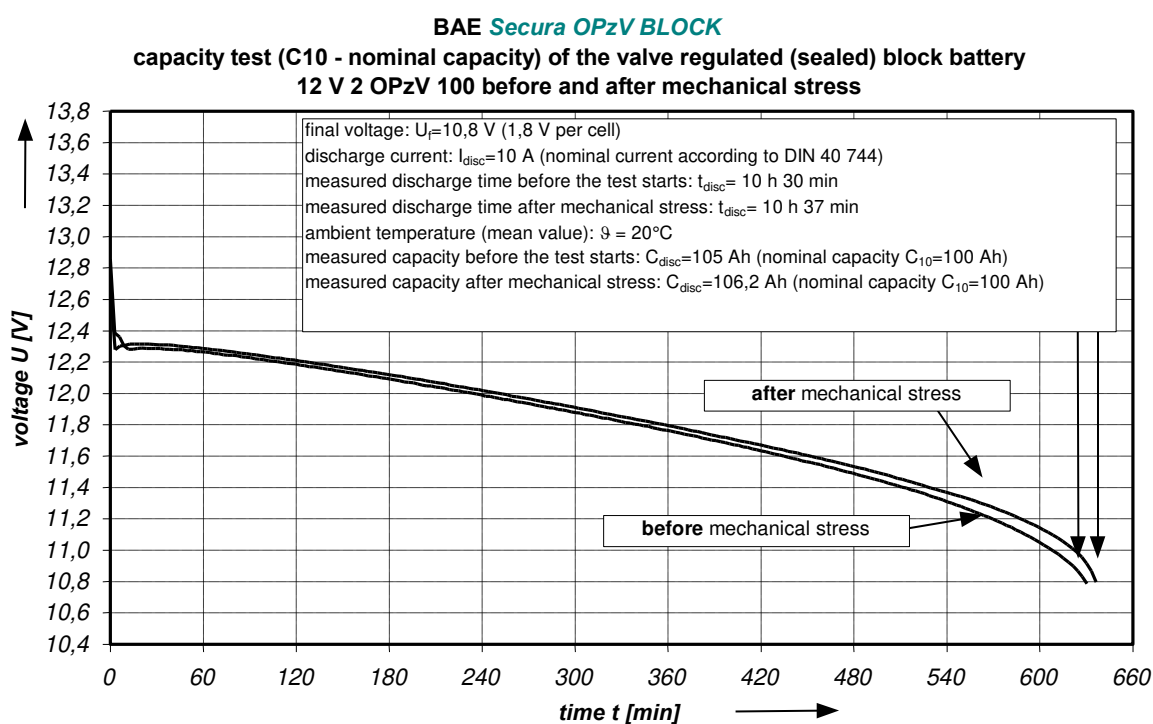


Figure 18 – Capacity of block battery before and after mechanical test.

Product range:	Valve regulated lead acid batteries Stationary block batteries with positive tubular plates BAE SECURA OPzV
Type designation:	12V 1 OPzV 50 - 12V 3 OPzV 150 6V 4 OPzV 200 - 6V 6 OPzV 300 2V 4 OPzV 600 - 2V 6 OPzV 900
Test:	Temperature dependency of the capacity (block batteries)
Test laboratory:	BAE Batterien GmbH
Test temperature:	-40 °C, -18 °C, -5 °C and 20 °C

Test performance:

The test was carried out on two BAE block batteries 6V 4 OPzV 200. The test subjects were charged and put in a climatic chamber at the temperature of -40 °C, -18 °C, -5 °C and 20 °C during 24 h. After climatic stress the capacity was measured at the above mentioned temperatures.

Results:

After climatic stress no mechanical defects or other changes were detected. The measured C_{10} capacity at 20 °C (nominal temperature) was in excess of the nominal capacity. The capacity difference (at -40 °C, -18 °C and -5 °C) from the measured capacity at nominal temperature was in normal range.

$$0.315 \times \text{capacity } (C_{10}, 20 \text{ °C}) = \text{capacity } (C_{10}, -40 \text{ °C})$$

$$0.623 \times \text{capacity } (C_{10}, 20 \text{ °C}) = \text{capacity } (C_{10}, -18 \text{ °C})$$

$$0.824 \times \text{capacity } (C_{10}, 20 \text{ °C}) = \text{capacity } (C_{10}, -5 \text{ °C})$$

Capacity behaviour depends on the temperature variation (see at page 39, Figure 22).

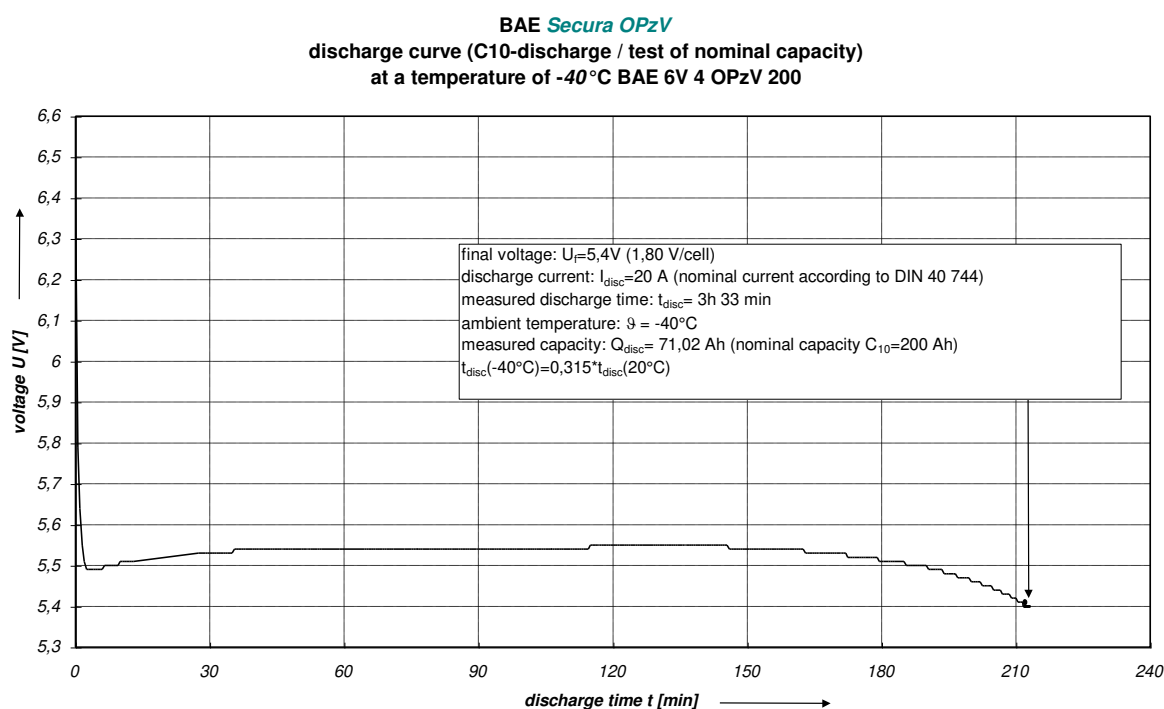


Figure 19 – Capacity behaviour (C_{10}) at -40°C of BAE 6V 4 OPzV 200 block batteries.

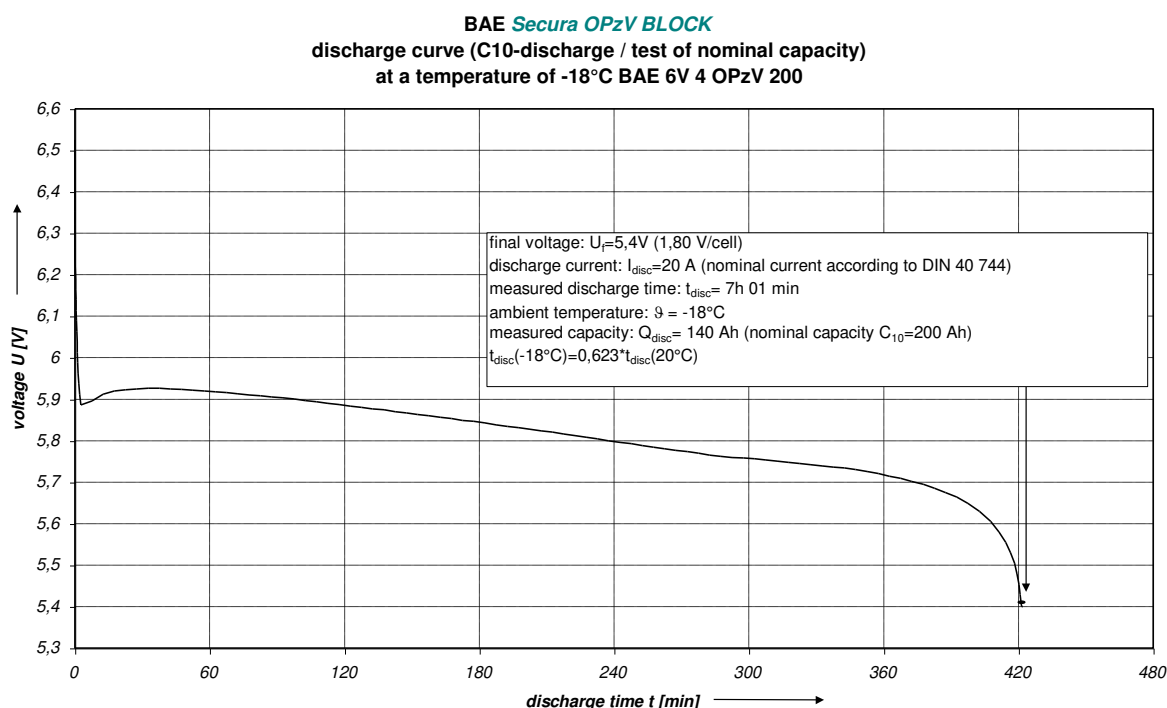


Figure 20 – Capacity behaviour (C_{10}) at -18°C of BAE 6V 4 OPzV 200 block batteries.

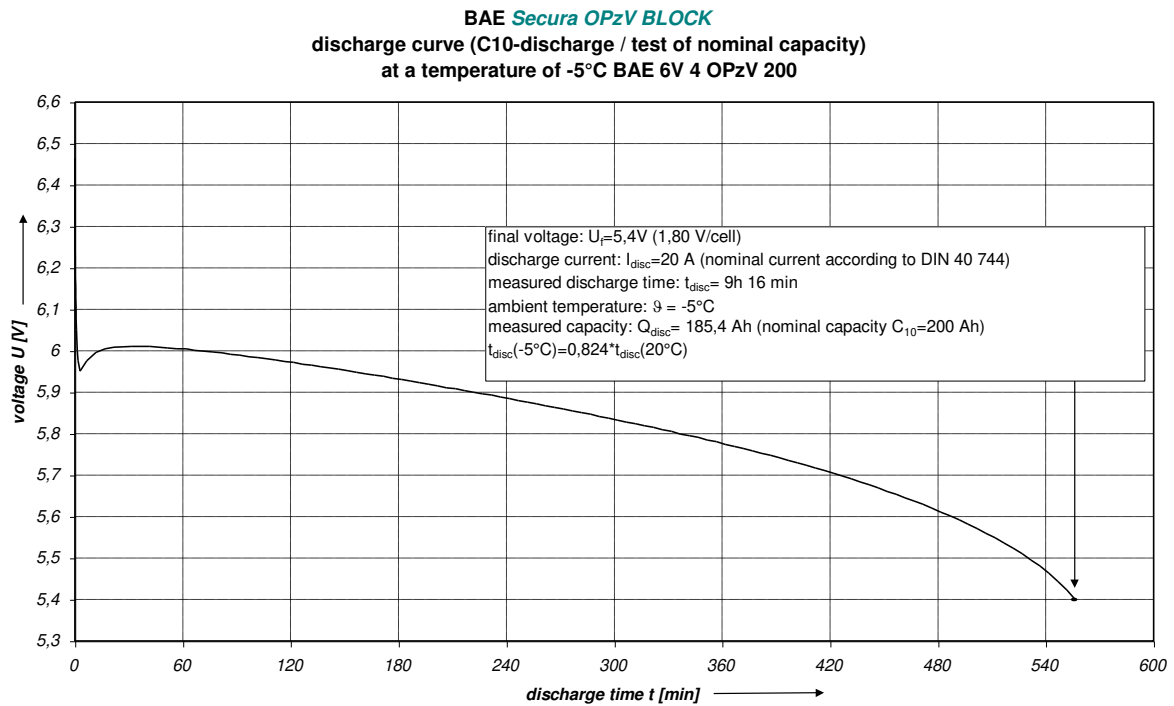


Figure 21 – Capacity behaviour (C_{10}) at -5°C of BAE 6V 4 OPzV 200 block batteries.

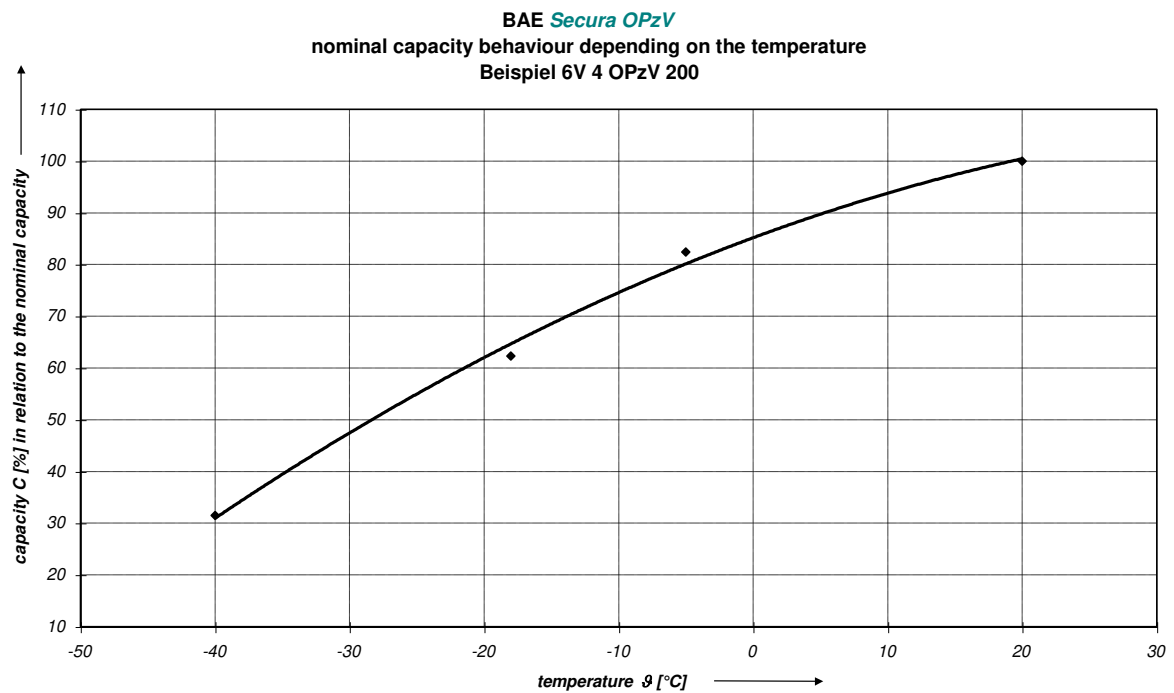


Figure 22 – Capacity behaviour depending on the temperature.

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Stability against cyclic over-discharge**

Test, chapter: High current safety tests,
IEC 896-2 Annex A / BS 6290

Test laboratory: BAE Batterien GmbH

Test temperature: 20 °C (mean value)

Test performance:

The 6 test cells of 2 OPzV 100 were tested at the 3 h-rate. Then, a deep discharge with the 10 h current down to an average of 1.25 V was performed for 5 times with a recharge at float over 168 h. In addition, the 3 h test was repeated.

	C ₃ / Ah	C ₃ / %	Standard deviation
Before the test	95.9	108.7	+/- 1.16 %
After 5 deep discharge cycles	98.7	111.9	+/- 0.92 %

The excellent results demonstrate the stability of the OPzV battery against deep discharges.

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Stability of OPzV batteries against deep discharges**

Test, chapter: High current safety tests,
IEC 896-2 Annex A/BS 6290 part 4/DIN 43539 Teil 5

Test laboratory: BAE Batterien GmbH

Test temperature: 20 °C (mean value)

Test performance:

A 6 OPzV 300 cell was discharged and bridged with a cable with a resistance of 1.8 mOhm, to simulate the case of a breakdown for many hours or even days, where the battery is not disconnected. The battery was deeply discharged. In this way the battery voltage was kept at 0 Volt over 30 days (see Figure 23).



Figure 23 – Bridged 2V 6 OPzV 300 single cell

Before and after deep discharge the 10 h-capacity was tested and recorded.

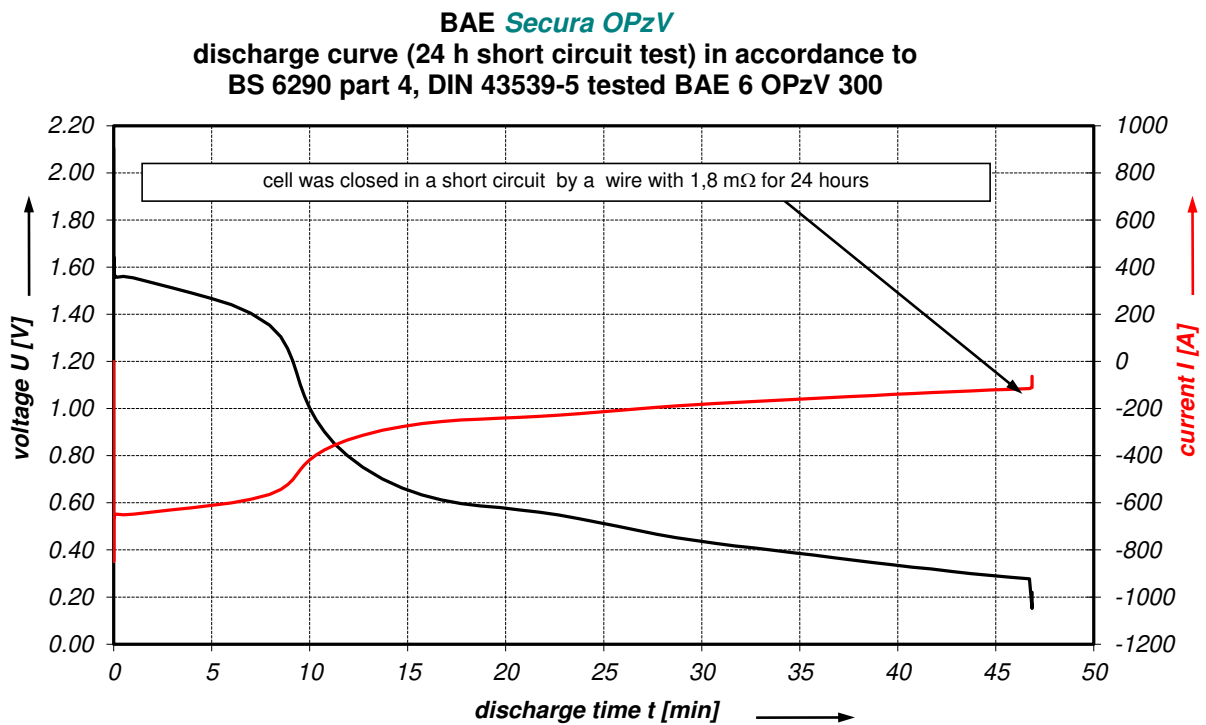


Figure 24 – Voltage and current discharge curve during 24 h short circuit test

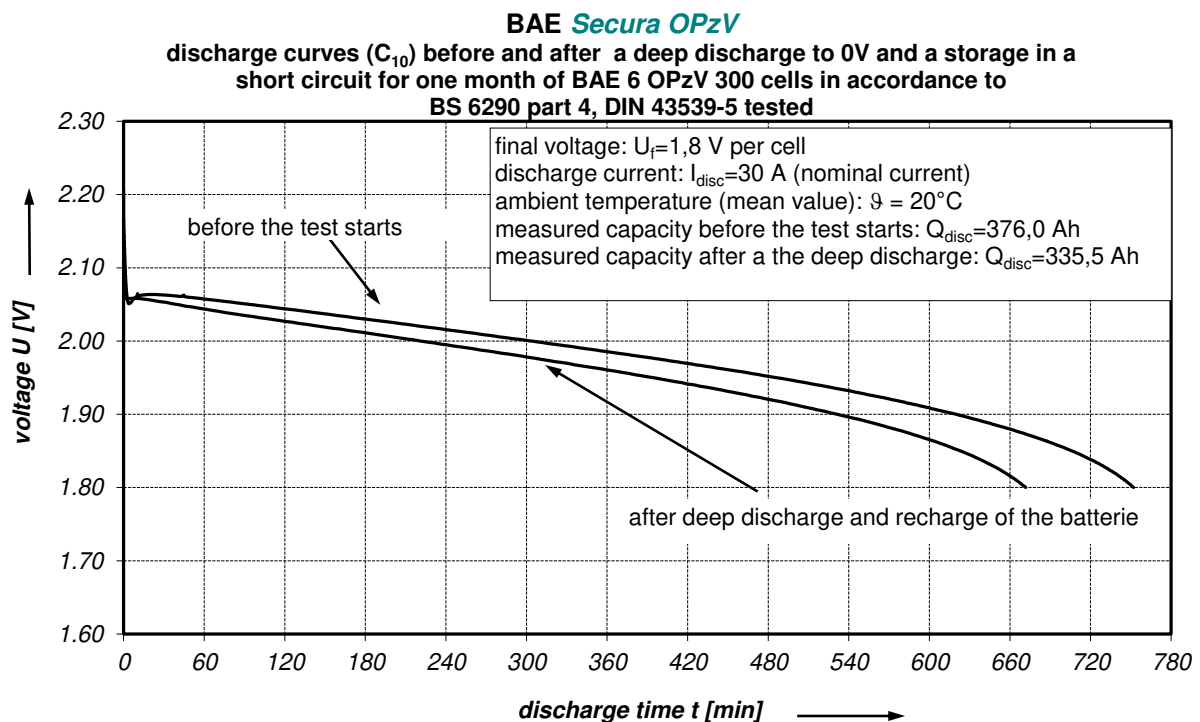


Figure 25 – Capacity comparison before and after deep discharge.

The recovery charge were performed after the deep discharge at 2.40 V over 24 h. The comparison of the capacity before and after the test is explored at Figure 25 page 42.

Result:

The cells have shown outstanding results regarding the current carry capability and deep discharge recovery. In relationship to the initial capacity after the short circuit the cell capacity was recovered to 89.1 %. After the deep discharge the battery capacity was still higher than the nominal capacity (see Figure 25 page 42). During the discharge by short circuit no burns or any mechanical damages were detected. The experiment proofs the very good stability against occasional deep discharges of the BAE – GEL batteries.

Product group: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 4 OPzV 200 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 24 OPzV 3000

Test: **Mechanical abuse test**

Test, chapter: Stability against mechanical abuse of units during installation,
IEC 60896-21, chapter 6.21

Test laboratory: BAE Batterien GmbH

- Test measurements:**
1. Two consecutive drops on the shortest edge with a torque-free release system over a triangular support profile according to IEC 60896-21, chapter 6.21 (Figure 26a).
 2. Two consecutive drops on the same corner with a torque-free release system over a triangular support profile according to IEC 60896-21, chapter 6.21 (Figure 26b).
 3. Inspection of the units for gas and liquid leaks.

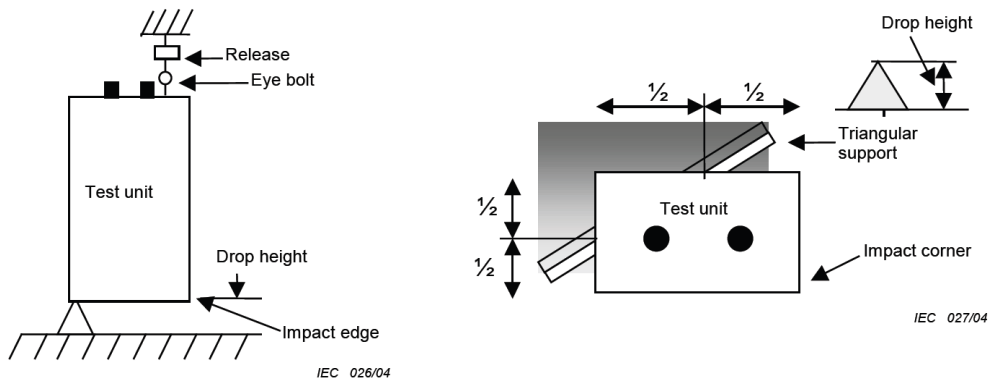


Figure 26 - Test setup for drop test on a) shortest edge and b) corner [IEC60896-21:2004]

Test subject: BAE **SECURA OPzV** 2 cells 8 OPzV 800
Serial numbers: 10317292/1; 10317292/2
Container material: ABS
Weight per cell: 68.8 kg
Drop height: 50 mm

The cells were connected with a crane by a torque free release system and lifted to the required drop height. The drop was then triggered with the release system. All drops were performed on the positive terminal side of the cells.

BAE SECURA OPzV

Cells 8 OPzV 800 - Drop on Corner

Experimental Set-Up:

Two consecutive drops on the same corner of cell 10317295 / 01.

Set-up according to IEC 60896-21, Chapter 6.21.4, Drawing 11.



Figure 27 – Test set-up for the drop on one corner.

Results:

No movement of the terminals could be observed. The open-circuit voltage of the cell after the test was $U_{OCV} = 2.111 \text{ V}$.

The surface of the corner was slightly dented in the area of the lower radius. Also, the base-profile of the container was slightly deformed, fitting the impact angle. No leakage or cracks could be observed. The deformations were only found by focused search and were better to be found tactile than visible. In order to detect leaking acid the cells were kept on an indicator mat for 48 hours after the test. After a discharge/recharge cycle (build-up of pressure) the cells were re-examined for leakage. Again, no leakage or cracks could be observed and no acid could be found leaking during test period of 48 hours.

Conclusion:

The electric function of the cells was not impaired by the tests. No leakages or cracks could be observed on the containers. Small dents and deformations were found but proved irrelevant for the mechanical integrity of the containers.

Electrical test field	Page 45 of 62	Research and Development
OPzV/e Status: JULY-2016		

BAE SECURA OPzV

Cells 8 OPzV 800 - Drop on Shortest Edge

Experimental Set-Up:

Two consecutive drops on the same short edge of cell 10317295 / 02.

Set-up according to IEC 60896-21, Chapter 6.21.4, Drawing 11.



Figure 28 – Test set-up for the drop on the shortest edge.

Results:

No movement of the terminals could be observed. The open-circuit voltage of the cell after the test was $U_{OCV} = 2.110 \text{ V}$.

Both corners of the impact edge wore slight scratches on the surface. The base-profile of the container was minimally deformed on the corners. No leakage or cracks could be observed. The deformations were only found by focused search and were better to be found tactile than visible. In order to detect leaking acid the cells were kept on an indicator mat for 48 hours after the test. After a discharge/recharge cycle (build-up of pressure) the cells were re-examined for leakage. Again, no leakage or cracks could be observed and no acid could be found leaking in 48 hours.

Conclusion:

The electric function of the cells was not impaired by the tests. No leakages or cracks could be observed on the containers. Small scratches and deformations were found but proved irrelevant for the mechanical integrity of the containers.

Electrical test field	Page 46 of 62	Research and Development
OPzV/e Status: JULY-2016		

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Low temperature service**

Test, chapter: Low temperature service,
IEC 896-2, 11/2000 draft

Test laboratory: BAE Batterien GmbH

Test temperature: -18 °C (mean value)

Test performance:

A telecom battery in a very cold environment is in an air-conditioned room of 20 °C. Power supply fails, the battery is discharged to 1.80 V with the 10 h rate, the temperature falls down to -18 °C. The question is, if the battery can be recharged and brought to normal function after the power supply recovery? For this situation the 11/2000-draft of the IEC 896-2 defines a low temperature service test.



Figure 29 – Picture of test sample during low temperature discharge test: The side walls bulge by about 4 mm.

After 72 h at -18 °C the cells are charged at room temperature for 168 h at 2.25 V/cell.

	C ₁₀ / Ah	C ₁₀ / %	Standard deviation
Before test	115	115	+/-0.84 %
After first test	121	121	+/-1.28 %
After second test	115	115	+/-1.38 %
After third test	112	112	+/-1.43 %

OPzV-batteries can withstand those frosty temperatures in the discharged state. The side walls bulge during the low temperature discharge by about 4 mm according to Figure 29, but the bulging is reversible and no damages occur.

Product range: Valve regulated lead acid batteries
Stationary block batteries with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Test: **Test for gas emissions (block batteries)**

Test, chapter: Test for gas emissions IEC 896-2, Annex D page 45 to 51

Test laboratory: BAE Batterien GmbH

Test performance:

1. Float for 30 days at 2.23 V per cell.
2. Measure current, temperature and gas volume over a period of further 14 days.
3. Discharge at 57.6 A (C_3 -current) to 1.6 V per cell, measure gas volume and temperature.
4. Recharge at 2.23 V per cell/57.6 A, measure gas volume, current and temperature over a time period of 2 days.
5. Continue charge for 14 days at 2.23 V per cell, measure gas volume, current and temperature.

Test subject: BAE **SECURA OPzV** 4 × 6V 4 OPzV 200

Initial weights:

Block number	1	2	3	4
Weight in kg	48.139	47.983	48.021	48.161

Measured current, temperature and gas volume over a period of further 14 days at float charge:

Block number	Gas volume [ml] per block	Mean value of float charge current [mA]
1	1932	13.8
2	1703	12.2
3	1788	12.5
4	1954	13.9

Mean gas value per block (V_{gas1}): 1845 ml
Mean temperature: 21.1 °C

Measured gas volume and temperature at a discharge with 57.6 A to 1.6 V per cell over 3 hours.

Block number	Gas volume [ml] per block
1	326
2	310
3	315
4	335

Mean gas value per block (V_{gas2^*}): 322 ml
Mean temperature: 23.8 °C

Measured gas volume, current and temperature over 2 days.

Block number	Gas volume [ml] per block	Mean value of float charge current [mA]
1	138	55.9
2	131	53.2
3	134	54.1
4	145	58.7

Mean gas value per block ($V_{\text{gas2}^{**}}$): 548 ml
Mean temperature: 20.8 °C

Measured gas volume, current and temperature at a charge with 2.23 V per cell over 14 days.

Block number	Gas volume [ml] per block	Mean value of float charge current [mA]
1	1433	18.0
2	1350	17.3
3	1270	16.0
4	1501	18.5

Mean gas value per block (V_{gas3}): 1389 ml
Mean temperature: 20 °C

Normalized gas volumes by the equation:

$$V_{gas} = \frac{P \times 293 \times gas}{P_0 (T + 273)}$$

V_{gas} is the normalized volume in cubic centimeters / ml

gas is the recorded gas volume in cubic centimeters / ml

P is the ambient atmospheric pressure at the time of measurement in kilo pascal

P₀ = 101.3 kPa

T is the ambient temperature of the measuring cylinder in degrees Celsius

$$V_{gas} = \frac{P \times 293 \times V_{gas,1}}{P_0 (T_1 + 273)} + \frac{P \times 293 \times V_{gas,2^*}}{P_0 (T_{2^*} + 273)} + \frac{P \times 293 \times V_{gas,2^{**}}}{P_0 (T_{2^{**}} + 273)} + \frac{P \times 293 \times V_{gas,3}}{P_0 (T_3 + 273)}$$

$$V_{gas} = \frac{101.5 \text{ kPa} \times 293 \times 1845 \text{ ml}}{101.3 \text{ kPa} (21.1^\circ \text{C} + 273)} + \frac{101.5 \text{ kPa} \times 293 \times 322 \text{ ml}}{101.3 \text{ kPa} (23.8^\circ \text{C} + 273)} \\ + \frac{101.5 \text{ kPa} \times 293 \times 137 \text{ ml}}{101.3 \text{ kPa} (20.8^\circ \text{C} + 273)} + \frac{101.5 \text{ kPa} \times 293 \times 1389 \text{ ml}}{101.3 \text{ kPa} (20^\circ \text{C} + 273)}$$

$$V_{gas} = 1846 \text{ ml} + 319.1 \text{ ml} + 137.2 \text{ ml} + 1394 \text{ ml} \\ = \frac{3696.3 \text{ ml}}{200 \text{ Ah}} = 18.5 \frac{\text{ml}}{\text{Ah}}$$

$$V_{gas} = 18.5 \text{ ml / Ah per block} = \underline{6.16 \text{ cm}^3 / \text{Ah per cell}}$$

Limit value given by IEC 896-2, Annex D:

Gas evolution during 30 days (see page 2) 30 cm³ / Ah per cell.

Result:

BAE OPzV cells passed the test with a safety factor of **4.9**.

Gas development test for OPzV cells

Product range: Valve regulated lead acid batteries
Stationary cells with positive tubular plates
BAE SECURA OPzV

Type designation: 4 OPzV 200 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 24 OPzV 3000

Test: **Test for gas emissions (cells)**

Test, chapter: Test for gas emissions, DIN EN 60896 - 2 (IEC 896 - 2)
Annex D page 45 to 51

Test laboratory: BAE Batterien GmbH

Test performance: The test carried out on 6 units 5 OPzV 350 (50 Ah plate).

1. Float for 30 days at 2.25 V per cell.
2. Measure current, temperature and gas volume over a period of further 14 days.
3. Discharge at 107 A (C_3 -current) to 1.75 V per cell, measure gas volume and temperature.
4. Recharge at 2.25 V per cell / 107 A, measure gas volume, current and temperature over a time period of 2 days.
5. Continue charge for 14 days at 2.23 V per cell, measure gas volume, current and temperature.

Test subject: BAE **SECURA OPzV** 6 cells × 5 OPzV 350

Initial weights:

Cell number	1	2	3	4	5	6
Weight in kg	31.059	31.295	31.249	31.401	31.143	31.389

Measured current, temperature and gas volume over a period of further 14 days at float charge:

Cell number	Gas volume [ml] per cell	Mean value of float charge current [mA]
1	1324	24.8
2	1420	26.7
3	1060	27.8
4	1325	32.0
5	1134	26.9
6	1258	23.0
Average	1253.5	27.0

Mean gas value per block (V_{gas1}): 1253 ml
Mean temperature: 22.7 °C

Electrical test field OPzV/e Status: JULY-2016	Page 52 of 62	Research and Development
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Gas development test for OPzV cells

Measured gas volume and temperature at a discharge with 107 A to 1.6 V per cell over 3 hours.

Cell number	Gas volume [ml] per cell
1	270
2	288
3	230
4	219
5	234
6	256
Average	249.5

(Temperature was measured at positive cell pole during the discharge.)

Mean gas value per cell (V_{gas2^*}): 249.5 ml

Mean temperature: 24.3 °C

Measured gas volume, current and temperature over 2 days with charging voltage of 2.25 V after the recharge of the battery with C_3 current as initial charging current and 2.25 V float voltage.

Cell number	Gas volume [ml] per cell	Mean value of float charge current [mA]
1	176	90
2	189	115
3	178	113
4	200	125
5	176	105
6	165	93
Average	180.7	106.8

Mean gas value per cell ($V_{\text{gas2}^{**}}$): 180.7 ml

Mean temperature: 20.8 °C

Measured gas volume, current and temperature at a charge with 2.25 V per cell over 14 days.

Cell number	Gas volume [ml] per cell	Mean value of float charge current [mA]
1	5089	33.2
2	4378	28.9
3	4780	34.5
4	3489	33.0
5	4560	24.6
6	3837	27.9
Average	4355.5	30.35

Mean gas value per cell (V_{gas3}): 4355 ml

Mean temperature: 20.2 °C

Normalized gas volumes by the equation:

$$V_{gas} = \frac{P \times 293 \times gas}{P_0 (T + 273)}$$

V_{gas} is the normalized volume in cubic centimeters / ml

gas is the recorded gas volume in cubic centimeters / ml

P is the ambient atmospheric pressure at the time of measurement in kilo pascal

P₀ = 101.3 kPa

T is the ambient temperature of the measuring cylinder in degrees Celsius

$$V_{gas} = \frac{P \times 293 \times V_{gas,1}}{P_0 (T_1 + 273)} + \frac{P \times 293 \times V_{gas,2^*}}{P_0 (T_{2^*} + 273)} + \frac{P \times 293 \times V_{gas,2^{**}}}{P_0 (T_{2^{**}} + 273)} + \frac{P \times 293 \times V_{gas,3}}{P_0 (T_3 + 273)}$$

$$V_{gas} = \frac{101.5 \text{ kPa} \times 293 \times 1253.5 \text{ ml}}{101.3 \text{ kPa} (22.7^\circ\text{C} + 273)} + \frac{101.5 \text{ kPa} \times 293 \times 249.5 \text{ ml}}{101.3 \text{ kPa} (24.3^\circ\text{C} + 273)} \\ + \frac{101.5 \text{ kPa} \times 293 \times 180.7 \text{ ml}}{101.3 \text{ kPa} (20.8^\circ\text{C} + 273)} + \frac{101.5 \text{ kPa} \times 293 \times 4355 \text{ ml}}{101.3 \text{ kPa} (20.2^\circ\text{C} + 273)}$$

$$V_{gas} = 1242 \text{ ml} + 246.4 \text{ ml} + 180.7 \text{ ml} + 4352 \text{ ml} \\ = \frac{6021.1 \text{ ml}}{350 \text{ Ah}} = 17.2 \frac{\text{ml}}{\text{Ah}}$$

V_{gas} = 17.2 ml / Ah per cell

Limit value given by IEC 896-2, Annex D:

Gas evolution during 30 days (see page 2) 30 cm³ / Ah per cell.

Result:

BAE OPzV cells passed the test with a safety factor of **2**.

Tightness test

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Tightness test**

Test, chapter: Tightness test for valve regulated batteries

Test laboratory: BAE Batterien GmbH

Test performance:

Every produced cell or block battery is tested before delivery for the tightness of the pole bushing and carrier with a pressure of 200 mbar during 60 seconds. After the equalization of the pressure, the pressure lost should be not higher than 0.1 mbar (measurement uncertainty) during 5 sec.



Figure 30 – Tightness test of 12 OPzV 1500 single cells.

Tightness test



Figure 31 – *Test equipment.*



Figure 32 – *Measurement of tightness with over pressure.*

Valve test

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: Opening and closing pressure of the valve

Test laboratory: BAE Batterien GmbH

Test performance:

BAE VRLA batteries are equipped with a valve enabling the escape of gas at certain internal pressures. The battery (6 OPzV 300 cell) was overcharged with 1.33 C₁₀ current. The pressure on the valve was measured with a pressure sensor during the overcharge and after the overcharge. For the OPzV and OGiV block batteries opening pressures of 100 mbar ± 20 mbar and closing pressures of 50 mbar ± 10 mbar are normal.

Test of the valves for the opening and closing pressure (example):

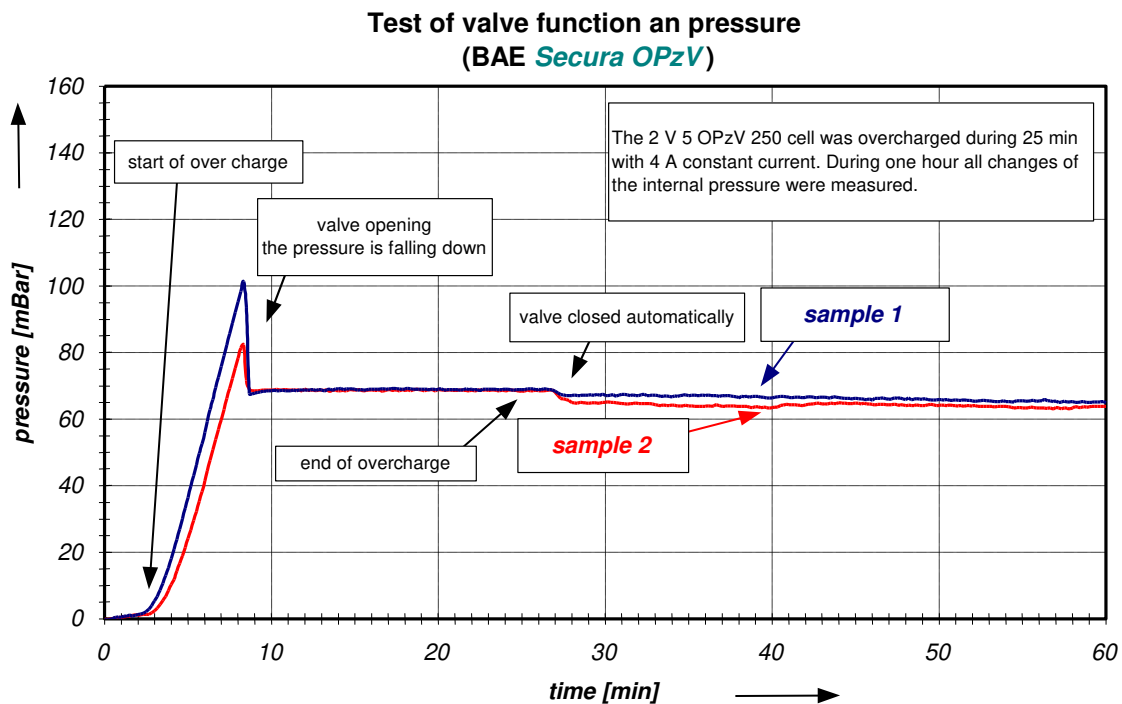


Figure 33 – Measurement of opening and closing pressure.

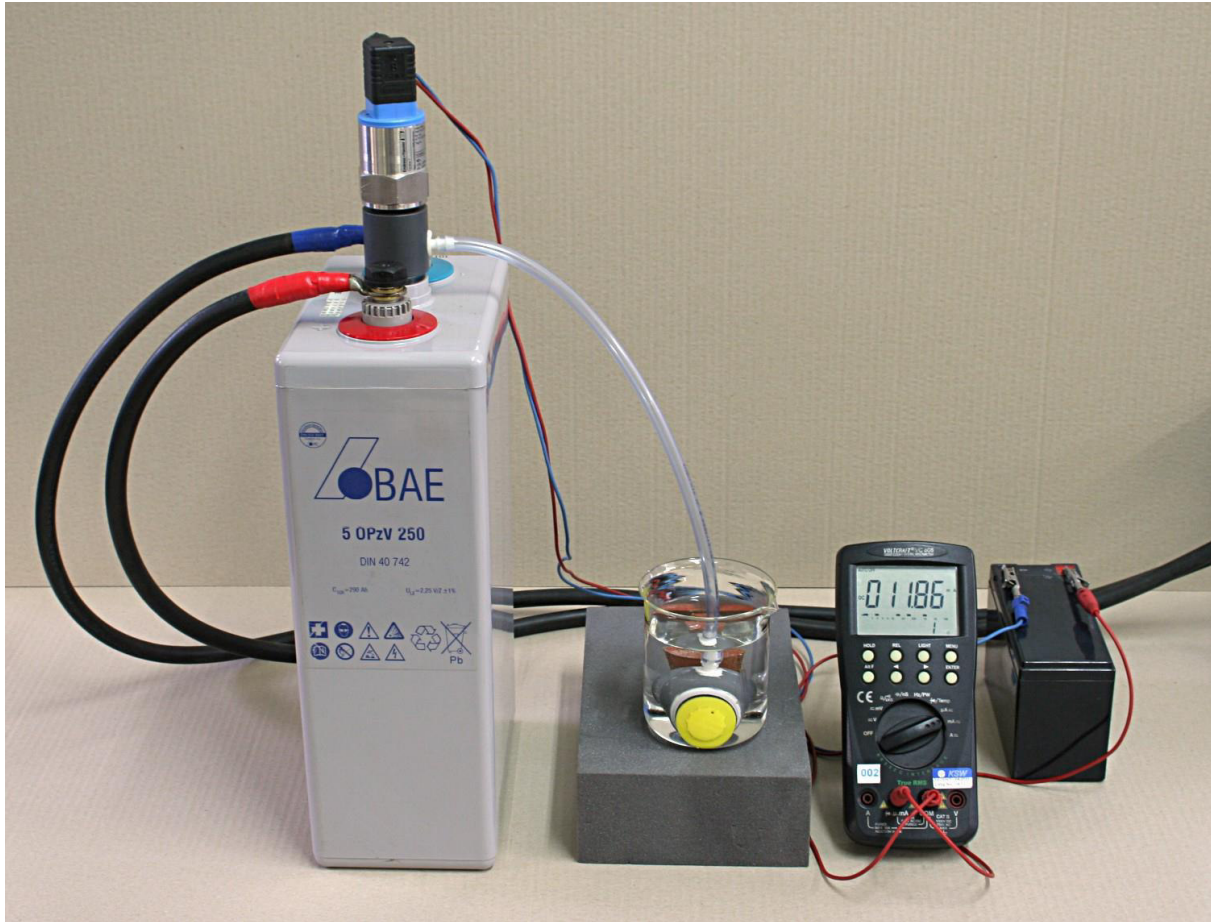


Figure 34 – *Test configuration for pressure measurement.*

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Material tests**

Test, chapter: Valve regulated batteries

Test laboratory: BAE Batterien GmbH

Test performance:

In accordance with the BAE specification every material and part of the battery (separators, containers, valves plugs and so on) has to be tested to gain approval for use in the production. The tests are performed at the chemical laboratory. The material has to pass the contact to sulphuric acid (acid density of 1.28 kg/l) during 336 h (14 days) at a temperature of 80 °C. After the test the mass loss should be lower than 0.5 % of the whole mass of the test subject.

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Ventilation test**

Test, chapter: NEMA Norm IB 7-1.02 A / valve regulated batteries

Test laboratory: BAE Batterien GmbH

Test performance:

Both tests were carried out in accordance with the requirements of the NEMA Norm IB 7-1.02 A (1980). Both tests were passed at the BAE electrical test field.

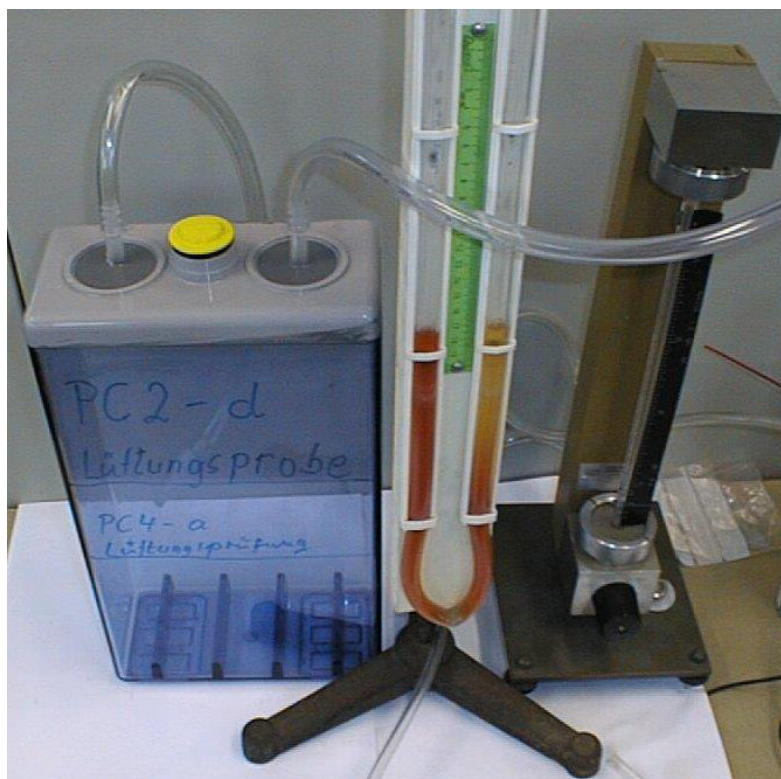


Figure 35 – Ventilation test.

Product range: Valve regulated lead acid batteries
Stationary block batteries and cells with positive tubular plates
BAE **SECURA OPzV**

Type designation: 12V 1 OPzV 50 - 12V 3 OPzV 150
6V 4 OPzV 200 - 6V 6 OPzV 300
2V 4 OPzV 600 - 2V 6 OPzV 900

Type designation: 2 OPzV 100 - 6 OPzV 300
5 OPzV 350 - 7 OPzV 490
6 OPzV 600 - 12 OPzV 1200
12 OPzV 1500 - 26 OPzV 3250

Test: **Spark test**

Test, chapter: Valve regulated batteries

Test laboratory: BAE Batterien GmbH

Test performance:

The test was carried out 6 OPzV 600 cells. The cells were overcharged with 60 A during 10 min. A spark was evaluated by the electronic spark machine with 1 kV. No explosion was examined inside the valve regulated and vented cell during 5 min flashing time.

Annex A

Absolute measurement uncertainties:

Discharge current	$\pm 0.5 \%$ of setting value
Voltage	$\pm 0.1 \%$ of measured value
Current	$\pm 0.1 \%$ of measured value
Time	$\pm 0.5 \text{ s}$
Temperature	$\pm 2 \text{ }^{\circ}\text{C}$

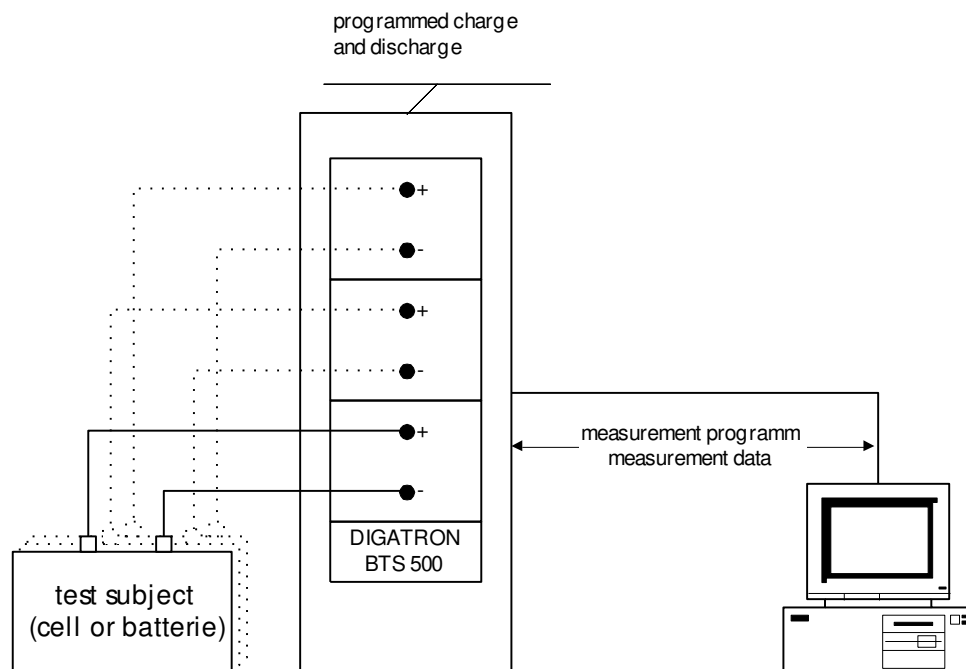


Figure 36 – *Test configuration.*

Testing laboratory for climatic, mechanical
and corrosive environmental stress



QUALITY TEST CERTIFICATE

Test report - No. 10720.03 / 14

Client	BAE Batterien GmbH Wilhelminenhofstraße 69/70 12459 Berlin	
Equipment under test	Battery Serial number	5 OPzV 350 10311787/001
Purpose	<i>Certification of the dynamic-mechanical resistance according to the specifications of the standards and to the demands of the client</i>	
Test program	<i>Vibration, sinusoidal</i>	<i>according to the IEC 60068-2-6 and to the demands of the client</i>
Total number of pages	2 (including 1 appendix)	
Test result	A vibration test according to the basic norm and to the UN2800 was successfully performed on the battery type 5 PVV 550 (see Pb. Nr. 10720.02 / 14 from 15.08.2014) According to the International Technical Information BAE the sample 5 OPzV 350 (see appendix) is identical in construction to the 5 PVV 550 and according to the information provided by the client has the same mechanical characteristics.	



Dipl.-Ing. R. Lein
Head of the testing laboratory

Berlin, 07 August 2015

Pictures



Picture 1
Battery 5 OPzV 350



Picture 2
Battery 5 OPzV 350



Picture 3
Battery 5 OPzV 350



Picture 4
Battery 5 OPzV 350

Battery Type 5 OPzV350 / various views /unstressed



INDUSTRIEANLAGEN-BETRIEBSGESELLSCHAFT

mit beschränkter Haftung

Test- and Analysescenter

Certified as per ISO 9001:2000

Test certificate

No. TA34-2004/2248/C5

Type of tests: Tri-axial time history tests

Client: BAE Berliner Batterie GmbH
D-12459 Berlin

Test specimen: Batteries aged previously:
16 OPzV 2000, 7 OPzV 490 and 4 OPzV 200.

Manufacturer: BAE Berliner Batterie GmbH
D-12459 Berlin

Date of test: 16.07.2004

Test requirements: IEC 68-3-3, German edition EN 60068, part 3-3; Environ-
mental testing; Seismic test methods for equipments; Guid-
ance; 1993
IEC 68-2-6, German edition EN 60068, part 2-6; Environ-
mental testing; Test Fc and guidance: Vibration sinusoidal;
1995
IEEE 344, Recommended Practice for Seismic Qualification of
Class 1E Equipment for Nuclear Power Generating Stations;
1987
Specification of Qualification per test to the seismic and the
AOE for tubular vented and sealed batteries

Tests conducted: Simulation of operating basis (OBE)- and safe shutdown earth-
quake (SSE) loads using tri-axial time-histories with five times
testing on OBE- and once on SSE level. The required re-
sponse spectra (RRS) shall be enveloped by the test response
spectra (TRS) for 2 [%] damping (OBE) respectively 4 [%]
damping (SSE) at and above the half of the first mode fre-
quency.

Test result: The batteries withstood the loads. Neither damages nor
changes impairing the function could be detected.

D-85521 Ottobrunn; 2004-08-11

Responsible test engineer:



BAE ZERTIFIKAT / CERTIFICATE

Herkunftsbescheinigung

Hiermit wird bestätigt, dass alle im Folgenden aufgelisteten Produkte der BAE Batterien GmbH am Standort Wilhelminenhofstraße 69/70 in 12459 Berlin gefertigt werden.

Certificate of origin

Herewith we confirm that all types of batteries listed in the following table are manufactured in the BAE plant located in Wilhelminenhofstraße 69/70, in 12459 Berlin, Germany.

BAE SECURA OPzS	BAE SECURA PVS SOLAR	BAE NOVA trans PzS
BAE SECURA OPzV	BAE SECURA PVV SOLAR	BAE NOVA trans PzV
BAE SECURA OGi	BAE SECURA PVSM SOLAR	BAE SPECIAL RAIL PzS
BAE SECURA OGIV	BAE SECURA PVVM SOLAR	BAE SPECIAL RAIL PzV
BAE SECURA SPzS		BAE SPECIAL GiV
BAE SECURA SPzV		
BAE SECURA SGi		
BAE SECURA SGiV		



Peter Scholz
Product Manager

BAE Batterien GmbH

Berlin, 18.03.2014

CERTIFICATE

The Certification Body **ÖHMI EuroCert®** GmbH,
Berliner Chaussee 66, 39114 Magdeburg hereby certifies
that the organisation:



Energy from Batteries

BAE Batterien GmbH
Wilhelminenhofstraße 69/70
12459 Berlin

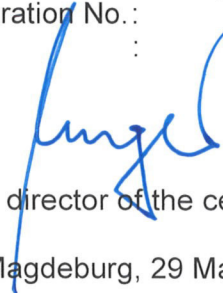
for the scope:

**Development, manufacture and sale of lead batteries
for motive power systems, railway vehicles and stand-by
application**

has implemented and maintains a quality management system.
Through a quality audit it was verified that the Management System
fulfills the requirements of the standard

EN ISO 9001:2015

The certificate is valid from 29 May 2017 to 28 May 2020.
Certificate Registration No.: CQ-DE-00070/08/eng
Renewal audit : 27 April 2017


Managing director of the certification body

Magdeburg, 29 May 2017

**PUG-Cert
Berlin**

CERTIFICATE

In reference to §9 UAG and to UAG-ZertVR
the Certification Organisation PUG-Cert Berlin
hereby confirms that the company

 **BAE Batterien GmbH**

**Wilhelminenhofstr. 69/70
D- 12459 Berlin**

has adopted, implements and maintains
an environmental management system.

It is confirmed by audit report-no. Z 06 – 16 / Ü2, that the
requirements of the standard are fulfilled.

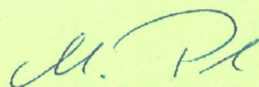
DIN EN ISO 14001:2015

This certificate is valid for three years until the 24th May 2019.

Certificate - No. 0066 / 04 - 07 / 57- 4

(initial certification July 30, 2004)

Berlin, 22.05.2018



Manfred Peters
Environmental Auditor
Registration No.: DE-V-0031

Certification Office
PUG-Cert Berlin
Reichnerweg 42
12305 Berlin

**PUG-Cert
Berlin**

CERTIFICATE

In reference to §9 UAG and to UAG-ZertVR
the environmental auditor PUG-Cert Berlin
hereby confirms that the company



BAE Batterien GmbH

**Wilhelminenhofstr. 69/70
D – 12459 Berlin**

has adopted, implemented and maintains
an energy management system.

It is confirmed by audit report-no. EnM 09 - 16, that the
requirements of the standard are fulfilled.

DIN EN ISO 50001:2011

This certificate is valid for three years until
June 12th 2019.

Certificate - No. 0005 / 13 - 06 / 004-1

(First Certificate 2013-06-12)

Berlin, 2016-05-27

A handwritten signature in blue ink, appearing to read 'M. Peters'.

Manfred Peters
Environmental Auditor
Registration No.: DE-V-0031

Certification Office
PUG-Cert Berlin
Reichnerweg 42
12305 Berlin

A handwritten signature in blue ink, appearing to read 'M. Peters'.

Martin Peters
Environmental Auditor
Registration No.: DE-V-0362

**PUG-Cert
Berlin**

CERTIFICATE

In reference to §9 UAG and to UAG-ZertVR
the Certification Organisation PUG-Cert Berlin
hereby confirms that the company

 **BAE Batterien GmbH**
Wilhelminenhofstr. 69/70
D- 12459 Berlin

has established and applies an Health and Safety Management
System within the total Organisational Unit including all activities at
the site.

Through an audit, Auditreport- Nr. Z 13 - 16, has been proved that
the requirements according to

OHSAS 18001:2007

are fulfilled.

The certificate is valid until
12th June 2020

Certificate- Nr. 097 / 14 - 06 / 083 - 1
(initial certification 12th June 2014)

Berlin, 27th April 2017



Manfred Peters
Environmental Verifier
Registration No.: DE-V-0031

Certification Office
PUG-Cert Berlin
Manfred Peters
Reichnerweg 42
12305 Berlin



Martin Peters
Environmental Verifier
Registration No.: DE-V-0362

BAE batteries – The right choice for your energy backup challenge

The countdown of the battery life-time starts immediately after the filling with electrolyte. During storage, the aging of the batteries continues. Typical aging effects are corrosion or sulphating of the electrodes, especially when the batteries are stored for a longer time without any recovering of self-discharge (recharging).

For a reliable supply of energy **BAE Batterien GmbH** is supplying to our customers always new manufactured batteries consisting of freshly produced positive and negative electrodes. The electrodes are stored in cool dry stock for a short period between the activation process with subsequent drying and battery assembly to ensure high quality.

Such type of storage ...

- ... avoids the undesired **moisture** formation in the electrodes, which may limit the battery activation process and the performance of the electrodes
- ... avoids **oxidation** of active mass of the negative electrode from Pb to PbO during storage time. The oxidation process may accelerate in humid atmosphere. The formed oxide layer has a high electric resistivity, which can affect the battery performance or commissioning process. This is why **BAE** uses special additives in the active material additionally, isolating the lead surface from contact with atmospheric oxygen and thus minimising the oxidation.

For the above mentioned reasons, **BAE** is joining the *First In First Out* philosophy for all electrodes. All electrodes are manufactured to 100 % at the **BAE** plant, in order to ensure that the electrodes meet the high quality requirements.

After the electrodes are assembled into batteries and are in contact with the electrolyte (i.e. after filling), the chemical interaction is starting. Thus, this is the beginning of life-time (date of birth) of the battery. Even though, if a filled and charged battery is not put into operation (connected to UPS), the ongoing corrosion processes of the positive electrodes cannot be interrupted, which means the aging processes start from the battery's date of birth.

During the storage, wet charged batteries are subjected to self-discharge due to the chemical water decomposition process, which is accelerated by higher ambient





temperature. If self-discharged batteries are not recharged or the storage time is exceeded, the electrodes will suffer from sulphation leading to irreversible capacity reduction and active mass shedding. In an extreme case, self-discharged batteries will lose most of their capacity and are then considered as unserviceable for use.

Hence, the supplied batteries at **BAE** are always manufactured for the customer project. It is our philosophy to provide our customers with new batteries which meet our high quality standards at any time.

At **BAE**, every battery is equipped with an individual barcode label stating the production batch, unit number (cell or block battery) and manufacturing date (month and year) as shown in the figure below.



Fig. 1: Cell/Block Barcode example

Tarek Fakih

Product Manager
BAE Batterien GmbH
Berlin, 10.02.2017



BAE Batterien GmbH

History

BAE History – Our “walk of fame”

1899:
Small transportable
lead-acid batteries for
torches, telegraphs
and signalling
annunciators



1922:
Transportable lead-acid batteries
for automobiles and aircrafts



1989:
12,000 Forklift batteries
42,000 Railway batteries
650,000 Cells per year

1994:
New traction batteries
BAE NOVA trans DUO
with electrolyte circulation



1995: Stationary batteries
BAE OPzS and BAE OGi
BAE OPzV and BAE OGiV



2005 BAE Batterien GmbH

1993 Refoundation: BAE
Berliner Batteriefabrik GmbH

1990 License agreement with
VARTA Batterie AG

1958 BELFA + AFO = BAE
Berliner Akkumulatoren- und Elementefabrik

1946 Akkumulatorenfabrik Oberspreew AFO

1904 VARTA, Vertrieb, Aufladung, Reparatur transportabler
Akkumulatoren

1901 AFA, Accumulatoren Fabrik Aktiengesellschaft

1899 Akkumulatorenwerke Oberspreew was founded

BAE – History



Production located in the south east of Berlin
one of the oldest battery manufacturers
in an area with long tradition!

Foundation of "Allgemeinen Elektrizitäts-
gesellschaft" (AEG) by Emil Rathenau in
1897 in Oberschöneeweide

→ Head office of AEG

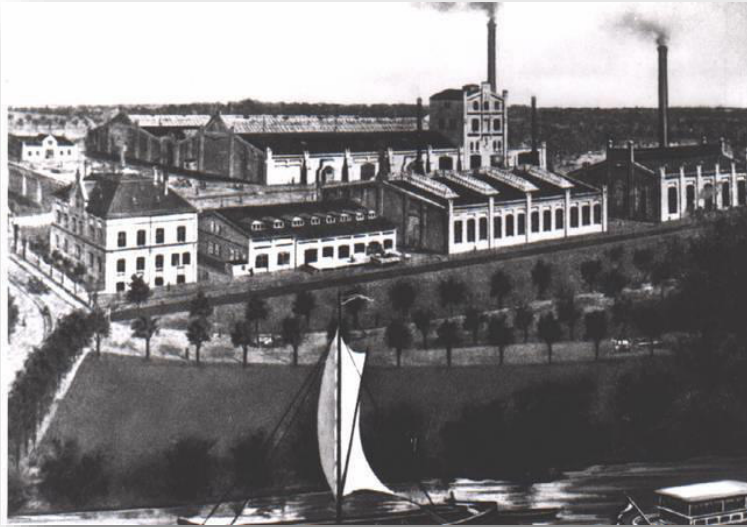
Settlement of other companies:

- 1897 Kupferwerke Deutschland AG
- 1898 Kabelwerk Wilhelminenhof AG
- 1898 Deutsche Niles-Werkzeugmaschinen-
Fabrik AG
- 1899 Akkumulatorenwerke Oberspree AG

... and thousands of employees moved to
"Elektropolis"!



BAE – History



1899 Foundation of Akkumulatorenwerke Oberspree AG in Berlin-Oberschöneweide by Ludwig Löwe → in 1901 hostile acquisition by Akkumulatorenfabrik AG (AFA)

1904 Varta Accumulatoren GmbH in Berlin-Oberschöneweide → VARTA = Sales, Charge and Repair of Transportable Accumulators



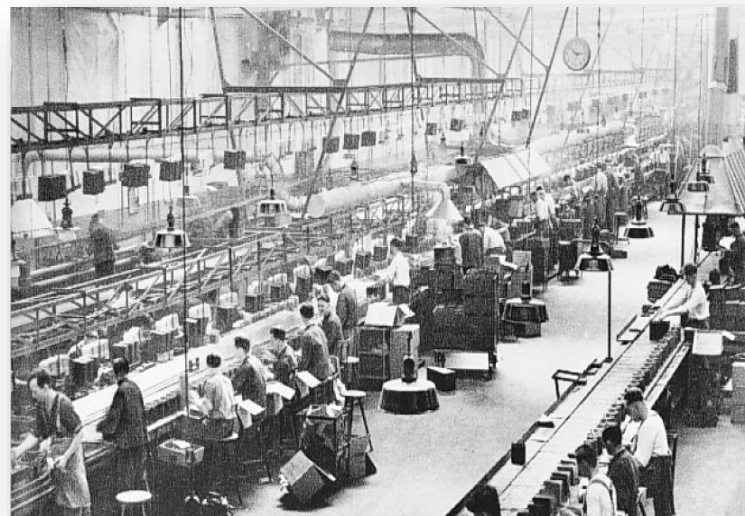
1905 Production of small, portable accumulators for torches, telegraphs, and annunciators

BAE – History

1922/23 Guenther Quandt takes over the VARTA company becoming one of the largest producers of lead-acid batteries for electrical vehicles and aircrafts

1926 Aquisition of Pertrix Chemische Fabrik AG (Berlin-Niederschöne-weide)
→ Anode- and dry-cell batteries
→ Increasing demand for batteries due to broadcasting
→ Foundation of Pertrix GmbH in 1927 together with AFA/VARTA

1945 Expropriation of Pertrix and AFA/VARTA through Soviet occupying power and GDR, respectively



BAE – History



- 1946 Re-foundation as Akkumulatorenfabrik Oberschöneweide (AFO)
- 1958 Berliner Elementefabrik (BELFA), former Pertrix, and AFO unify to Berliner Akkumuatoren- und Elementefabrik (BAE)
→ Focus on batteries for railway applications
- 1979 Start of production of industrial batteries
- 1986 New building for fabrication of electrodes
- 1989 Total production volume 650,000 cells per year (focus on traction)



BAE – History

- 1990 BAE comes under the “Escrow Management Trust” by the German government
 → License agreement with VARTA Batterie AG allowing the production under the name of VARTA
 → Modernization of products and production facilities
- 1992 End of license agreement with VARTA
- 1993 BAE is privatized becoming BAE Berliner Batteriefabrik GmbH
 → New product lines for motive power and stationary applications



BAE – History



1995 Certification acc. to DIN ISO 9001 by
“German Institute for Standardisation”

1995/96 Introduction of BAE stationary product
range in VLA & VRLA types as cells
and blocks



2004 Certification acc. to ISO 14001

2006 New product range for renewable
energies: BAE SECURA Solar

2007 Extension of stationary product range
for OPzS / OPzV and

2008 for OGi (200-350 Ah)



2012 Certification acc. to OHSAS 18001

BAE – Company



BAE – Profile

Made in
Germany



Foundation:	1899
Branch:	Production of Premium Lead Batteries
Status:	SME-Status
Standard:	“Quality made in Germany”
Production:	100% in Berlin
Turnover:	35 Mio € (2018E)
Employees:	180
Export:	75%



BAE Batterien GmbH



Thank you for your attention!



Perfil de empresa



BAE Batterien GmbH es un fabricante de baterías industriales de plomo con más de 117 años de historia ubicado en Berlín, Alemania, donde hoy en día continúa fabricando íntegra y exclusivamente sus productos bajo estrictos controles de calidad.

Los productos que fabrica BAE son baterías industriales DIN para aplicaciones estacionarias stand-by, sistemas de energías renovables, tracción eléctrica, metros y ferrocarriles.

Con un 85% de ventas en exportación BAE está presente internacionalmente por medio de distribuidores y partners altamente cualificados.

BAE es sinónimo de confiabilidad y experiencia en el mercado mundial de baterías industriales para los sistemas back-up de empresas de generación y distribución de energía, redes de telecomunicaciones y SAI para aplicaciones industriales. Las baterías **BAE SECURA** incluyen elementos 2V y Blocks de tipo OPzS, OPzV, OGi y OGiV.

Durante los últimos años BAE se ha convertido además en referente mundial en el mercado de las energías renovables, en particular en los sistemas solares fotovoltaicos off-grid e híbridos con almacenamiento.

Las baterías OPzS y OPzV de placa tubular constituyen la familia **BAE SECURA SOLAR**, elementos 2V y Blocks bajo el nombre comercial PVS y PVV, certificadas IEC 61427, tanto en tecnología de bajo mantenimiento (abiertas) como nulo mantenimiento (selladas GEL), han sido implantadas con éxito en todo el mundo: Mini-redes en el rango kW para electrificación rural de calidad, E.B.'s de telecomunicaciones, gaseoductos, etc.

Datos de contacto:

Gerente de Ventas Latinoamérica y Europa Sur

Ruth Pérez de Azpeitia (ruth.perez@bae-berlin.de)

Tel. +49 30 53001 673

Cel. +49 172 629 82 58

www.bae-berlin.de



BAE Batterien GmbH

Quality of BAE Batteries

04.07.2017

PM

Tubular plate manufacturing: BAE high pressure casting

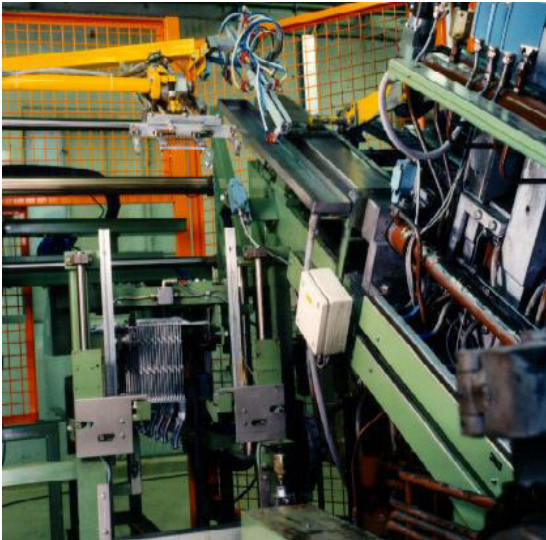


Fig 1: Pressure casting machine

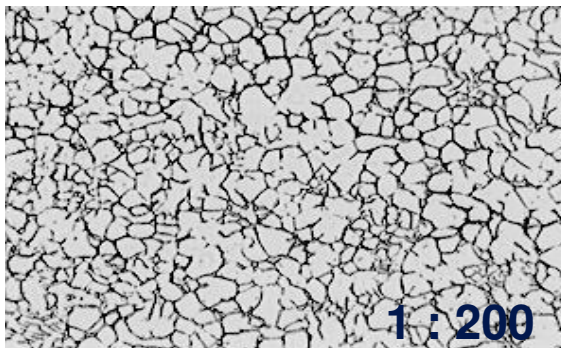


Fig 2: SEM of the plate structure

- Pressure casting of the grid 120 bar
- Permanent temperature control and periodical check of casting quality
- Antimony free lead calcium tin alloy PbCaSn (VRLA)
- Optimised antimony selenium alloy (VLA)
- High cooling rate by pressure casting leads to small grains with globulitic structure
- Very low corrosion



Secure outstanding corrosion
life time for standby and cycling
operation

Tubular plate manufacturing: Dry filling of red lead (minium)



Fig 3: Dry filling of red lead

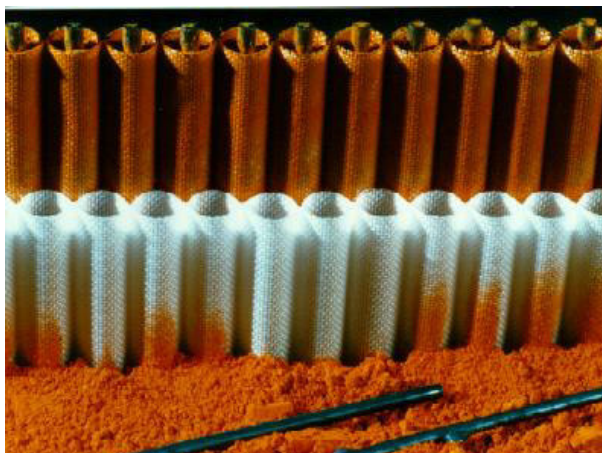


Fig 4: tubular plates before and after filling

Red lead filling (Pb_3O_4) with a calibrated particle size leads to:

- Low plate tolerances and cell capacity deviations
- Fast formation process with low stress of active mass
- Lowest effort for putting operation process at flooded batteries (VLA)
- Highest initial capacity for sealed and flooded batteries (VRLA/VLA)
- Uniform filling of all tubes over the complete length guarantees low mass shedding



**Best initial capacity and
easy putting into
operation process**

Formation process: BAE tank formation



Fig 5: Tank formation



Fig 6: Container formation

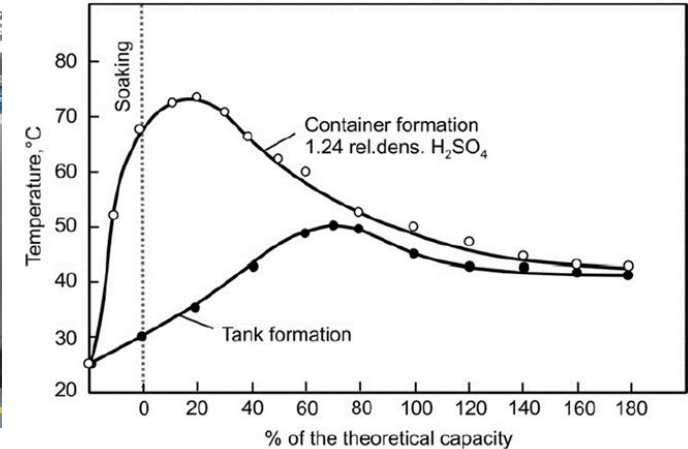


Fig 7: Temperature development container vs. tank formation
[source: Lead-Acid Batteries: Science and Technology, D. Pavlov]

- Ideal acid density of formation of 1.10 kg/l, large surplus acid
- Excellent formation results under constant conditions (temperatures)



Best initial capacity and easy putting into operation process

Tubular plate manufacturing: Use of reinforced non-woven gauntlets



Fig 8: Tubular pocket

- Higher resin content improves the oxidation resistance and the mechanic stability
→ Reduced mass shedding due to small pores
- Reinforced non-woven gauntlet: 29 μm
- 100 % tight lateral protection with hot melt
- Avoid lateral short circuits
- Low internal resistance and high porosity
- High energy density



Stable cycle life time

Tubular plate manufacturing: Use of reinforced woven gauntlets



Fig 9: Tubular plate

Constant pressure to the positive active mass leads to:

- Best contact between conductive lead and active mass (prevents effective PCL1 effect)
- Reduced mass softening and shedding (prevents effective PCL1 effect)



Stable cycle life time

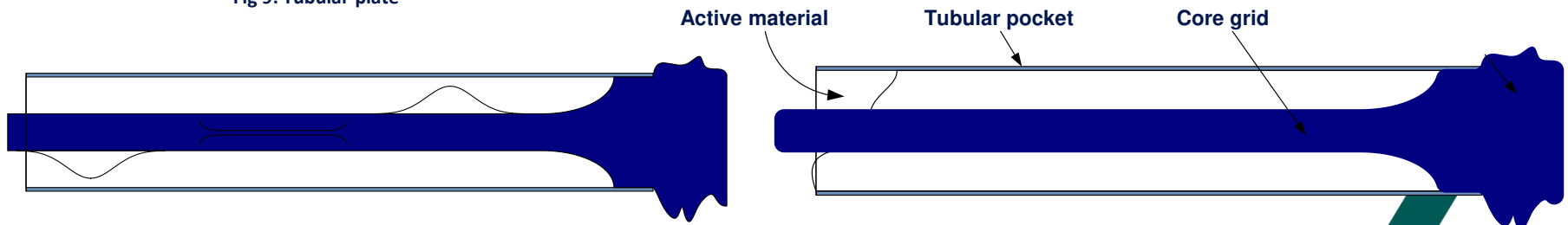


Fig 10: schematic view of a tubular plate before and after filling

Tubular plate manufacturing: Use of reinforced woven gauntlets



Fig 11: SEM of the woven gauntlet tubular pocket

- Holding back the active material
- Flexible and stable at the same time for long term periodical cycling and withstanding the extending tubes at each cycle
- Porous enough to let pass the sulphate ions

Design protected BAE Panzerpol – pole bushing

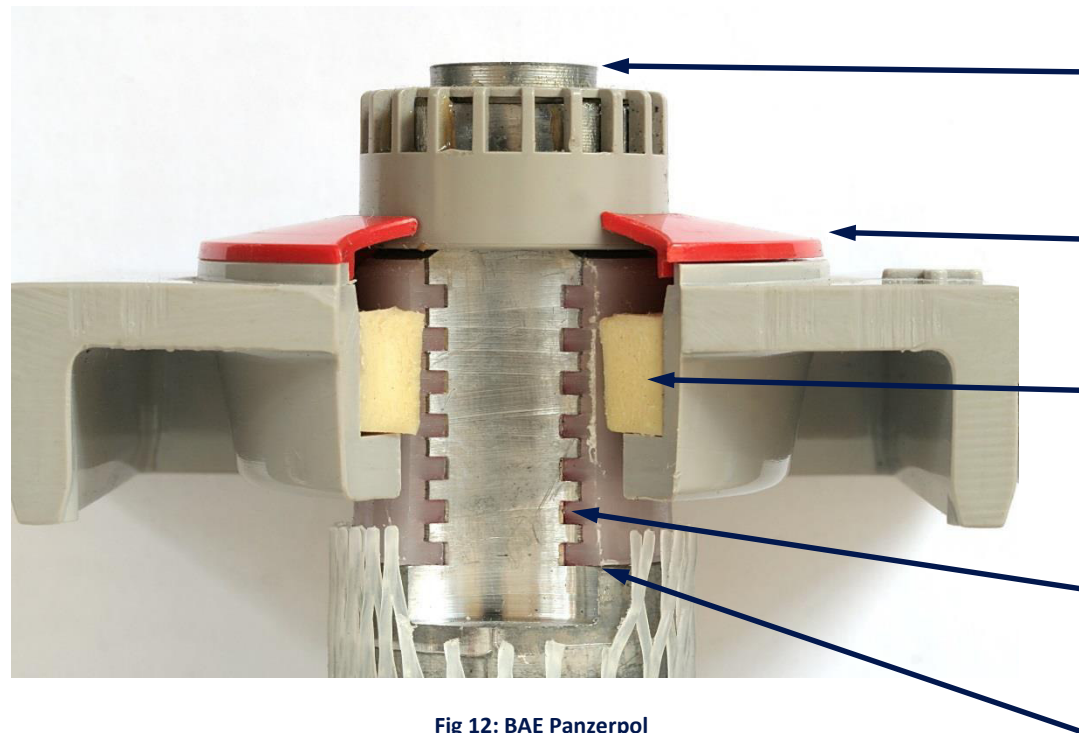


Fig 12: BAE Panzerpol

Lead pole with brass or copper inlay

Washers in polarity colours

Rubber gasket allows 16 mm (!) sliding of the pole while keeping 100% tight

Labyrinth with primer between plastic and pole

Plastic injection molding

Block and single cell production: Patented service ring and terminal design “Panzerpol”

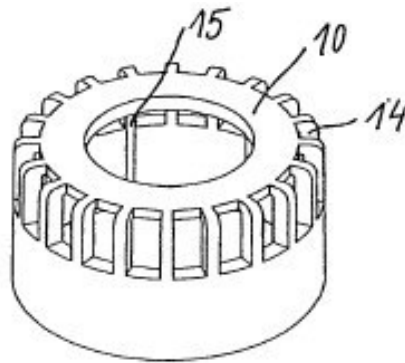


Fig 18: BAE insulated battery pole with service cap

Optimised pole bushing set and patented service ring:

- Sliding terminal construction allows growth of plate set over the life time and prevents damaging of battery lid
- Design is used for cells as well for block batteries (for every single cell at the block battery)
- Service ring allows access for maintenance (voltage reading) with installed connectors



Tight terminal bushing and access to poles over complete battery life time

Pole bushing and terminal design “Panzerpol”

6V 11 OGi 275 block battery – 10 years in operation at airport Dresden

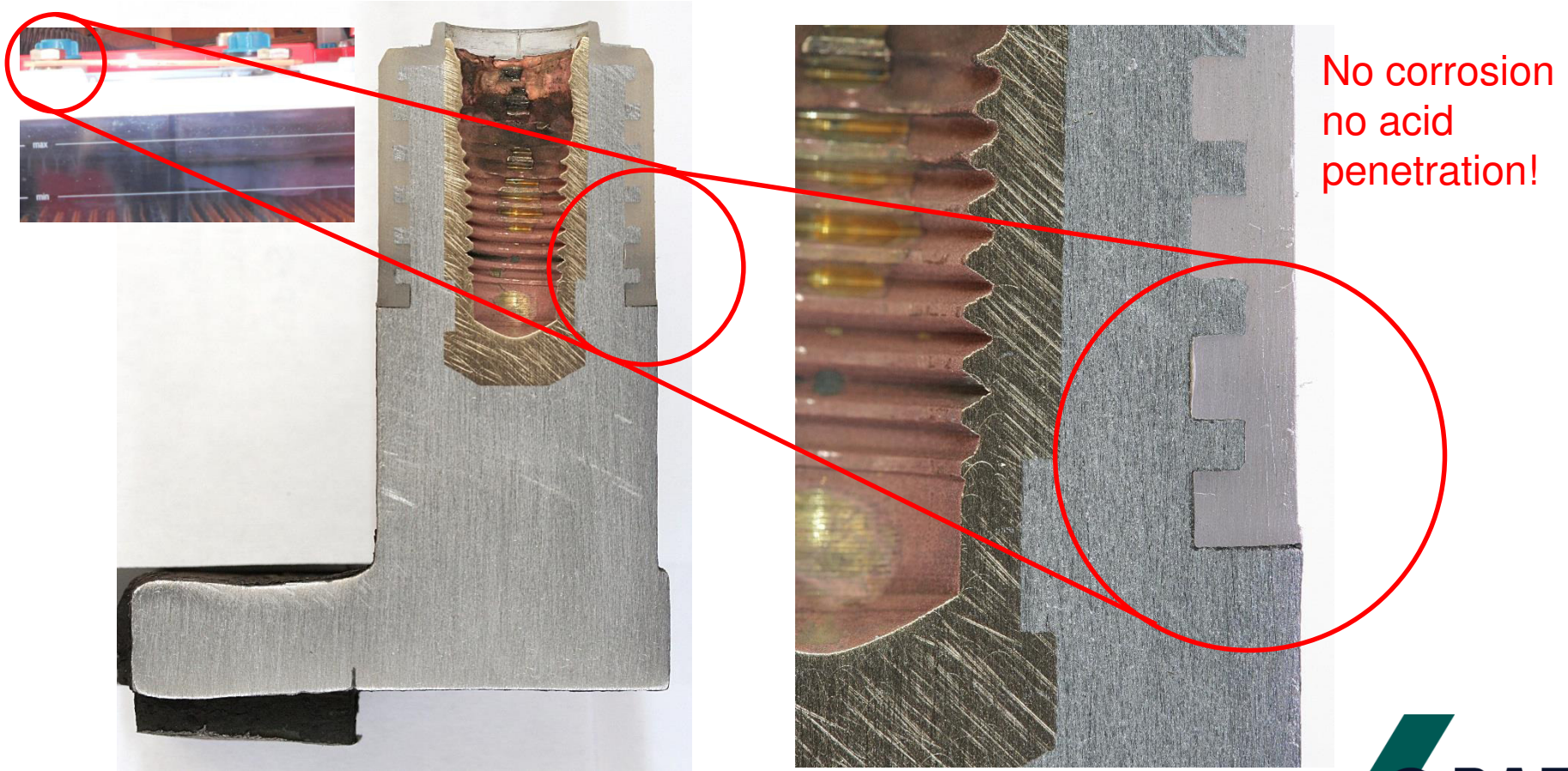


Fig 19: BAE Panzerpol shows no acid penetration after 10 years of operation

Block and single cell production: BAE “Panzerpol” inserts



Fig 20: Comparison of BAE Panzerpol inserts and competitor

- BAE is using long inserts
- Tinned inserts made from brass for OPzS, OPzV, OGiV and OPzV block
- Inserts made from copper for OGi cells



Best conductivity and current carry capability

BAE **SECURA** Product range – Quality



BAE sets the quality standard for battery cells ...

1

High pressure casting

2

Dry filling of red lead

3

Tank formation

4

Use of reinforced woven gauntlets

5

Patented BAE Panzerpol

**BAE Secura product range
for stationary applications**

BAE Batterien GmbH



Thank you for your attention!

BAE INFORMATION

BAE bestätigt die Einhaltung des Batteriegesetzes (BattG), gültig seit dem 01.12.2009, zuletzt geändert am 24.02.2012. BAE ist nach dem Batteriegesetz beim Umweltbundesamt als Hersteller von Industriebatterien registriert.

BAE confirms the compliance to the battery law, valid from 1 December 2009, last update on 24 February 2012. BAE is registered as a manufacturer of lead batteries in accordance with the battery law at the German environmental agency.

Melderegisternummer: 21000599

Umweltrelevante Einflüsse werden bereits während der Entwicklung und Fertigung von BAE Produkten berücksichtigt. Dies betrifft sowohl die umweltgerechte Herstellung der von BAE eingesetzten Komponenten, die uneingeschränkte Recyclingfähigkeit der Produkte und der eingesetzten Bauteile als auch die Auswahl der Prozesse und Verfahren.

BAE versichert, dass im Unternehmen ein mit den Behörden abgestimmtes und überwachtes eigenes Entsorgungssystem für Altbatterien und bleihaltige Abfälle betrieben wird.

BAE nimmt gemäß dem Batteriegesetz alle Bleibatterien und Einzelzellen, unabhängig von Herkunft und Herstelldatum, zurück und führt sie einem geordneten Recycling zu.

Zurückgenommene Altbatterien und eigene Produktionsabfälle führt BAE gemäß den Bestimmungen des Kreislaufwirtschafts- und Abfallgesetzes (KrW-/AbfG) dem Recycling zu. Auf Wunsch wird das von BAE in Verkehr gebrachte Verpackungsmaterial zurückgenommen und ordnungsgemäß nach dem KrW-/AbfG entsorgt. BAE setzt für Entsorgungen, Recycling und den dazugehörigen Transporten ausschließlich zertifizierte Fachunternehmen ein. Alle Vorgänge in Bezug auf Rücknahme, Abfallsammlung, Verwertung und Entsorgung werden im Verwaltungssystem lückenlos zur Nachweisführung dokumentiert. Diese Dokumentation wird behördlich und im Rahmen der Auditierung nach DIN ISO 14001 regelmäßig geprüft.

BAE versichert weiterhin, dass wir unseren Kunden und auch anderen Interessierten in Bezug auf Entsorgungsfragen jederzeit beratend zur Verfügung stehen.

Registration number: 21000599

Environmental impacts are already taken in consideration during the process of development and manufacturing of BAE products. Both environmentally compatible production of BAE made components and manufacturing of absolute recyclable products as well as the choice of environmentally friendly processes and methods.

BAE assures an official approved and supervised disposal system for used batteries and lead contented scrap.

In accordance with the battery law BAE takes back all lead batteries and single cells independently from origin and age and supplies them to a regular recycling.

Taking back old batteries as well as own process waste is given to a recycling system in accordance with the cycle waste avoidance and management Act. On request we take back and dispose the package material which was placed into circulation by BAE in accordance with the cycle waste avoidance and management Act. For disposal, transport and recycling BAE commissioned only certified companies. All activities concerning taking back, waste collection, disposal and recycling are documented consistently for verification management. That documentation is officially and regularly checked by auditing in accordance with DIN ISO 14001.

Furthermore, BAE assures to be available for any disposal questions of our customers or other interested parties.

Relevance of Environment for BAE Products

A safe handling of batteries means no immediate environmental impact. During operation a little amount of hydrogen escapes as a result of the chemical reaction during charging. Therefore, ventilation is necessary. (Operation instruction has to be observed)

1. General

Lead-acid batteries of BAE Batterien GmbH (BAE) must not dispose as waste product. BAE undertakes to take back their products from customers. 95 % of BAE batteries are recyclable.

2. Components of BAE Lead-acid batteries

2.1. Electrolyte

Skin contact is to avoid urgently. Protection glasses are necessary while working with the batteries. Remains of electrolyte must not give in the sewerage. The electrolyte has to be neutralized and the remaining materials dispose professionally. BAE realize that within the return. Remains of electrolyte must not contaminate the soil. That means a hazard for Animals and plants.

2.2. Plate material

The electrodes of lead-acid batteries mainly consist of ground lead (Lead powder/lead oxide). Skin contact has to be avoided because lead can come into the body through skin. Professional handling for lead up to reuse of secondary lead is absolutely necessary.

3. Hazard for environment during operation of Lead-acid-batteries

While working with batteries such as maintenance protective clothing is necessary as well as the observing of the safety and operating instructions.

4. Environmental impact in case of damage

Damage of one or more cells means a direct hazard for health of people in the immediate vicinity as well as for the environment unless the safety instructions have to be observed. In case of damage the contact to BAE is recommended.



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 Fax. +49 (0)30 5354949
 E-Mail: info@bae-berlin.de
www.bae-berlin.de

BAE *QUALITY CERTIFICATES*

BAE Batterien GmbH fulfills the quality standard DIN EN ISO 9001 and offers the following three different types of test certificates:

1. Test Certificate 3.1

BAE certifies that the delivered BAE cells/blocks are manufactured in accordance with the material and manufacturing specification and furthermore, that the test procedures meet the requirements of the test instructions. In particular the following tests are certified:

- Tightness
- Acid density
- Final charging voltage

An example of the Test Certificate 3.1 is enclosed as attachment 1.

2. Test Certificate 3.1 including capacity test

In addition to the test certificate 3.1.B all cells/blocks are discharged for 5 or 10 hours immediately after putting into operation. After 95% of the discharge time the cell voltages of all cells/blocks is measured in order to verify the capacity in accordance to IEC 60 896-11 or IEC 60896-21. An example of the test certificate 3.1. including an example capacity test is enclosed as attachment 2.

3. Test Certificate 3.1. including Capacity Test Report

In addition to the Test Certificate 3.1 including capacity test BAE offers an advanced and extensive test report. For the capacity test in this certificate all ordered cells/blocks are discharged for the time in accordance with the customer's requirements, measured and recorded. Furthermore, single acid densities and final voltages are recorded in detail.

An example of the Test certificate 3.1 including Capacity Test Report is enclosed as attachment 3. It shows measured cell voltages after 10%, 50%, 80%, 90%, 95% and 100% discharge time.

All described certificates are made by a manufacturing independent department and approved by an assigned technical expert.



Lars Plümer

Quality Department

BAE Batterien GmbH

24.09.2013

BAE QUALITY CERTIFICATE 3.1

Notes related to BAE Test Certificate 3.1

BAE certifies that the delivered BAE cells/blocks are manufactured in accordance with the BAE material and manufacturing specifications. Furthermore, the test procedures meet the requirements of the BAE test instructions. For creating the test certificate 3.1 the following test procedures are included:

Tightness

Each BAE cell/block shall be tested for tightness.

The sealing of all types of BAE *SECURA* OPzS, OPzV, OGi, OGiV, PVS and PVV have an adhesive bond (gluing) between lid and container. The pole sealing is enabled by a rubber ring between the plastic coated lead pole and the lid.

All types of BAE *SECURA* SPzS, SPzV, SGi, SGiV, PVSM and PVVM have a plastic welding connection between container and lid (heat sealing). Each pole bushing is permanently sealed by a screwed connection between pole nut and pole and two rubber rings in between.

In both cases straight after the production step of gluing or heat sealing a test for tightness will be done. A defined over pressure of air will be brought into the cell. The tightness test results will be monitored. If there is no leakage detected the cell or block production can be continued. Defective cells/blocks shall be removed.

BAE <i>SECURA</i> types	BAE Manufacturing Specifications	BAE Test Instructions	Measuring values with tolerances
OPzS, OPzV, OGi, OGiV, PVS, PVV	FS 080-18-1	PV 301-09	200 ± 2 mbar
SPzS, SPzV, SGi, SGiV, PVSM, PVVM	FS 080-03	PV 301-02	245 ± 3 mbar

Final charging voltage

For all filled BAE cells/blocks the final charging voltage will be measured after commissioning and charging. The final charging voltage shall be ≥ 2.6 V/cell at 20°C for all BAE *SECURA* products.

In the last phase of charging (0.5 h before end) the voltage of each single cell will be measured and logged.

BAE <i>SECURA</i> types	BAE Manufacturing Specifications	BAE Test Instructions	Measuring values with tolerances
OPzS, SPzS, PVS, PVSM	FS 080-20	PV 303-02	≥ 2.6 V/cell at 20°C
OGi, SGi	FS 080-26	PV 303-02	≥ 2.6 V/cell at 20°C
OPzV, SPzV, PVV, PVVM	FS 080-28-1	PV 303-03	≥ 2.6 V/cell at 20°C
OGiV, SGiV	FS 080-28-6	PV 303-03	≥ 2.6 V/cell at 20°C

Notes related to BAE Test Certificate 3.1



Acid density (only for VLA cells/blocks)

For filled flooded (VLA) batteries the acid density shall be tested right after commissioning and charging of all cells/blocks in the BAE charging station by an electronic density meter. If necessary the acid density shall be adjusted to the specified value.

BAE <i>SECURA</i> types	BAE Manufacturing Specifications	BAE Test Instructions	Measuring values with tolerances
OPzS, SPzS, PVS, PVSM	FS 080-20	PV 303-02	1.24 ± 0.01 g/cm ³
OGi, SGi	FS 080-26	PV 303-02	1.24 ± 0.01 g/cm ³

Definitions of terms:

VLA = Vented lead–acid batteries:

BAE *SECURA* OPzS, SPzS, OGi, SGi, PVS and PVSM

VRLA = Valve-regulated lead–acid batteries:

BAE *SECURA* OPzV, SPzV, OGiV, SGiV, PVV and PVVM

Lars Plümer

Quality Department

BAE Batterien GmbH

24.01.2014



VRLA TEST CERTIFICATE 3.1

according to EN 10204

certificate no.: 0.. / 13

Manufacturer: BAE Batterien GmbH / Germany		Customer: (Customer)	
Issued by: Quality department		BAE order No.: 411.... Customer order No.: 130.....	
Type : cell 6 OPzV 300 PPOl		Units delivered: 61 cells	
Serial – no.: 102..... / 01 - 61		Delivery time 10 nd Week 2013	
Tested parameter: <ol style="list-style-type: none"> 1. Production of the cells in accordance with BAE technical specifications 2. Tightness (testpressure 250 mbar) 3. Initial capacity according to DIN EN 60896 –21 (Optional) 4. End of charge voltage 5. Acid density (flooded types only) 		Units tested: 61 cells	
Test result: <ol style="list-style-type: none"> 1. The cells meets the requirements of the BAE technical specifications: O.K. 2. Tightness test result: O.K. 3. Capacity test: O.K. 4. End of charge voltage in accordance to BAE manufacturing specification: O.K. 5. Acid density (flooded types only) O.K. 			
Date: 10.03.2013		Quality Manager: i.A. Krüger Plümer	

CERTIFICATE OF AUTHORIZATION NR. 3591



This is to certify that ⁽¹⁾ ⁽²⁾ ⁽³⁾

BAE Batterien GmbH, Berlin (G)

is hereby authorized to act as

Manufacturer

in accordance with the applicable rules of

10CFR50 Appendix B

This authorization is granted on the basis of their "Integriertes Management – Handbuch" dated April 2016 which scope and implementation have been reviewed and accepted by Tractebel Engie on November 8th to 10th, 2016 (see audit report ref. TE - CNT-KCD/4FR/24457/000/01 and Type-test audit report ref. TE CNT-KCD/4FR/24457/001/00)

for the design, procurement, manufacturing, examination, testing, handling, packaging, storage, shipping of:

- **OPzS open tubular batteries with liquid electrolyte**
- **OPzV sealed tubular batteries with gel electrolyte, qualification level 1EB***

*(OpzV sealed tubular batteries with gel electrolyte (RSQ 55.20) may not be ordered)

At the above location only from November 10th, 2016 until November 10th, 2019.

François Lefèbvre
Group Manager
Nuclear Department

Christian PIERLOT
General Manager
Nuclear Department



AM-81-E | AUTHORI/4AC/3591 | CQR: 16067 | RSQ: 55.10 & 55.20

(1) This authorization does not relieve its holder from his contractual obligations towards the Owner. By this authorization, Tractebel does not "approve", "certify", "rate", or "endorse" any product or construction.
(2) In case of any change to the scope, performance address, company name, or any change in company organization or shareholding; the authorization document is deemed to be obsolete and will need renewal
(3) Acting for the benefit of Electrabel

BAE Konformitätserklärung **Declaration of conformity**

Der Hersteller / *The producer*

BAE Batterien GmbH
Wilhelminenhofstraße 69/70
12459 Berlin
Germany

erklärt hiermit, dass folgende Produkte / *declares the following products*

BAE SECURA OPzS
BAE SECURA OPzS BLOCK
BAE SECURA OPzV
BAE SECURA OPzV BLOCK
BAE SECURA OGi
BAE SECURA OGi BLOCK
BAE SECURA OGiV BLOCK
BAE SECURA PVS solar
BAE SECURA PVS BLOCK solar
BAE SECURA PVV solar
BAE SECURA PVV BLOCK solar

die Schutzart IP 25 haben gemäß / *have protection class IP 25 according to*

EN 60529

Schutzarten durch Gehäuse (IP-Code)

Degrees of protection provided by enclosures (IP Code)

BAE Batterien GmbH

Dr. Julia-Beatrix Nehmann

Berlin, March 2016

BAE Batterien GmbH
Wilhelminenhofstraße 70
D-12459 Berlin - Germany
Postfach 9 • D-12442 Berlin - Germany



FINAL REPORT

QUALIFICATION 1EB NON IRRADIATED BATTERIES FOR NUCLEAR POWER PLANTS TYPE OPzV



fig. a: Test equipment for the ageing at 62,8°C, laboratory BAE



fig b: Test-batteries OPzV during the seismic test at IABG, Munich

BAE Berliner Batterie GmbH Wilhelminenhofstraße 69/70 D-12459 Berlin

ENERGY FROM BATTERIES





FINAL REPORT

Contents

1. Purpose of the tests.....	3
2. Type of tested equipment	3
3. Parameters of the tests	4
4. Results to be achieved (criteria's)	6
5. Achieved Results.....	7
6. Results of the seismic test.....	9
7. Conclusions.....	10

Appendix A	Time table
Appendix B	Test certificate of the seismic test
Appendix C	Test protocol of the discharge test after passing the seismic test
Appendix D	Test results of the discharge tests
Appendix E	Drawings of the racks
Appendix F	Test report of the seismic test (IABG)

FINAL REPORT

1. Purpose of the tests

The batteries BAE SECURA OPzV shall be qualified according to the **IEEE Std 535-1986 as Class 1E Lead Storage Batteries for Nuclear Power Generation Stations**.

The batteries should be resistant against seismic vibrations over their whole life of 15 years at 23 °C.

To cover the whole spectrum of BAE SECURA OPzV-batteries three different cell sizes with each 3 samples were chosen for the test.

According to IEEEStd 535 the batteries were aged at high temperatures to accelerate the whole life of 15 years. After that the 3 samples were build in plastic coated steel racks and exposed to seismic vibrations according to the **“Specification of qualification per test to the seism and the AOE for tubular vented and sealed batteries”**. After the vibration test the batteries were capacity tested to check the potential influence of the seismic vibration.

2. Type of tested equipment

The batteries BAE SECURA OPzV are based on 50, 70, 100 and 125Ah plates. We selected the smallest, the tallest and a medium-sized plate: 50, 70 and 125Ah plates. These batteries are defined by DIN 40 742.

We applied the panzer pole bushing.

The cells are made according to our standard manufacturing specifications and tested according to our standard test specifications.

Number of sample	Type	Pole bushing	C10 $U_f=1,80V$	C3 $U_f=1,75V$ (DIN 40742)	Type of used plates
9	4 OPzV 200	Panzer	200 Ah	150Ah	50 Ah
8	4 OPzV 200	Panzer	200 Ah	150Ah	50 Ah
7	4 OPzV 200	Panzer	200 Ah	150Ah	50 Ah
6	7 OPzV 490	Panzer	490 Ah	368Ah	70 Ah
5	7 OPzV 490	Panzer	490 Ah	368Ah	70 Ah
4	7 OPzV 490	Panzer	490 Ah	368Ah	70 Ah
3	16 OPzV 2000	Panzer	2000 Ah	1488Ah	125 Ah
2	16 OPzV 2000	Panzer	2000 Ah	1488Ah	125 Ah
1	16 OPzV 2000	Panzer	2000 Ah	1488Ah	125 Ah

table 1: overview of the selected samples

The cells were placed in a heating cabinet filled with water (see fig.a). A heater, a pump and temperature measuring devices were working in a coordinated way to secure a temperature of 62,8 °C +- 1 °C. The capacity tests were made at 25 °C. To avoid water vapour inlet from the water bath into the cells all OPzV cells were

FINAL REPORT

surrounded by a special bag, which consists of three layers: a polyester layer for heat-welding the bag, an aluminium layer as a water vapour barrier and a polyethylene layer as protection of the aluminium. This bag was tightly assembled around the cells by a special tape.

We used for the OPzV test the same plastic coated steel racks as used for the OPzS cells. For the drawings of these steel racks see Appendix E. The distance between the cells and the rack, necessary for the assembling, was filled by plastic spacers. The racks are designed for each 6 cells. To get a full load for the racks we used each three OPzV cells and three OPzS cells as dummy load. The arrangement can be seen in Fig.b.

3. Parameters of the tests

In IEEE Std 535-1986, 8.2.2 table 1 the thermal ageing factors are given: $365/20 = 18,25$ for lead calcium-pasted and $365/25 = 14,6$ for lead antimony-pasted batteries.

The batteries BAE SECURA OPzV have a lead calcium tin alloy and have tubular design. Concerning life time and ageing behaviour it corresponds to the lead-calcium-pasted type.

The chosen factor of 18,25 means 15 years at 25 °C corresponds to 300days at 62,8 °C.

Tractebel has a life time requirement of 15 years at 23 °C. The ageing factor has therefore to be extrapolated from 25 °C to 23 °C by the Arrhenius law.

$$k(T) = A * e^{-\frac{E}{RT}}$$

$$\frac{k_2}{k_1} = e^{-\left(\frac{E}{RT_1} - \frac{E}{RT_2}\right)}$$

equation 1: arrhenius law

with the terms:

k_1, k_2 :	aging factors for different temperatures
T_1, T_2 :	various temperatures (simulated and reference temperature)
E :	activation energy
R :	gas constant 1,987 cal/mol/K

Using $T_1=25\text{ °C}$, $T_2=62,8\text{ °C}$ and $k_2/k_1=18,25$ the Arrhenius equation calculates an activation energy of 15.280cal/mol.

Using $T_1=23\text{ °C}$, $T_2=62,8\text{ °C}$ and an activation energy of 15.280cal/mol the Arrhenius equation calculates $k_2/k_1=21,7$.

15 years at 23 °C corresponds then to 252 days.

We decided to divide the test into 5 periods, every period 50 days long. As we can see from the time table (see Appendix A) it takes at least one day to change the temperature from 25 °C to 62,8 °C or back. Insofar we have further 10 days in the mediate temperatures.

Every 50 days we perform a 3h-capacity test. This enables us to see the development of the capacity over life time.

FINAL REPORT

The float voltage during the 5 times 50 days was 2,25V per cell.

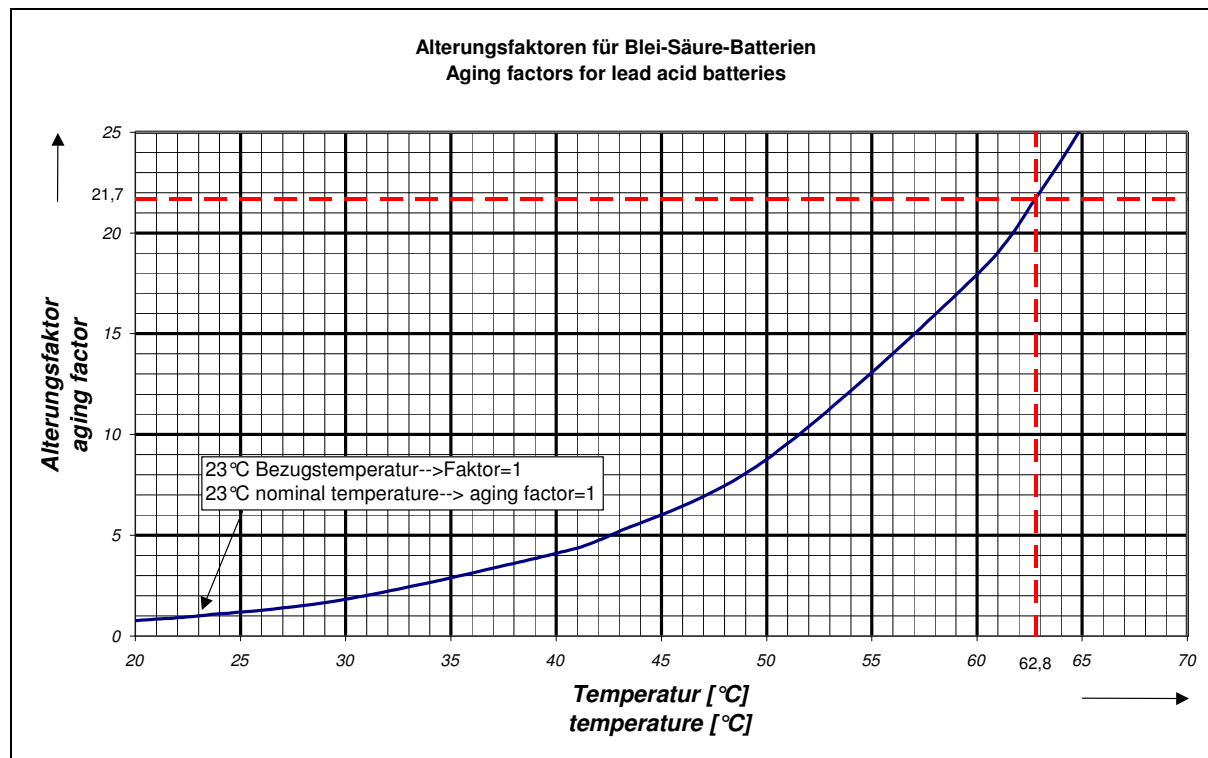


figure 1: Aging factors

Parameters for the seismic test

Each three cells 4 OPzV 200, 7 OPzV 490 and 16 OPzV 2000 were assembled in the steel racks together with each three corresponding OPzS cells. These batteries were mounted on the platform together with a 48V 6 SPzV 360 battery in a steel rack. The platform can be accelerated in all 3 axis.

The seismic vibration requirements are given by the **“Specification of qualification per test to the seisms and the AOE for tubular vented and sealed batteries”**

TISSIT/4NT/0053709/001/00 Edition 031003.

In §3 the following tests are required:

- preliminary tests of search for natural frequencies per sinusoidal sweeping in three directions
- 5 tests OBE each 30 s, response spectrum with 2% damping
- 1 test SSE and AOE 30 sec, response spectrum with 4% damping

FINAL REPORT

4. Results to be achieved (criteria's)

The reference capacity is the 3h-capacity. In DIN 40 742 the 3 hour capacities at the reference temperature of 20 °C are listed:

type	Nominal capacity 10h rate, 1,8V/cell [Ah]	Nominal capacity 3h rate 1,75V/cell [Ah]	3h rate [A]
4 OPzV 200	200	150	50
7 OPzV 490	490	368	122,7
16 OPzV 2000	2000	1488	496

table 2: capacities acc. DIN 40 742

The criteria for a successful test are:

- 3h-capacity better than 95% of the DIN values at start.
- 3h-capacity better than 80% after the ageing test
- 3h-capacity better than 80% after the seismic test
- All cells should keep during the whole test their integrity, no cracks of the lid and container, no acid loss due to damages or corrosion effects at the pole bushing.

The capacity tests and their temperature compensation are ruled by IEC 60896-11:2002

$$C_{a23^{\circ}C} = \frac{C}{1 + \lambda(\vartheta - 23^{\circ}C)}$$

with :

$C_{a23^{\circ}C}$ = capacity at 23°C

C = measured capacity at temperature ϑ

λ = correction factor; 0,006 for the 3 - hour discharge rate

equation 2: formula for temperature compensation

Example:

Capacities measured at 27 °C have to be reduced by 2,4% to get the value at 23 °C.

FINAL REPORT

5. Achieved Results

The test procedure and its timetable is shown in the Appendix A.

Every discharge was done in a water reservoir tempered to 25°C. The temperature correction factor to the required 23°C is –1,2%.

In table 3 we have given the average values of all 6 cells. The single cell values are given in Appendix C and D.

type	initial discharge			first discharge test			second discharge test		
	time [min] @25°C	% @25°C	% @23°C	time [min] @25°C	% @25°C	% @23°C	time [min] @25°C	% @25°C	% @23°C
4 OPzV 200	219	122	120,8	235	131	129,8	234	130	128,8
7 OPzV 490	255	141	139,8	264	147	145,8	263	146	144,8
16 OPzV 2000	236	131	129,8	231	128	126,8	224	125	123,8

type	third discharge test			fourth discharge test			fifth discharge test		
	time [min] @25°C	% @25°C	% @23°C	time [min] @25°C	% @25°C	% @23°C	time [min] @25°C	% @25°C	% @23°C
4 OPzV 200	235	131	129,8	229	127	125,8	233	130	128,8
7 OPzV 490	251	139	137,8	232	129	127,8	213	118	116,8
16 OPzV 2000	219	121	119,8	203	113	111,8	170	94	92,8

table 3: results of the five high temperature cycles

After successful completion of the ageing test, the seismic test at the IABG, Ottobrunn took place on the 16. July 2004. Results see §6.

During the seismic tests a small current was generated by the batteries. In the IABG test report (see Appendix F) it can be seen, that during the seismic test the current was flowing without interruption, i.e. no internal mechanical damage occurred.

On 13. August 2004 the capacity test after the seismic test took place at BAE (see also Appendix C, Test protocol of the discharge test). The cells from the seismic test were discharged at room temperature with the nominal current (see table 2). The initial cell temperatures were 27,3°C, 28,5°C and 27,8°C. The results of this discharge test are listed in table 4. The correction factor is: 1,026, 1,033 and 1,029.

FINAL REPORT

type	sixth discharge test (after the seismic test)		
	time [min]	%	% @23°C
4 OPzV 200	> 190min at 27,3°C	> 105,5% at 27,3°C	> 102,8%
7 OPzV 490	> 190min at 28,5°C	> 105,5% at 28,5°C	> 102,1%
16 OPzV 2000	179 at 27,8°C	99,4% at 27,8°C	96,6%

table 4: results of the discharge test after the seismic test

In figure 2 the float current normalized to 100Ah nominal capacity (C10) is displayed. The float current is in the same region as the float current of the OPzS cells. They don't increase during life, because we have no antimony-effect as for the OPzS cells. The low float current means less energy consumption and less heat evolution. Insofar no danger of thermal runaway exists. After the capacity tests at 50, 100, 150 and 200 days the float current is higher due to more oxygen in the cells, which is produced during recharging of the cells and is consumed during subsequent float.

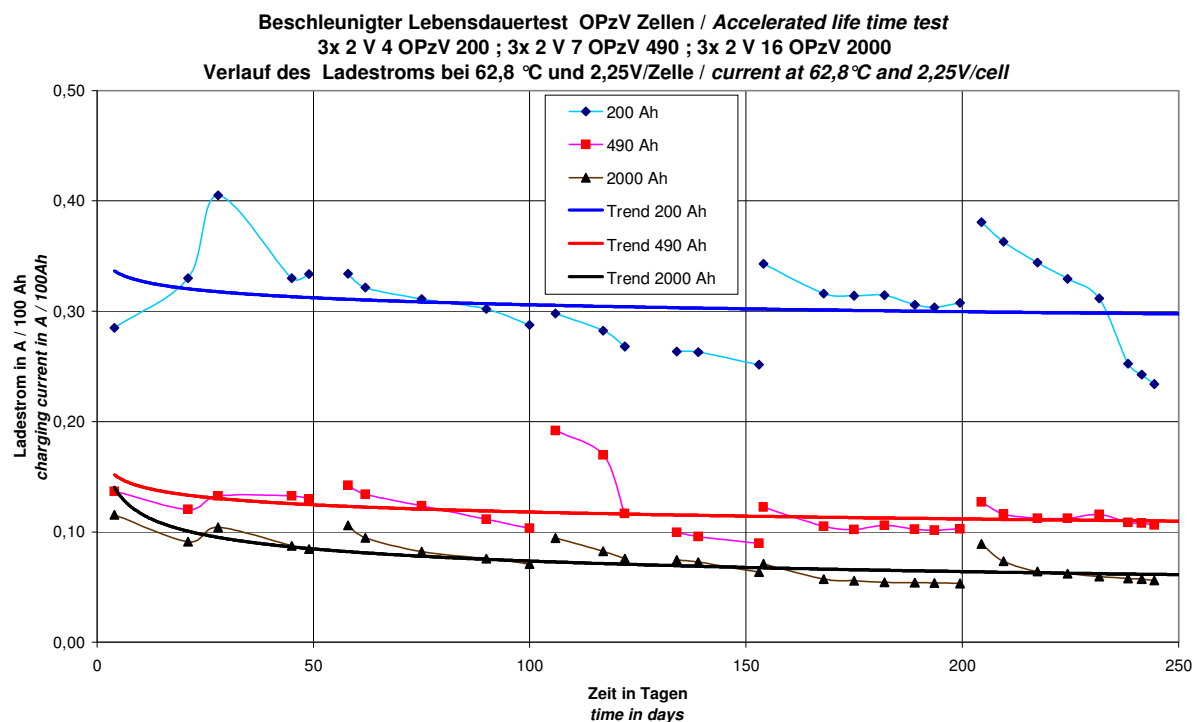


figure 2: charging current during float operation

FINAL REPORT

6. Results of the seismic test

A complete test report is in Appendix F.

The test certificate is in Appendix B.

	x	y	z
12V 4 OPzV 200	Values have to written in		
12V 7 OPzV 490			
12V 16 OPzV 2000			

table 5: resonance frequencies of the test batteries

Most of the building resonance frequencies are in the range from 10 to 18 Hz. Insofar it is a good quality of the battery/rack design and construction to have resonance frequencies above 20Hz.

The test response spectra (TRS) in the frequency range of 1,5Hz to 30Hz are well above the required response spectra (RRS). See appendix F. Therefore the batteries were exposed to accelerations above the requirements.

After the test all the OPzV cells were examined. No external damage was observed after the seismic tests at all the batteries.

FINAL REPORT

7. Conclusions

After a period of 250 days under float voltage and at a temperature of 62,8°C and a tri-axial time history seismic test every tested cell has a capacity of >80%_{23°C}.

The reached capacities for the 4OPzV 200 cells is >102,8%, for the 7OPzV 490 >102,1% and for the 16OPzV 2000 96,6% of the nominal capacity.

This is high above over the required 80% of the nominal capacity.

With the 250 days at 62,8°C 15 years at 23°C battery temperature are simulated.

The seismic test (certificate see Appendix B, test report appendix F) caused no damages or cracks of the containers, lids, pole bushings or other components of the pre-aged cells.

After the seismic test the function of the battery was ensured.

The batteries BAE SECURA OPzV cells are very well suited for the special requirements of nuclear power plants.

They fulfil the **IEEE Std 535-1986 as Class 1E Lead Storage Batteries for Nuclear Power Generation Stations**.

Dr.Wieland Rusch
Research & Development

Sven Zarske
Electrical test

Rene Meinhardt
Seismic test

BAE Berliner Batterie GmbH - Wilhelminenhofstraße 69/70 - D-12459 Berlin

Berlin, 13.8.2004

Sachverständiger für Ladegeräte, Batterien und Elektroenergieversorgung durch Batterien.

Gerhard Miltenberger
Friedrich-Ebert Str. 14
D-63694 Limeshain

Certificate of conformity of special BAE-Batteries to IEC 896-2 : 1995 "Stationary lead-acid batteries - General requirements and methods of test - Part 2: Valve regulated types

- 1.1. Client:** BAE Berliner Batterie GmbH
Wilhelminenhofstrasse 69
Herr Dr. Wieland Rusch R + D
D-12459 BERLIN
- 1.2. Scope of order:** Evaluation of valve regulated lead acid batteries of the
product range
"BAE Secura OPzV"
to their conformity to IEC 896-2 : 1995 : Part 2

2. Assessment:

All required test procedures, refer to the demands of the IEC 896-2 : Part 2, have been tested in the labs of the BAE Berliner Batteriefabrik GmbH as well as in the lab of AUCOTEAM GmbH Berlin (mechanical tests, vibration and shock).

All test data und results are reported in the "TEST REPORT BAE Secura OPzV" dated 01.04.03, confirm the demands of the IEC 896-2 : 1995.

3. Enclosure:

Enclosed please find the report "TEST REPORT BAE Secura OPzV", dated 01.04.03.
This paper is a constituent part of this certificate.


Gerhard Miltenberger
01.05.03



file: IEC_BAE_2e.doc

Telefon: 06048-9602 0
Telefax: 06048-9602 21
eMail: GMiltenerberger@t-online.de

Bankverbindung: Volksbank Büdingen eV
BLZ: 507 613 33
Konto Nr. 247 715



INVERSOR DC/AC

CONTENIDO

- Carta de garantía del fabricante.
- Términos de Garantía.
- Certificados EN 60950-1 Y EN 62109-1



LIMITED FACTORY WARRANTY

Warranty Period

Studer Innotec SA (hereafter Studer Innotec) warrants its full range of products to be free from defects in workmanship and materials for the applicable Warranty Period:

- for the AJ, Compact, SI, VarioString, VarioTrack, Xtender, and all Studer-made accessories: 5 years starting on the earlier of (i) 6 months from shipment from Studer Innotec, and (ii) the final sale of the product.
- for all other products, including battery accessories such as the MBC, MDC, MDCI, MBI, MBR, MBW, SBM-02, etc.: 2 years starting on the earlier of (i) 6 months from shipment from Studer Innotec, and (ii) the final sale of the product.

Extended Warranty Period

For the AJ, VarioString, VarioTrack and Xtender products manufactured after 1 January 2018, an additional 5-year Extended Warranty Period (total 10-year Warranty) is granted for those products that are registered online with Studer Innotec within 90 days of their final sale. The date of product registration does not delay the start of the Warranty Period.

The Extended Warranty is subject to the following limitations:

- it does not cover defects due to failure of the following components that are subject to aging by harsh conditions: fans and capacitors.
- it does not cover the VarioString and VarioTrack products for non-solar PV applications.

Warranty eligibility

Only the original owner of the product at the place of its first installation is eligible to make a claim on the warranty. Resale or reinstallation of the product without authorization from Studer Innotec will result in loss of warranty.

Warranty coverage

During the Warranty and Extended Warranty Periods, Studer Innotec will, at its option, repair or replace the defective product free of charge. Studer Innotec shall not be liable for damages, whether direct, incidental, special, or consequential, caused by negligence or fault, even if having been advised of the probability of such damages.

Exclusions

This warranty will not apply where the product has been misused, neglected, improperly installed, or repaired by anyone other than Studer Innotec or one of its QSP. To qualify for the warranty, the product must not be disassembled, modified, or have suffered any physical damage internally or externally.

This warranty does not cover damages arising from improper use such as:

- Reverse of battery polarity.
- Inadequate installation of the product and/or of its accessories.
- Mechanical shock or deformation.
- Contact with liquid or oxidation by condensation.
- Use in an inappropriate environment with exposure to dust, corrosive vapour, humidity, high temperature, etc.
- Intrusion of insects, animals, or any living organism.

- Breakage or damage due to lightning or overvoltage due to any external cause.
- Damage to connection terminals and screws from misuse or incorrect tightening.
- Damage during transport.
- Force majeure.

Warranty service

Studer Innotec owns all parts removed from repaired products. Studer Innotec uses new or reconditioned parts made by various manufacturers in performing warranty repairs and building replacement products. If Studer Innotec or a QSP repairs or replaces a part of a product, its Warranty Period is: (i) the remaining time of the original Warranty Period or (ii) 6 months from the date of shipment from Studer Innotec or the QSP, whichever is longer.

Warranty procedure

If a product requires service, the product reseller should be contacted first. In the event the reseller cannot be contacted, or if they are not able to provide service, direct contact should be made with Studer Innotec.

If Studer or a QSP determine the product should be sent in for service, a Return Form for Service is required before the product will be accepted for service.

The warranty claimant must provide all necessary information to process the warranty claim including, when applicable, the purchase invoice, product serial number, date of installation, and Extended Warranty Certificate. The faulty product must be sent at the sender's expense back to a QSP or Studer Innotec.

CAUTION: transport must be organized in a way to avoid damage to the product.

Life Support Policy

As a general policy, Studer Innotec prohibits the use of any of its products in life support applications where failure or malfunction of the Studer Innotec product can be reasonably expected to cause failure of the life support device or to significantly affect its safety or effectiveness. Studer Innotec does not recommend the use of any of its products in direct patient care. Studer Innotec will not knowingly sell its products for use in such applications unless it receives written assurance, satisfactory to Studer Innotec, that the risks of injury or damage have been minimised, the customer assumes all such risks, and the liability of Studer Innotec is adequately protected under the circumstances.

Applicable law

Swiss law is exclusively applicable, and the jurisdiction is Sion, Switzerland.

Severability

If a part of the terms and conditions set out above is held invalid, void, or unenforceable due to any national or international legislation, it shall not affect other parts of the remaining terms and conditions.

Sion, 1 June 2018



EU Declaration of Conformity (DoC)

Name of manufacturer: Studer Innotec SA

Address of manufacturer: Rue des Casernes 57, CH - 1950 Sion

Type of product: Sine wave inverter/charger

Series name: **Xtender – Medium size (XTM)**

Product reference:

XTM 1500-12	XTM 2000-12
XTM 2400-24	XTM 3500-24
XTM 2600-48	XTM 4000-48

Serial numbers:

From EXHN00001 to EXHN29999	(XTM 1500-12)
From FXHN00001 to FXHN29999	(XTM 1500-12)
From EXEN00001 to EXEN29999	(XTM 2000-12)
From FXEN00001 to FXEN29999	(XTM 2000-12)
From EXJN00001 to EXJN29999	(XTM 2400-24)
From FXJN00001 to FXJN29999	(XTM 2400-24)
From EXFN00001 to EXFN29999	(XTM 3500-24)
From FXFN00001 to FXFN29999	(XTM 3500-24)
From EXKN00001 to EXKN29999	(XTM 2600-48)
From FXKN00001 to FXKN29999	(XTM 2600-48)
From EXGN00001 to EXGN29999	(XTM 4000-48)
From FXGN00001 to FXGN29999	(XTM 4000-48)

The products with the serial numbers mentioned above are in conformity with the following EU directives and harmonised standards:

Safety: **Low Voltage Directive (LVD) 2014/35/EU**

- EN 50178:1997
- EN 62109-1:2010

EMC: **EMC Directive 2014/30/EU**

- EN 61000-3-2:2014
- EN 61000-3-3:2013
- EN 61000-6-1:2007
- EN 61000-6-2:2005/AC:2005
- EN 61000-6-4:2007/A1:2011

RoHS: **RoHS Directive 2011/65/EU**

Place and date: Sion, 15.10.2018

Signatory: Loïc Viret (Managing Director)

Viret L.

Gama
Xtender



Modelo	XTS 900-12	XTS 1200-24	XTS 1400-48	XTM 1500-12	XTM 2000-12	XTM 2400-24	XTM 2600-48	XTM 3500-24	XTM 4000-48	XTH 3000-12	XTH 5000-24	XTH 6000-48	XTH 8000-48	
Inversor														
Tensión nominal de batería	12Vdc	24Vdc	48Vdc	12Vdc		24Vdc	48Vdc	24Vdc	48Vdc	12Vdc	24Vdc	48Vdc		
Campo de tensión de entrada	9.5 - 17Vdc	19 - 34Vdc	38 - 68Vdc	9.5 - 17Vdc		19 - 34Vdc	38 - 68Vdc	19 - 34Vdc	38 - 68Vdc	9.5 - 17Vdc	19 - 34Vdc	38 - 68Vdc		
Potencia continua @ 25°C	650**/500VA	800**/650VA	900**/750VA	1500VA	2000VA	2000VA	2000VA	3000VA	3500VA	2500VA	4500VA	5000VA	7000VA	
Potencia 30 min. @ 25°C	900**/700VA	1200**/1000VA	1400**/1200VA	1500VA	2000VA	2400VA	2600VA	3500VA	4000VA	3000VA	5000VA	6000VA	8000VA	
Potencia 5 sec. @ 25°C	2.3kVA	2.5kVA	2.8kVA	3.4kVA	4.8kVA	6kVA	6.5kVA	9kVA	10.5kVA	7.5kVA	12kVA	15kVA	21kVA	
Carga máxima	Hasta corto circuito													
Carga asimétrica máxima	Hasta Pcont													
Detección de carga (stand-by)	2 a 25 W													
Cos φ	0.1-1													
Rendimiento máximo	93%	93%	93%	93%		94%	96%	94%	96%	93%	94%	96%		
Consumo OFF/Stand-by/ON	1.1W/1.4W/7W	1.2W/1.5W/8W	1.3W/1.6W/8W	1.2W/1.4W/8W	1.2W/1.4W/10W	1.4W/1.6W/9W	1.8W/2W/10W	1.4W/1.6W/12W	1.8W/2.1W/14W	1.2W/1.4W/14W	1.4W/1.8W/18W	1.8W/2.2W/22W	1.8W/2.4W/30W	
Tensión de salida	Sinusoidal pura 230Vac (+/- 2%) / 120Vac ⁽¹⁾													
Frecuencia de salida	50Hz / 60Hz ⁽¹⁾ +/- 0.05% (controlado por cuarzo)													
Distorsión armónica	<2%													
Protección de sobrecarga y corto circuito	Desconexión automática con 3 intentos de reinicio													
Protección de sobre temperatura	Alarma antes de corte y reinicio automático													
Cargador de batería														
Características de carga	6 etapas: Bulk-Absorción-Flotación-Ecualización-Flotación reducida-Absorción periódica													
	Número de etapas, umbrales, corriente de fin de etapa y tiempos completamente ajustables con el RCC-02/-03													
Corriente de carga máxima	35A	25A	12A	70A	100A	55A	30A	90A	50A	160A	140A	100A	120A	
Compensación por temperatura	Con BTS-01 o BSP 500/1200													
Corrección del factor de potencia (PFC)	EN 61000-3-2													
Datos generales	XTS 900-12	XTS 1200-24	XTS 1400-48	XTM 1500-12	XTM 2000-12	XTM 2400-24	XTM 2600-48	XTM 3500-24	XTM 4000-48	XTH 3000-12	XTH 5000-24	XTH 6000-48	XTH 8000-48	
Rango de tensión de entrada	150 a 265Vac / 50 a 140Vac ⁽¹⁾													
Frecuencia de entrada	45 - 65Hz													
Corriente máx. de entrada (relé de transferencia) / corriente máx. de salida	16Aac/20Aac								50Aac/56Aac					50Aac/80Aac
Tiempo de transferencia (UPS)	<15ms													
Contactos multifuncionales	Módulo ARM-02 con 2 contactos, en opción			2 contactos independientes (libres de potencial con 3 puntos, 16Aac/5Adc)										
Peso	8.2 kg	9 kg	9.3 kg	15 kg	18.5 kg	16.2 kg		21.2 kg	22.9 kg	34 kg	40 kg	42 kg	46 kg	
Dimensiones AxaxL [mm]	110x210x310			133x322x466						230x300x500				
Índice de protección	IP54			IP20						IP20				
Conformidad	Directiva CEM 2004/108/CE: EN 61000-6-1, EN 61000-6-3, EN 55014, EN 55022, EN 61000-3-2, 62040-2 Directiva de baja tensión 2006/95/CE: EN 62040-1-1, EN 50091-2, EN 60950-1													
Rango de temperatura de trabajo	-20 a 55°C													
Humedad relativa de funcionamiento	100%			95% sin condensación						95% sin condensación				
Ventilación	Módulo de ventilación ECF-01 en opción			Forzada a partir de 55°C						Forzada a partir de 55°C				
Nivel acústico	<40dB / <45dB (sin/con ventilación)													
Garantía	5 años													
Opciones														
Control remoto RCC-02 o RCC-03	•	•	•	•	•	•	•	•	•	•	•	•	•	
Módulo XCOM-232i	•	•	•	•	•	•	•	•	•	•	•	•	•	
Sets de comunicación por internet Xcom-LAN/Xcom-GSM	•	•	•	•	•	•	•	•	•	•	•	•	•	
Controlador del estado de carga de batería BSP	•	•	•	•	•	•	•	•	•	•	•	•	•	
Módulo de entrada remota RCM-10 (3 m)	•	•	•	•	•	•	•	•	•					
Módulo con 2 contactos auxiliares ARM-02	•	•	•											
Módulo de ventilación ECF-01	•	•	•											
Sensor de temperatura de batería BTS-01 (3 m)	•	•	•	•	•	•	•	•	•	•	•	•	•	
Cable de comunicación para 3ph y // CAB-RJ45-8-2	•	•	•	•	•	•	•	•	•	•	•	•	•	
Marco de montaje X-Connect										•	•	•	•	

* Ajustable con el RCC-02/03

** Valores mencionados únicamente válidos con el módulo de ventilación ECF-01.

(1) Con -01 al final de la referencia, significa 120V/60Hz. Disponible para todos los Xtender excepto el XTH 8000-48

Estos datos pueden cambiar sin preaviso.



ELECTRODOMESTICOS DE APLICACIÓN FOTOVOLTAICA

CONTENIDO

- Ficha técnica congelador.
- Ficha técnica nevera

Steca PF 166-H | PF 240-H

Frigorífico/congelador solar

Los frigoríficos Steca de la serie PF son algunos de los frigoríficos de CC con ahorro de energía más eficientes que jamás se han desarrollado. Ahora lleno de un refrigerante aún más amigable con el clima, pueden utilizarse como congelador o como frigorífico.

Los Steca PF 166-H y Steca PF 240-H son totalmente programables. La temperatura interior y otros parámetros pueden ser ajustados según las necesidades del usuario. Por ellos son ideal para todas las aplicaciones de CC, incluyendo la refrigeración de medicamentos en hospitales. Con el control electrónico óptimo y la regulación del número de revoluciones del compresor se garantiza una utilización extremadamente eficiente de la energía. Esto implica un importante ahorro en costos.

Estos productos se distinguen por su facilidad de manejo mediante una gran pantalla digital con opciones de ajuste, el más alto estándar de calidad y fiabilidad, luz interior LED ahorro de energía y una larga vida útil. Además, los equipos son fáciles de limpiar, ya que incluyen una salida de agua en el fondo.



Características del producto

- Enfriado rápido y eficiente gracias a la regulación del número de revoluciones del compresor
- El frigorífico puede utilizarse en casi todas las zonas climáticas con un módulo fotovoltaico de 70 W
- Selección automática de tensión
- Temperatura programable
- Función de frigorífico o congelador ajustable
- Para todas las aplicaciones de CC
- Mantenimiento mínimo y limpieza fácil
- Cerradura con dos llaves
- Apropiado también para la utilización móvil
- Auto dimming para reducir el consumo propio
- Refrigerante ecológico
- Luz interior LED ahorro de energía

Funciones de protección electrónica

- Protección contra polaridad inversa
- Protección contra descarga total
- Visualización de corte de corriente
- Alarma de temperatura

Indicaciones

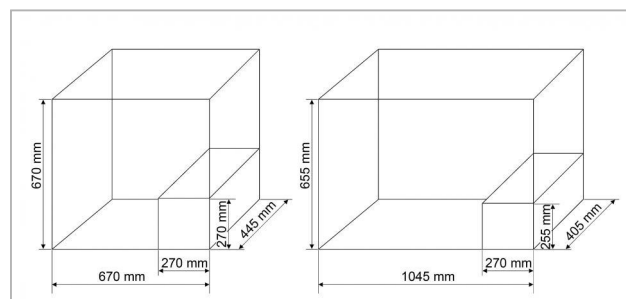
- Display LED multifuncional
- Visualización digital de temperatura

Manejo

- Programación por medio de botones

Certificaciones

- Conforme a los estándares europeos (CE)
- Conforme a RoHS
- Se prescinde de los materiales que ponen en peligro la capa de ozono en virtud de la directiva europea 1005/2009 (no utilización de CFC)
- Fabricado en EU
- Fabricado conforme a ISO 9001 e ISO 14001



	PF 166-H	PF 240-H
Funcionamiento		
Tensión del sistema	12 V (24 V)	
Potencia nominal	50 W ... 72 W	
Volumen de refrigeración (neto)	166 litros	240 litros
Temperatura de frigorífico	+2 °C ... +12 °C	
Temperatura de congelador	-20 °C ... -10 °C	
Datos de entrada CC		
Tensión de entrada	10 V ... 17 V (17 V ... 31,5 V) 12 V / 24 V batería	
Datos de salida CC		
Tensión de reconexión (LVR)	11,7 V (24,2 V)	
Protección contra descarga profunda (LVD)	10,4 V (22,8 V)	
Condiciones de uso		
Temperatura ambiente	+10 °C ... +43 °C	
Equipamiento y diseño		
Dimensiones (X x Y x Z)	872 x 917 x 709 mm	1288 x 919 x 760 mm
Grosor del aislamiento	11 cm	12 cm
Peso	47 kg	62 kg
Disipación	compresor	
Refrigerante	60 g R290	70 g R290
Unidad de temperatura (grados Celcius / Fahrenheit)	ajustable	
Brillo del display	ajustable	
Cestas colgables	2	
Bandejas de congelado	3	
Acumulador de frío	1	
Modo de ahorro de energía automático	sí	

Steca PF 166 consumo [Wh / al día]		
Temperatura ambiente	25 °C	40 °C
Temperatura interior +8 °C	87	232
Temperatura interior +3 °C	113	303
Temperatura interior -10 °C	277	624
Temperatura interior -20 °C	525	1215
Steca PF 240 consumo [Wh / al día]		
Temperatura ambiente	25 °C	40 °C
Temperatura interior +8 °C	93	266
Temperatura interior +3 °C	136	361
Temperatura interior -10 °C	370	878
Temperatura interior -20 °C	764	1794

Haceb

FICHA TÉCNICA DE PRODUCTO REFRIGERACIÓN

DESCRIPCIÓN		ESPECIFICACIONES			
REFERENCIA(S)	902064312191MIPC	NEV AR 219L CE 1P DA DC TI			
Volumen nominal bruto	219L				
Refrigerador clase	T (tropical) (+ 16° C a +43° C)	CLASE DE CONGELADOR	☐	☆☆☆ Temperaturas ≤ -18° C	
Corriente nominal de operación	5,4 Amp				
Tensión nominal de operación	24 VDC				
Consumo de energía / Clasificación energética	0,877 kWh/24 hA		☐	☆☆ Temperaturas ≤ -12° C	
Frecuencia nominal de operación	DC				
Tiempo Fabricación de hielo	4 ± 0.2 h				
VOLÚMENES Y ÁREAS		COMPARTIMIENTO SUPERIOR	COMPARTIMIENTO INFERIOR	NOMINAL TOTAL	
Volumen nominal de almacenamiento (L)	24,8	181,6	206,4		
Área nominal de almacenamiento (dm²)		76,26	76,26		
GAS ESPUMANTE	CICLOPENTANO				
Compresor	EMBRACO DC VEMY 4HM /24Vol				
Relay	-				
Térmico	-				
Refrigerante R134a	62 gr				
Condensador	563 x 459 mm, tubo de hierro de 3/16", 101 Varillas				
Evaporador	Tubo chapa 204 x 475 x 272 mm (HACEB)				
Intercambiador	Tubo aluminio Ø 7.0 mm, longitud 898 mm, Tubo de cobre Ø 6.35 mm, longitud 310 mm				
Serpentín	-				
Termostato	Robertshaw TXV0003-80, con descongelación semiautomatica				
Tubo capilar	Ø 0,028” x 1440 mm, cobre				
Filtro secador	XH9, 15 gramos				
Motoventilador	-				
Resistencia de descongelación	-				
Timer	-				
Iluminación	Luz 24VDC				
DIMENSIONES GENERALES					
	Con empaque	Sin empaque	Gabinete metalico	VOLUMEN BRUTO EMPACADO (m³)	
ALTO (cm)	127	122	116		
ANCHO (cm)	65,5	61	61	0,60725	
PROFUNDIDAD (cm)	73	69	52	VOLUMEN NETO (m³)	
PESO (Kg)	40,93	37,8			
				0,51350	
ACCESORIOS				CARACTERÍSTICAS GENERALES	
Entrepañó plástico	1	Dispensador de agua	1	Gabinete interior	Poliestireno
Bandeja de vegetales con control de humedad	1	Anaque! grande	1		
Tapa Bandeja de vegetales	1	Anaque! mediano	1		
Separador bandeja de vegetales	1	Anaque! pequeño	1	Gabinete exterior	Lamina cold rolled cal 26 recubierta con pintura electrostática
Bandeja fria	1	Tapa lácteos	2	Colores	Almendra / Blanco / Titanio (gabinete gris, puerta lámina prepintada metalizada)
Puerta Evaporador	1	Separador de botellas	1		
Cubetas plásticas	1	Porta huevos	1		
				Número de puertas	1
				☒	Manija Integrada
				☐	Manija Externa
Normas Técnicas	Norma		Nombre de la norma		
	NO HAY NORMATIVIDAD VIGENTE PARA ESTE PRODUCTO				

Elaborado por: Nelson Echeverri / Juan Ospina

Actualizado por:

Actualización: 00

Fecha: 2014/09/18



PLANTA DE TRATAMIENTO DE AGUAS (PTAP)

CONTENIDO

- Carta de garantía del fabricante.
- Términos de Garantía.
- Certificados EN 60950-1 Y EN 62109-1

DISFRUTE LUJO Y CONFORT DE AGUA POTABLE DEL GRIFO

TODO EL DIA – A TODA HORA



DISEÑADO Y FABRICADO POR
TRUNZ SUIZA 

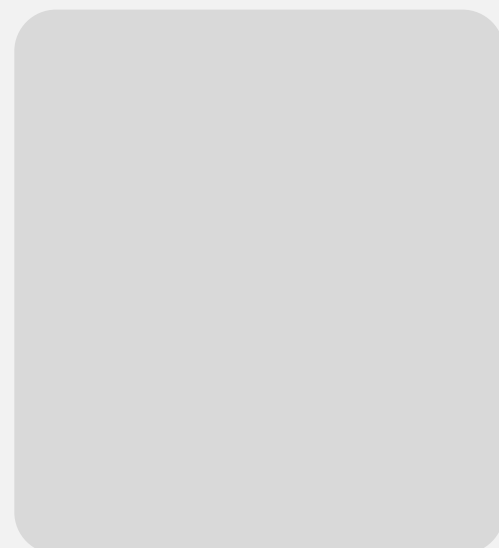
TWM LIGHT: LA UNIDAD DE TRATAMIENTO DE
AGUA CONFIABLE, ASEQUIBLE, COMPACTA.

- ✓ Agua potable en cada grifo del edificio
- ✓ No más transporte de garrafrones y botellas
- ✓ Protección activa del medio ambiente
- ✓ No más desperdicio de botellas plásticas

Trunz Water Systems AG
CH-9323 Steinach

Phone 0041 71 447 85 45
Email water@trunz.ch

Distribuidor exclusivo:



TWM LIGHT

El sistema Trunz Wall Mounted Light es una unidad compacta instalada en la pared para el tratamiento de agua municipal. El TWM Light viene completo y listo para instalar en la tubería de entrada del edificio. Requiere de una presión de alimentación y suministro de agua constante para operar fácilmente. La unidad está equipada con una membrana de ultrafiltración que elimina todo virus y bacterias con un retrolavado automático de la membrana y un filtro de carbón activado, el cual elimina los malos olores y sabores del agua. Este proceso mantiene los minerales naturales y vitales de la fuente de agua. Trunz Wall Mounted Light es la solución perfecta para aplicaciones en viviendas, restaurantes, oficinas, clínicas, etc. Este sistema compacto es de fácil instalación y mantenimiento.



Fácil instalación + bajo mantenimiento = diseñado para aplicación gastronómicas, medicas, residenciales, rurales con acceso de agua municipal, pozo, cisterna.

Medidas	h x w x d	780 x 580 x 170 mm
Peso	net	15 kg / 33 lbs
Tecnología de filtración		Ultrafiltración por membrana
Fuente de abasto		Agua municipal, pozo, cisterna
Contaminación		Orgánica
Medida de partículas eliminadas		Debajo de 0.02 micras
Calidad del agua producida		99.9999% libre de virus y bacterias
Aplicación / Instalación		Pared / vertical / interna
Capacidad		Hasta 800 litros por hora
Pre filtro	1 pc.	50 micras
Membranas	1 pc.	Ultrafiltración / 0.02 micras
Filtro de carbón activado	1 pc.	20 micras
Suministro de energía		Ninguno/no necesario
Bomba de alimentación		Ninguna/ no necesario
Presión mínima del agua		2 bar / 29 psi (para retrolavado)
Temperatura máxima del agua		0/45° C
Temperatura máxima ambiental		0/50° C

TWM Light



1 de 11

Regresa

Contenido de sal de agua cruda

<1'000 ppm, suave / fresca

Fuente de agua cruda

Suministro de agua municipal mín. 3 bar

Aplicación / instalación para montaje en

pared / interior

Capacidad

aprox. 180 l / h

Certificación

NSF / ANSI 61, KTW,

TÜV - EN

ISO 9001: 2008, 14001, CE "

Opcional:

Centro de energía solar



Fuente 1 : <https://www.trunzwatersystems.com/component/advportfolioprop/project/100-products/2-twm-light>

Certifications



NSF International

RECOGNIZES

INGE AG
Plant at: GREIFENBERG, GERMANY

AS COMPLYING WITH NSF/ANSI 61.
PRODUCTS APPEARING IN THE NSF OFFICIAL LISTING ARE
AUTHORIZED TO BEAR THE NSF MARK.



This certificate is the property of NSF International and must be returned upon request. In case of cancellation, all NSF/ANSI 61 products must be destroyed.

August 11, 2003
Certificate 05071 - 01

Mark L. Ross, Sales V.P., Water Systems
Water Distribution Systems

Mark L. Ross

CERTIFICATE



Management system as per
EN ISO 9001:2008

In accordance with TUV AUSTRIA CERT procedures, it is hereby certified that



Inge wasser technologies AG
Flurstraße 27
D-86926 Greifenberg



Inge GmbH
Flurstraße 27
D-86926 Greifenberg

applies a management system in line with the above standard for the
following scope

research, development, production and distribution of
micro- and ultrafiltration modules

Certificate Registration No. 20 100 32000485

Valid until 2013-04-12
Initial certification 2004-04-14

Vienna, 2010-04-08

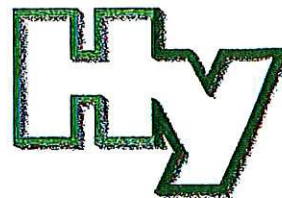
R. Fritsch
Certification Body
at TUV AUSTRIA CERT GMBH

This certificate was issued in accordance with TUV AUSTRIA CERT auditing and certification
procedures and is subject to regular surveillance audits.
TUV AUSTRIA CERT GMBH - Krugstrasse 16 - A-1015 Wien - www.tuv.at



Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Umweltmedizin
Direktor: Prof. Dr. rer. nat. L. Dunemann



Hygiene-Institut · Postfach 10 12 55 · 45812 Gelsenkirchen

Rotthäuser Str. 19
45879 Gelsenkirchen

Zentrale (0209) 9242-0
Durchwahl (0209) 9242-210
Telefax (0209) 9242-212
E-Mail a.koch@hyg.de
Internet www.hyg.de

Unser Zeichen: K-184521-09-Ko
Ansprechpartner: Herr Dr. Koch

Gelsenkirchen, 02.12.2009

Confirmation

hereby we confirm to the applicant:

Inge watertechnologies AG
Flurstraße 27
86926 Greifenberg

that the construction units used in the UF module **dizzer XL**, were examined for the drinking water contact. All examined construction units fulfill the drinking water-hygienic requirements of their appropriate area of application with regard to the KTW- recommendation, the KTW-guideline and/or the epoxy resin guideline.

Der Direktor des Instituts
i.A.

(Dr. rer. nat. A. Koch)
Head of the Dept. for water
hygienic material testing



Die Ergebnisse und Bewertungen beziehen sich auf die untersuchten Prüfgegenstände und die geltenden gesetzlichen Regelungen.
Die Gültigkeit dieses Dokuments erlischt bei Veränderungen in der Zusammensetzung des Werkstoffs oder an den Verarbeitungsbedingungen.

Dieses Dokument darf ohne unsere schriftliche Genehmigung nur vollständig und unverändert veröffentlicht oder vervielfältigt werden.

Träger des Hygiene-Instituts: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V., Gelsenkirchen



DAP-PL-2548.00

Material of Construction (MOC)

Module dizzer XL

Membrane: PESM

Housing: PVC-U white (Tube according to DIN 8061 / 62)

End-cap: PVC-U grey

End-cap coupling: SS (sealing EPDM)

Filtrate connector: PVC-U grey

Approval: Test certificate according to the German KTW guideline for the use for plastics in contact with drinking water issued by institute of hygiene „Hygiene-Institut des Ruhrgebiets“, dated December 2, 2009

Firma.:
(Company)
inge GmbH

Name:
(Name)
Hans-Martin Zünke

Unterschrift QMB:
(Signature QMB)

inge GmbH
Flurstraße 27
D-86926 Greifenberg

Datum:
(Date)
21.7.2010



PLANTA DE TRATAMIENTO DE AGUAS RESIDUALES (PTAR)

CONTENIDO

- Carta de garantía del fabricante.
- Términos de Garantía.
- Certificados EN 60950-1 Y EN 62109-1

ECOROCK-5000

Treatment Unit

Tank volume 5000 L

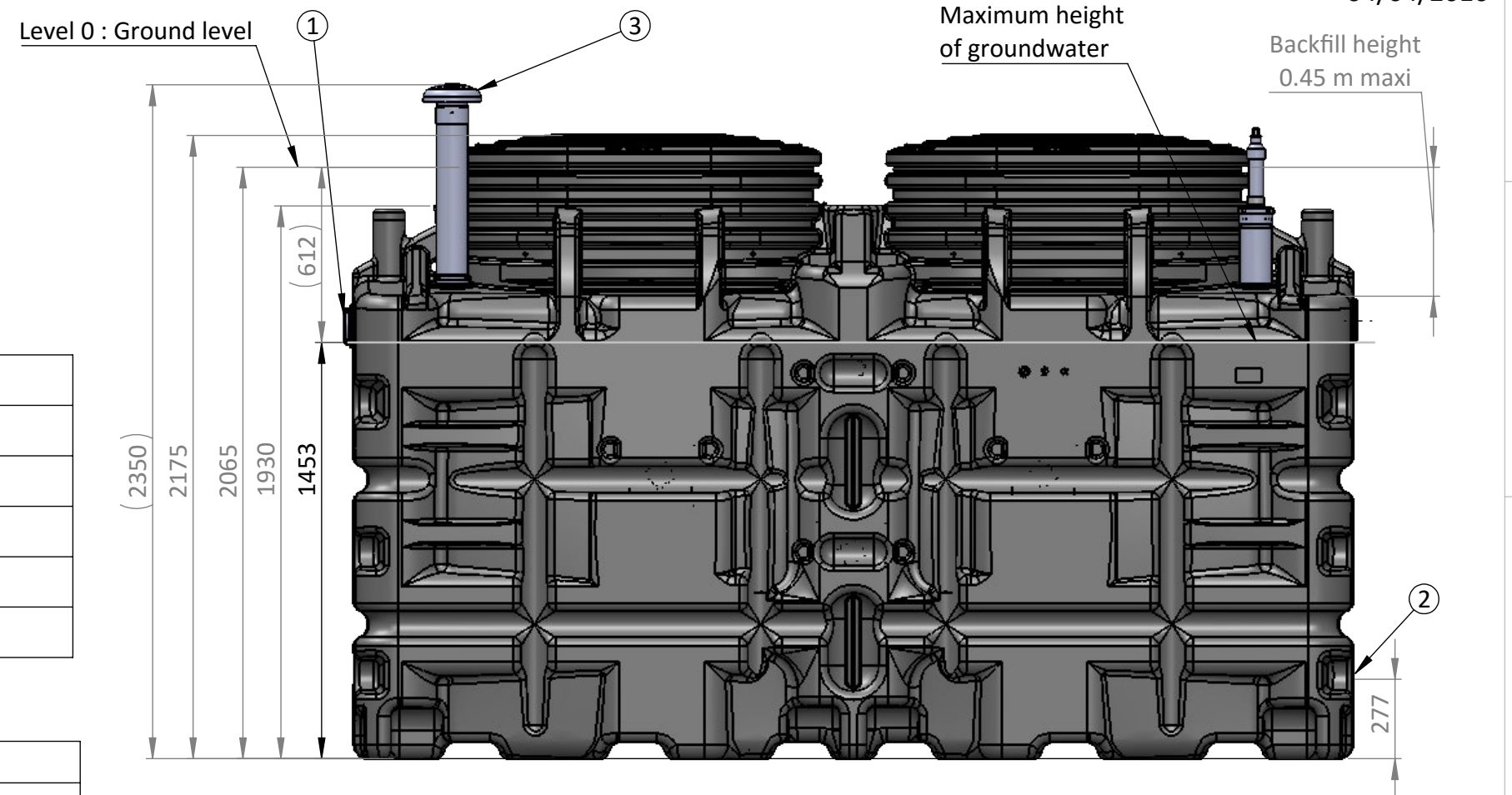
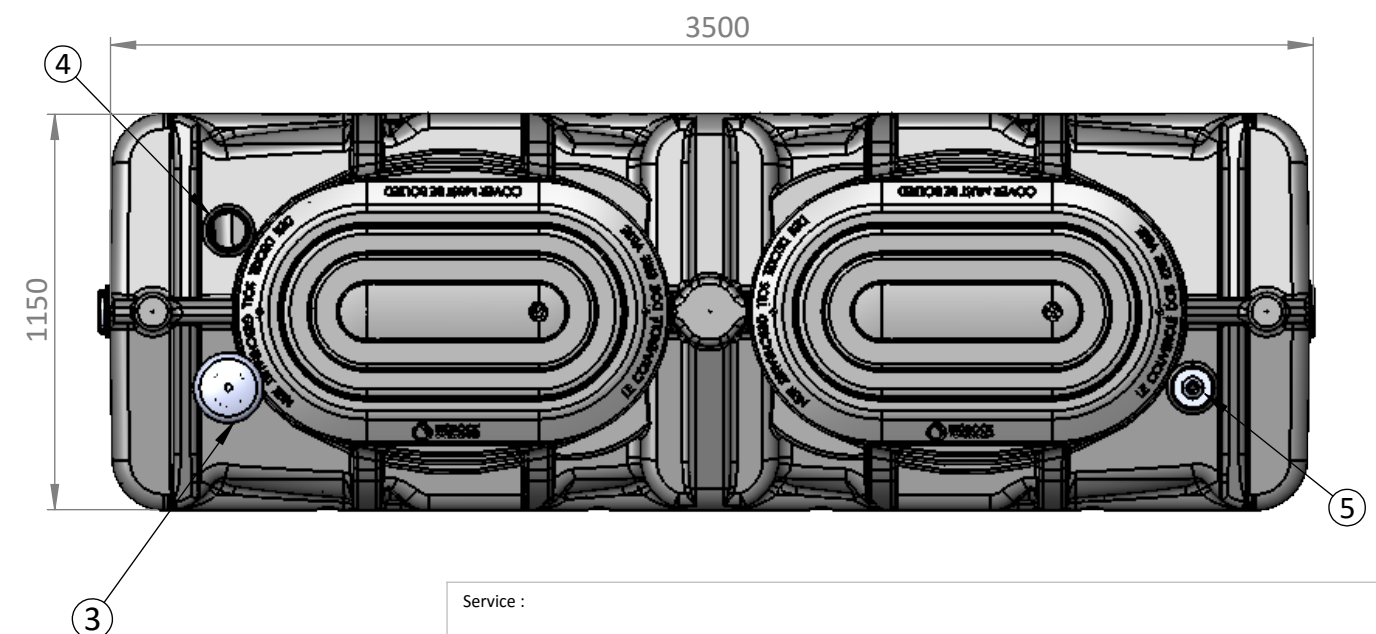
1	Water inlet
2	Water outlet
3	Air inlet
4	Air outlet
5	Overflow Alarm

Characteristics	Value	Unit
ECOROCK-5000 Treatment Unit		
Minimum volume pre-treatment*	500	liters/PE
Capacity in population equivalent	30	PE
Daily volume of wastewater **	150	litres/day/PE
Daily hydraulic load	4.5	m ³ /day
Organic load per PE	60	gr.BOD ₅ /PE/jour
Organic load raw influent up to	1.8	kg BOD ₅ /day
Specification	Value	Unit
Tank volume	5000	Liters
Overall length	3500	mm
Overall width	1150	mm
Total height of the tank	2175	mm
Overall height (+ventilation pipe)	2350	mm
Total weight (without water)	680	Kg
Pipe diameter	110	mm

This treatment unit can be installed in high ground water table.

*minimum 2000 liters of pre-treatment

**according to DIN EN 12566-3



Service :			
ORIGINATOR			
NAME	SIGNATURE	DATE	
AUTHOR	AQ	04/04/2016	
APPROV.			
CHANGES			
NAME	SIGNATURE	DATE	
AUTHOR			
APPROV.			
CHANGES			
NAME	SIGNATURE	DATE	
AUTHOR			
APPROV.			
TITLE:			
Nb. of PLAN			
ECOROCK-5000			
UT-X5000			A3
SCALE:1:22			

Overall tolerance : 3%

DATA SHEET

Waste Water
Treatment Plants

Ecorock



ECOROCK is a revolutionary compact waste water treatment plant system used to treat organic waste including sewage, light paper and most household cleaners. It consists of HDPE tanks and special BIOROCK media dispensing the need for any concrete works. Preferably installed in ground, it minimises visual impact and covers a smaller footprint. Systems are also suited to seasonal conditions operating effectively for upto 6 months when left unused.

The two stage treatment process produces high quality effluent that may be discharged into sensitive watercourses. The biological process is simple and is gravity fed thereby ensuring reliability and low maintenance over traditional systems. The treatment process is as follows;

Stage 1

The raw sewage enters a primary tank where separation and breakdown of organic solids takes place.

Stage 2

The sewage then passes through an effluent filter before discharging into the ECOROCK® unit which incorporates ECOROCK media. This specially formulated media facilitates aerobic digestion and also contains microscopic pollution degradation bacteria preventing it from clogging. After digestion, a filtration process takes place before the effluent is discharged.

Features include;

- Works without electric power due to the design dispensing the need for pumps, blowers and compressors reducing lifetime costs.
- No moving parts resulting in no downtime due to breakdowns or wear and tear.
- Silent operation.
- Minimal maintenance.
- Ease of handling and installation eliminating need for concrete.

Biorock Purification Results*:

BOD: 4mg/l, 99%

COD: 26mg/l, 96%

TSS: 3mg/l, 99%

*Testing done in conformity to EU Norm EN 12566-3, testing Institute: PIA in Aachen, Germany.

OPERATING CONDITIONS:

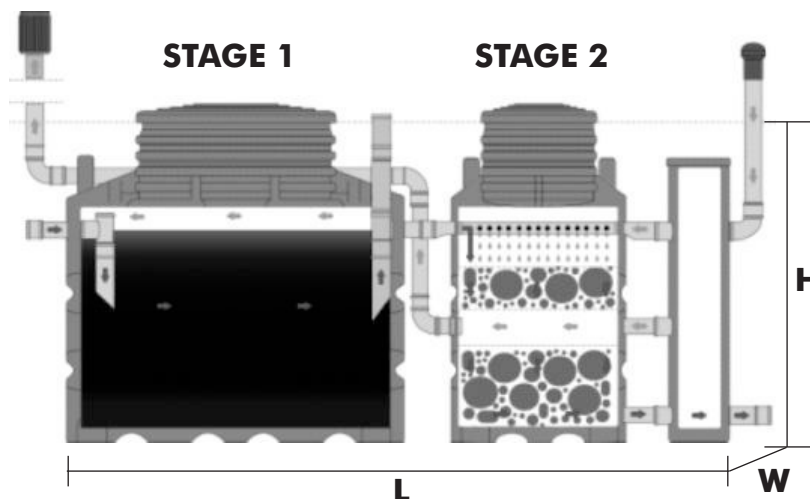
Medium: Organic waste not containing aggressive medium

Max. Ambient Temperature: 40°C

Max. Medium Temperature: 25°C

EQUIPMENT SPECIFICATION

Model*	ECOROCK 1500	ECOROCK 3000	ECOROCK 5000	Multi-30 2XER3000	Multi-60 2XER5000	Multi-90 2XER5000	Multi-120 4XER5000
Population Equivalent (PE)	6	18	30	36	60	90	120
Flow, m ³ /day	0.9	2.7	4.5	5.4	9	13.5	18
Organic Loading (Kg/BOD ₅ /day)	0.36	1.08	1.8	2.16	3.6	5.4	7.2
Nitrogen Loading (Kg/NH/day)	0.05	0.15	0.25	0.29	0.48	0.72	0.96
Length, m	1.15	2.15	4.5	2.15	4.5	4.5	4.5
Width, m	1.01	1.15	1.15	2.3	2.3	3.45	4.6
Height, m	2.1	2.1	2.1	2.1	2.1	2.1	2.1



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DT362A -09/16

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Quality management

BIOROCK has an ISO 9001:2008 for the production and sales of the BIOROCK Sewage treatment plants.

BIOROCK provides products liability for the complete treatment units and Bioreactors (If installed accordingly the BIOROCK Installation and Maintenance Guidelines). In our production facilities we work with the highest standards available while continuously applying quality assurance tests during every production fase.

Gestión de la calidad

BIOROCK tiene una ISO 9001: 2008 para la producción y venta de las plantas de tratamiento de aguas residuales de BIOROCK. BIOROCK proporciona la responsabilidad de los productos para las unidades de tratamiento completas y los biorreactores (si se instalan de acuerdo con las Pautas de instalación y mantenimiento de BIOROCK). En nuestras instalaciones de producción, trabajamos con los más altos estándares disponibles y aplicamos continuamente pruebas de control de calidad durante cada fase de producción.

The screenshot shows the BIOROCK website header with the logo and navigation menu. Below the header is a blue banner with the text "BIOROCK Production And Distribution Quality Management". On the left, there is a "More information" sidebar with a list of links: "About BIOROCK", "Mission", "Why BIOROCK?", "Partners", "10 reasons to buy a BIOROCK unit", "The way we do business", and "Quality management". The "Quality management" link is highlighted. The main content area is titled "Quality management" and contains the following text: "BIOROCK has an ISO 9001:2008 for the production and sales of the BIOROCK Sewage treatment plants. BIOROCK provides products liability for the complete treatment units and Bioreactors (If installed accordingly the BIOROCK Installation and Maintenance Guidelines). In our production facilities we work with the highest standards available while continuously applying quality assurance tests during every production fase. There is a guarantee of 15 years at all the PE components."

BIOROCK
WASTEWATER TREATMENT

HOW BIOROCK WORKS PRODUCTS CERTIFICATIONS FAQ WHAT'S NEW WHERE TO BUY? CONTACT

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BIOROCK Production And Distribution Quality Management

More information

- > About BIOROCK
- > Mission
- > Why BIOROCK?
- > Partners
- > 10 reasons to buy a BIOROCK unit
- > The way we do business
- > **Quality management**

Quality management

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Fuente 1 : <https://biorock.com/biorock/quality-management>

Fuente 2 : Guia de instalación



INSTALLATION AND USER GUIDE

ECOROCK-5000 & BIOROCK® Multirock systems *BIOROCK Multiple Installations*

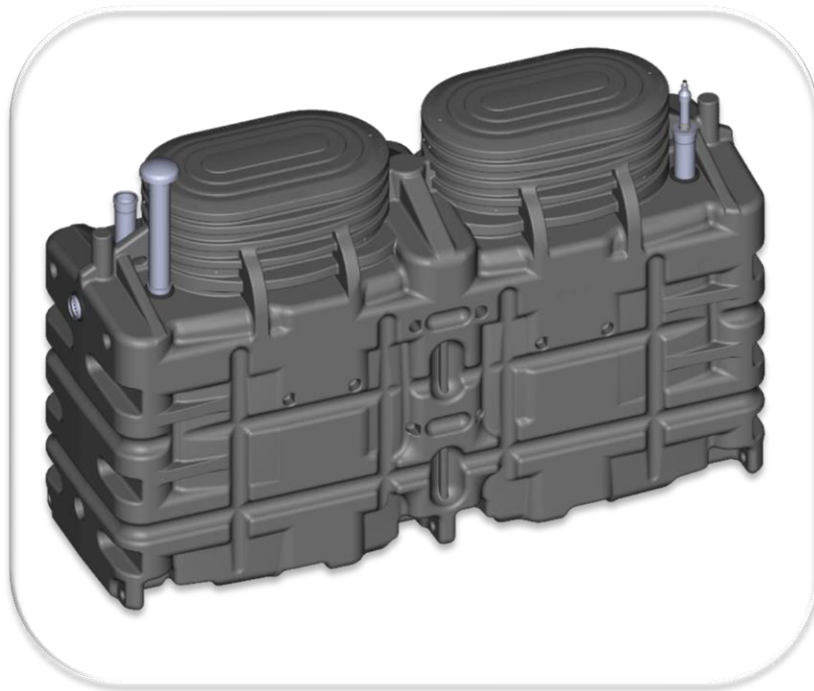




TABLE OF CONTENTS

A.	INSTALLATION GUIDE	4
B.	USER GUIDE	27
C.	APPENDICES	39



Dear Customer,

Congratulations on your purchase of this BIOROCK® Domestic Sewage Treatment Plant. Your new BIOROCK will guarantee years of trouble-free operation, peace of mind and protection for the environment.

We highly recommend that you familiarize yourself with this guide for the installation, commissioning and maintenance of your new BIOROCK system.

The instructions for the maintenance and visual checks of the system will ensure that you have a reliable and long-lasting sewage treatment plant.

Please do not hesitate to contact your BIOROCK distributor for any queries or further assistance. Thank you for choosing BIOROCK.

READ CAREFULLY

The installation and commissioning of your BIOROCK system should be carried out by a BIOROCK trained and approved installer. Your installer will be able to offer you a maintenance contract. The BIOROCK Warranty is only valid if the required maintenance is carried out by a BIOROCK trained and approved installer.

Should you not wish to take out a maintenance contract, make sure you have your sewage treatment plant inspected and maintained on a regular basis by an industry trained, competent wastewater professional.

BIOROCK S.à.r.l.

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A. INSTALLATION GUIDE

ECOROCK-5000

&

BIOROCK Multirock systems

BIOROCK Multiple Installations

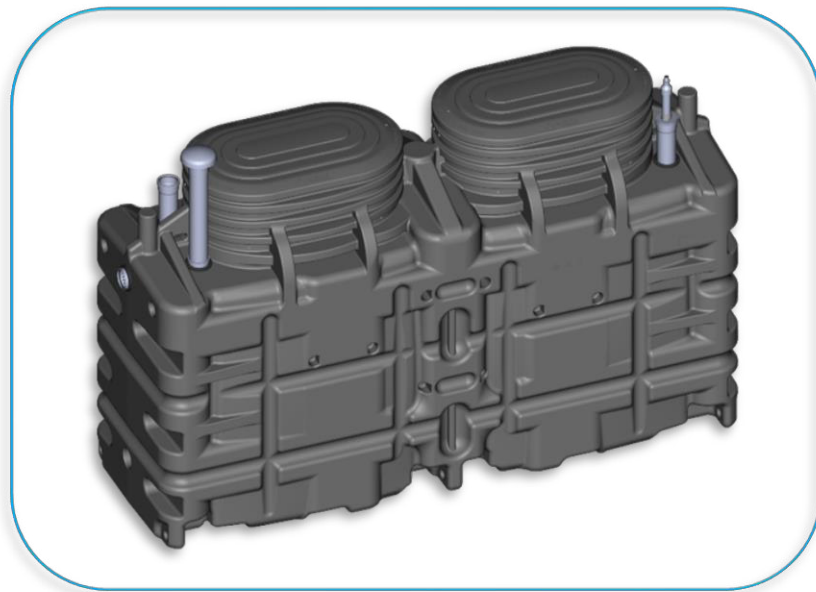


TABLE OF CONTENTS

1. THE BIOROCK SEWAGE TREATMENT SYSTEM	7
1.1. General points	7
1.2. Sizing	7
1.3. Precautions	8
1.4. Identification	9
1.5. Handling and transport of the tanks	9
2. OPERATING PRINCIPLE OF AN ECOROCK SEWAGE TREATMENT PLANT	10
2.1. The Primary Tank	10
2.1.1 Ventilation of the Primary Tank	10
2.1.2 Performance of the Primary Tanks (PT).....	10
2.2. The BIOROCK Treatment Unit (Bioreactor) – ECOROCK-5000	12
2.3. ECOROCK-5000 Treatment Unit : Technical	12
3. INSTALLATION LAYOUTS	13
3.1 Installation layout n°1.: Gravity discharge (non-electric)	13
3.2 Installation layout n°2.: Pumped discharge (pump after PT)	13
3.3 Installation layout n°3.: Pumped discharge (pump after ECOROCK unit)	13
4. INSTALLATION OF THE TANKS	14
4.1 Installation principle	14
4.1.1 Before the installation of the complete system.....	15
4.1.2 Installation of the Primary Tank	15
4.1.3 Installation of the ECOROCK treatment unit	16
4.2 Installation in dry ground conditions	16
4.2.1 Installation and digging in dry ground conditions.....	16
4.2.2 Installation of the Tanks in dry ground conditions	16
4.2.3 Backfilling in dry ground conditions	17
4.3 Installation in wet ground conditions.....	17
4.4 Installation in “difficult” areas and sites.....	19
4.4.1 Installation in difficult areas and sites	19
4.4.2 Installation in difficult ground conditions	19
4.4.3 Backfilling in difficult ground conditions	19
4.5 Installations under roads, courtyards or storage areas.....	20
4.6 Other specific cases	20
4.6.1 Incline too steep (> 5%)	20
5. VENTILATION AND WATER DISTRIBUTION	21
5.1 Ventilation of the Primary Tank.....	21
5.2 Ventilation of the ECOROCK-5000 treatment unit	22
5.3 Water distribution pipe	22
5.4 BIOROCK® media	23
5.5 Securing the lids.....	23
6. STOPPING AND RESTARTING THE SYSTEM	24
7. CONFORMITY AND WORK COMPLETION	24
8. RECOMMENDATIONS OF USE AND MAINTENANCE	24
9. COMPLIANCE WITH REGULATIONS AND STANDARDS	24
10. WARRANTY	25



1. THE BIOROCK SEWAGE TREATMENT SYSTEM

1.1 GENERAL POINTS

The ECOROCK-5000 unit from BIOROCK is a compact non-electric Sewage Treatment Plant. The treatment relies on the revolutionary BIOROCK biological purification process. The ECOROCK-5000 sewage treatment unit is exclusively designed for domestic waste water purification.

The BIOROCK plant consists of a Primary Tank and an ECOROCK-5000 Bioreactor. Both parts (Primary Tank and Bioreactor) must be **independently ventilated**.

A small pump can be installed in a pump shaft downstream of the system to lift the treated water and discharge to a higher level if needed.

BIOROCK recommends the installation of an effluent sampling at the outlet of the treatment unit.

The ECOROCK-5000 treatment unit can be installed after a non-BIOROCK Primary Tank, provided that this tank is properly sized, equipped with an efficient effluent filter and properly, independently vented.

1.2 SIZING

The ECOROCK-5000 unit has a capacity of 30 P.E. (Person Equivalent). The capacity of the individual ECOROCK-5000 unit can be increased if the required final effluent quality is of a lower standard than the results, achieved during the EN-12566-3 Performance test.

The ECOROCK-5000 units can be installed in parallel for larger capacities (BIOROCK Multirock Systems).

When the ECOROCK-5000 units are installed in parallel, we recommend the use of a Flow Management System between the Primary Tank and the Treatment Units. The BIOROCK Flow Control Chamber (FCC) and Splitterbox (SB) are an option.

The FCC acts as a 'header tank' to provide a controlled surge flow to the SB and guarantees equal flow to each of the BIOROCK units installed in parallel.

The standard BIOROCK Flow Control Chamber and BIOROCK Splitterbox are suited for a maximum of 3x ECOROCK-5000 units; for more ECOROCK-5000 units in parallel, another Flow Control Chamber and Splitterbox with a larger capacity should be used.

	VOLUME PRIMARY TANK	FLOW CONTROL CHAMBER	Maximum ORGANIC LOAD	Maximum HYDRAULIC LOAD
Up to 30 PE 1x ECOROCK-5000	BIOROCK recommends a minimum volume of 3x the daily water production	NO	2,25 Kg BOD ₅ /day	4.500 L./ day
Up to 60 PE 2x ECOROCK-5000		YES	4,50 Kg BOD ₅ /day	9.000 L./ day
Up to 90 PE 3x ECOROCK-5000		YES	6,75 Kg BOD ₅ /day	13.500 L./ day
Up to 120 PE 4x ECOROCK-5000		YES	9,00 Kg BOD ₅ /day	18.000 L./ day
Etc.		YES	11,25 Kg BOD ₅ /day	22.500 L./ day





1.3 PRECAUTIONS

Please note that BIOROCK shall not be responsible for any installation design parameters and groundworks at any case. We recommend to involve a civil engineer or a specialized design office in the design of the system installation if necessary and to follow best practices of the industry.

This is especially true for the Multirock installations; considering the larger volumes of wastewater to be treated, a proper dispatching through all Treatment Units is essential for efficiency of the system.

It is the installer's responsibility to ensure equal distribution of the wastewater by testing the Flow Management System prior to leaving site. The installer should ensure any necessary supplementary setting on the BIOROCK or non-BIOROCK Flow management System if necessary.

Important precautions for the proper use of the BIOROCK system: Only domestic sewage should enter the system; no rainwater is allowed.

To ensure the good working order of the BIOROCK system, the use of automatic toilet cleaners, electric waste-disposal systems and pumps equipped with blades are not to be used.

If there is a professional kitchen on site, an efficient and properly sized grease trap should be installed. The grease trap should be installed before the primary tank.

Do not dispose of the following items to the BIOROCK system:

Kitchen or motor oils, fats, wax, resin, paint, solvents, hydrocarbon-based products (petrol, crude oil etc.), any pesticide or antibacterial product, items of a toxic nature, boiler or air-conditioning condensate, swimming pool backwash, rainwater, drainage water or ground-water.

An effective effluent filter should be installed in the outlet of the Primary Tank, before the water goes on to the Bioreactor.

Pipework after the ECOROCK units, and especially after Multirock installations, should allow sampling.

Special care should be taken with the aeration of the system. The aeration should be checked by the installer using a smoke test once pipework and ventilation ducts have been connected and before backfilling the system. The smoke test should be performed under normal representative conditions.

Each system should be vented independently and equipped with its own ventilator (wind driven or electrical). The number of elbows used in the pipework should be limited as much as possible. 90° elbows should not be used, 45° elbows should be used instead. The high air outlets should be installed as close as possible to the low air inlets.

Achieving efficient ventilation is the responsibility of the installer as he is familiar with the implementation, site and local conditions that may interfere in the system's venting.

The Primary Tank should be aerated separately in accordance with the manufacturer's instructions.



1.4 IDENTIFICATION

Before installing please copy the serial number of each tank on to the documents to be kept by the customer (Appendix 5 of this Guide.)

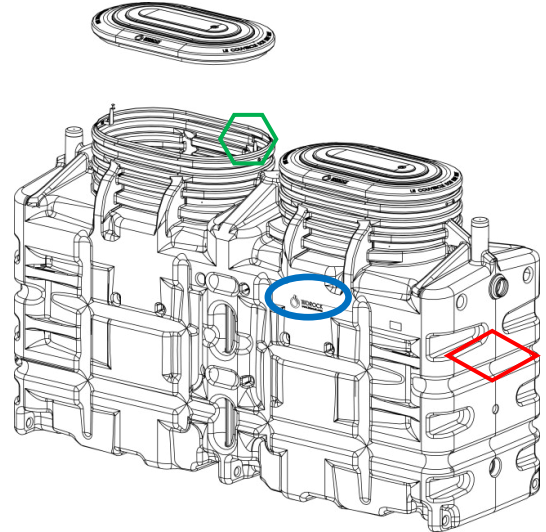
When looking at the tank facing the BIOROCK® logo, the serial number is:

- On an identification tag inside the tank, and /or

Marked  as on the drawing below

- Engraved on the area to your right at the bottom of the rounded top.

Marked  as on the drawing below



> Detail of the identification plate inside the tank:



1.5 HANDLING AND TRANSPORT OF THE TANKS

Two integrated slots on the bottom of the tank enable a safe movement by fork lift.

Four lifting eyes are situated on the top corners of each tank, enabling lifting by crane or JCB.

The tanks should be handled, transported and stored with care after delivery to avoid being damaged.



2. Operating principle of an ECOROCK Sewage Treatment Plant

A BIOROCK system is composed of a Primary tank and one or several ECOROCK treatment units (Multirock installations). Initially the raw sewage enters the primary tank to provide separation and the breakdown of organic solids (Primary Treatment). The sewage then passes through an effluent filter before discharging into the ECOROCK Treatment Unit which incorporates the well proven aerobic digestion process (Secondary Treatment) and filtration process (Tertiary Treatment).

In case of Multirock installation, and when more than three Treatment Units are installed in parallel after a Primary Tank, the installation of a Flow Management System is necessary and highly recommended.

2.1 THE PRIMARY TANK

The effluent (domestic wastewater composed of black water: origin toilets – and grey water: origin kitchen, bathroom, laundry) enters the primary tank. This Primary Tank carries out the first basic phase of wastewater treatment, that is separation of solids and fats by flotation (formation of a grease layer) and by clarification (the suspended solids sink to the bottom of the tank by natural settlement). Separated solids building up at the bottom of the primary compartment are called “primary sludge”. This sludge breaks down in time by anaerobic digestion.

The primary tank should always be equipped with an efficient effluent filter. This filter holds back remaining suspended solids, fats and other floating matter which enables a higher quality of pre-treatment.

In case of Multirock installation, when a BIOROCK effluent filter is fitted into the Primary Tank, and when the Primary Tank is of a volume of more than 7500 liters (included), a Ø110mm effluent filter may be not sufficient for the flow and a Ø160 mm effluent filter may be necessary instead.

2.1.1 Ventilation of the Primary Tank

Any Primary tank should have a proper unencumbered low level and high level vent. The low level vent should be connected directly on the outlet side of the tank and the high level on the inlet side and should not be positioned more than 10 m¹ from the tank and at a minimum height of 4 m¹ with a wind driven ventilator also fitted. The water inlet should be made air tight. All ventilation should be checked with a smoke test.

2.1.2 Performance of the Primary Tanks (PT)

If the Primary Tank being used is not a BIOROCK tank, make sure that the quality of the effluent from the PT meets the BIOROCK requirements. Proper ventilation of a PT is necessary, not only to avoid smell problems, but also to evacuate the gasses produced. A Primary Tank generates malodorous gases like hydrogen sulphide (H₂S). Ventilation of the gasses is necessary to prevent H₂S being transformed into harmful sulphuric acid (H₂SO₄). Sulphuric acid will harm the biological process and can cause degradation of the BIOROCK Media.



BIOROCK requires the following performance of a PT in front of the ECOROCK unit(s):

Composition of normal domestic wastewater (according to EN12566-3+A2 Annex B.3.2):			
	Variation		
 BOD ₅ * ¹ :	150 - 500	mg O ₂ /l	
COD* ¹ :	300 – 1000	mg/l	
S.S.:	200 - 700	mg/l	
KN:	25 - 100	mg/l	
NH ₄ -N:	22 - 80	mg/l	
P-Total:	5 - 20	mg/l	
* ¹ : The ration between BOD ₅ and COD should always be < 2			

Minimum performance requirements of a Primary Tank*²:				
	Effluent PT		Average	
	EN 12566-6: 2008			
 BOD ₅ :	100 - 350	mg O ₂ /l	200 ± 50	mg O ₂ /l
COD:	200 - 600	mg/l		
S.S.:	40 - 150	mg/l	80 ± 20	mg/l
KN:	35 - 100	mg/l		
NH ₄ -N:	30 - 80	mg/l		
P-Total:	4 - 20	mg/l		
* ² : The sampling should be done with a minimum 24 hour sampling				

The effluent is easy biodegradable if the ratio of BOD₅ and COD is less than 2. Between 2 and 3 it is partially biodegradable and greater than 3, the effluent is not biodegradable.



2.2 THE BIOROCK TREATMENT UNIT (Bioreactor) – ECOROCK-5000

The ECOROCK-5000 sewage treatment unit is a biological purification system, using the BIOROCK media as a carrier material for bacteria. The ECOROCK-5000 unit consists of two biological filtration stages and one aeration stage, has pre-treated water passed through it by gravity. The pre-treated water is spread over the surface of the first layer of BIOROCK media by a distribution system and penetrates into the media for purification.

The treated water discharging from the unit must flow by gravity to the next stage or a discharge point.

2.3 ECOROCK-5000 TREATMENT UNIT: TECHNICAL

- ◆ The tanks and covers are made of polyethylene
- ◆ Each tank has two lifting eyes that are situated at the middle of the tank
- ◆ The water inlet has a $\varnothing$ of 110 mm
- ◆ Air inlet and air outlet have a $\varnothing$ of 110 mm
- ◆ The water outlet has two possible diameters; $\varnothing 75$ and $\varnothing 110$ mm
- ◆ Each unit has a serial number that is located on the right side of the tank (*A/Chapter 1.3*)
- ◆ All materials in the BIOROCK plants are resistant to corrosion and guarantee a long-term lifespan
- ◆ The tanks are made by rotational molding in HDPE (High Density Polyethylene)
- ◆ The tanks are UV resistant and have a lifespan of at least 25 years
- ◆ The HDPE tanks are 100% recyclable
- ◆ The screws are made of stainless steel
- ◆ The pipes are made of PVC and Polypropylene
- ◆ The entire system is nearly 100% recyclable



3 Installation layouts

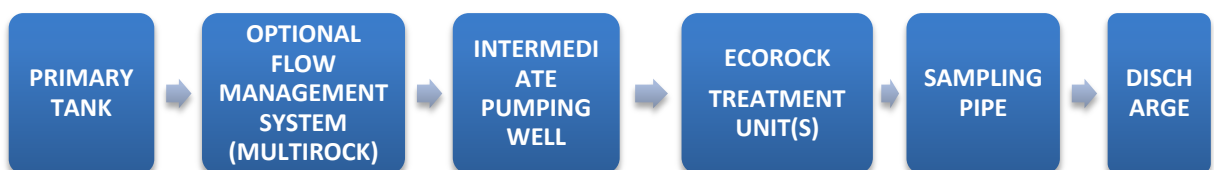
The installation of the BIOROCK system depends on the available site, gradient, type of ground, the level of the water inlet and the discharge options.

When the outlet for final effluent is not accessible, a sampling shaft should be installed. When using a final effluent pump the pump shaft can be used as a sampling shaft.

3.1 INSTALLATION LAYOUT N°1 GRAVITY DISCHARGE (non-electric)



3.2 INSTALLATION LAYOUT N°2 PUMPED DISCHARGE, PUMP AFTER THE PRIMARY TANK



In case of use of an intermediate pump well between the primary tank and the treatment unit, an intermediate Flow Control Device may be required after the pump well for smooth water discharge to the Treatment Units.

3.3 INSTALLATION LAYOUT N°3 PUMPED DISCHARGE, PUMP AFTER THE TREATMENT UNIT(S)



4 INSTALLATION OF THE TANKS

This chapter provides a guide to the installation and commissioning of the BIOROCK system. This manual cannot be a substitute for documentation and instructions from manufacturers of non-BIOROCK products integrated into the system by the installer/user, i.e Flow Management Devices or Primary Tank.



Please take photographs of each stage of the installation with particular attention to all of the connecting pipework



**DO NOT completely fill the tanks with water before unit is backfilled
DO NOT use dirty or contaminated water**



DO NOT use a mechanical compactor, only compact manually



DO NOT reuse the excavated soil or spoil from the site



**DO NOT install the system too close to the house or other buildings
DO NOT install the system too close to large trees**

4.1 INSTALLATION PRINCIPLE

Dimensions and weight of the ECOROCK-5000 treatment unit:

Biological Treatment Unit - ECOROCK-5000	Value	Measure
Capacity in Person Equivalent (PE) ^{*1}	30	PE
Volume of the ECOROCK-5000 unit	5.000	Litres
Length of the Tank	3.500	mm
Width of the Tank	1.150	mm
Height of the Tank	2.175	mm
Total weight (empty) of the ECOROCK-5000 unit	679	Kg
Pipe diameters	110	mm
Cover (2x)	1.200 x 700	mm

Capacity of the ECOROCK-5000 unit can be decreased or increased if the required effluent quality is of a higher or lower standard than the results achieved during the EN-12566-3 performance test



4.1.1 Before the installation of the complete system

- ♦ Always keep the system accessible
- ♦ Check the tanks and the associated equipment (internal reinforcements, connections, seals, etc.) before installation, see technical details for each tank
- ♦ A minimum distance of about 3 m¹ from the house and 3 m¹ from trees which have extensive roots should be ensured
- ♦ A minimum distance of 2.5 m¹ from any building should be ensured, otherwise the stability of the building should be checked
- ♦ The installation should be located away from any traffic areas and parking (at least 2 m¹)
- ♦ The installation of the BIOROCK system is possible in high ground water conditions if special precautions are taken
- ♦ Consult a professional engineer if the units are to be installed with extension sets
- ♦ System lids should not be buried and should always remain accessible for maintenance
- ♦ The minimum distance between the primary tank and the treatment unit is 300 mm
- ♦ The distance between the side of the excavation and the tanks must be minimum of 300 mm
- ♦ Connections for the BIOROCK system are made with flexible seals with a diameter of 110 mm
- ♦ Local rules and legislation must be followed

4.1.2 Installation of the Primary Tank

- ♦ The Primary Tank must be installed as close as possible (less than 10 m¹) to the wastewater discharge point of the property; this avoids fats clogging in the inlet pipe. With a longer pipe run from the property to the primary tank the installation of a grease trap may be necessary
- ♦ This 110 mm diameter pipe (100 mm minimum, 160 mm maximum) should have a minimum gradient of 2 % and a maximum of 4%
- ♦ The Primary Tank should always discharge by gravity into the (optional) Flow Management System and ECOROCK Treatment Units
- ♦ Install the Primary Tank allowing a gradient towards the BIOROCK system
- ♦ The Primary Tank should be installed away from any traffic area, unless special precautions are in place



The Primary Tank must be equipped with an efficient Effluent Filter



For installation at Commercial Sites such as Restaurants, Hotels, Pubs etc... particular attention should be taken to FOG (Fats, Oil and Greases) management.

Excess of FOGs may affect the overall performance of the system and special precautions for their removal may be necessary.

It is the installer's responsibility to ensure that special precautions (i.e. properly-sized Grease Trap or other extra devices) are in place to avoid FOGs affecting the BIOROCK system.



❖ Installation of a Pump Well

If the effluent can't be discharged by gravity, a pump well should be installed for above-ground discharge. The pump is required to lift the effluent (treated water) to a higher level.

BIOROCK has developed an optional PE pump well with a diameter of 400 mm. The PE pump well has the same height as the ECOROCK-5000 unit. All the connections are matching with the openings at the ECOROCK units.

At the end of the ECOROCK-5000 the treated water (effluent) is collected in the pump shaft and can be easily pumped to a higher level with a normal submersible pump.

- ♦ The seals on the BIOROCK tanks are flexible and have a diameter of 110 mm
- ♦ The discharge pipe for the treated effluent should have a minimum gradient of 1%

4.1.3 Installation of the ECOROCK treatment unit(s)

- ♦ The ECOROCK-5000 unit(s) must be installed downstream of the Primary Tank
- ♦ The effluent from the Primary Tank should flow by gravity to the Treatment Units
- ♦ The gradient of the treated effluent pipe to the BIOROCK units should be a minimum of 1%

4.2 INSTALLATION IN DRY GROUND CONDITIONS

See Appendix «Installation in dry ground conditions»

❖ Conditions for installation:

- Dry and stable ground conditions
- Absence of water at the bottom of the excavation

4.2.1 Installation and digging in dry ground conditions

- ♦ The maximum level of top soil above the backfill is 200 mm
- ♦ The units must stand on a clean and stable base such as concrete
- ♦ In dry ground conditions pea gravel can be used
- ♦ Mud and other soft materials must be removed from the bottom of the excavation prior to Installation.
- ♦ A stable base must be created at the bottom of the excavation
- ♦ The base of the excavation should be level and compacted
- ♦ There must be a distance of at least 300 mm between the walls of the excavation and the Units. Same distance applies between the tanks in case of Multirock installations.

4.2.2 Installation of the tanks in dry ground conditions

- ♦ Once the base of the excavation is stable, the installation can begin
- ♦ The Primary Tank should not be positioned horizontally; it must have a slight gradient towards the water outlet
- ♦ Before connecting any water or ventilation pipes, ensure that the units are perfectly Installed.
- ♦ Ensure that all levels are correct so that the wastewater can flow freely through the system
- ♦ Check that all connections are correctly positioned
- ♦ Ensure that the seals are watertight



4.2.3 Backfilling in dry ground conditions

- ♦ Backfill the hole with 3 to 6 mm smooth pea gravel, or lean-mix concrete whilst filling the tanks with water at the same level
- ♦ Do not exceed 300 mm per filling and compaction cycle
- ♦ Make sure that the BIOROCK® media is completely saturated with water
- ♦ Do not backfill with the soil removed during the excavation: roots and stones can damage the tank.
- ♦ Do not compact the backfill material mechanically: compact manually.
- ♦ Backfilling around and filling both the Primary Tank and BIOROCK unit(s) with water should take place at the same time.
- ♦ Once the backfilling is finished and compacted, check the levels of the tanks again
- ♦ The lids or access covers of the system should be installed just above ground, level to provide easy access for maintenance.
- ♦ Close and secure all covers with screws
- ♦ Complete the backfilling once all pipework has been checked and connected.

4.3 INSTALLATION IN HIGH GROUND WATER CONDITIONS

Appendix «Installation in high ground water conditions»

The ECOROCK-5000 units can be installed in high ground water conditions with special precautions.

If you don't use a BIOROCK Primary Tank, please confirm with the manufacturer that this Primary tank is suitable for high ground water conditions.



If you don't use a BIOROCK Primary Tank, please consult the manufacturer to ensure this Primary Tank is suitable for high ground water conditions.



The level of the water table must never exceed the level of liquid inside the Primary Tank. Extremely high water tables signify a flood risk which could cause water ingress or collapsed tanks.



Multirock installations: The level of the water table must never exceed the level of water inlet pipe of the Treatment Units. Extremely high water tables signify a flood risk which could cause water ingress or collapsed tanks.

Perform the same work as in dry ground conditions with the additional recommendations and modifications below:

- ♦ For installations in a high water table area, ensure the adequate drainage of the excavation during installation.



- ♦ Anchor the unit(s) to the concrete slab (slab thickness should be a minimum 150 mm)
- ♦ The base must extend to a minimum distance of 300 mm beyond the base of the tanks on all sides
- ♦ If you are unsure, a qualified civil engineer should be consulted
- ♦ Anchoring the tanks to the base is achieved with a system using the anchoring points; these are positioned on the lower corners of the tanks



For installations in a high water table area, ensure the adequate drainage of the excavation during installation and anchor the unit to the concrete slab

Important:

- ♦ The tanks should be secured and anchored to the concrete base
- ♦ In all high ground water conditions, the backfilling should be carried out to a level of 20 cm below the tank covers.
- ♦ We recommend that the tanks are backfilled with (lean mix) concrete instead of a regular backfill



4.4 INSTALLATION IN «DIFFICULT» AREAS AND SITES

❖ Conditions of installation:

- ♦ Difficult ground conditions can be unstable ground, clay, rocks, etc.
- ♦ If necessary, ensure the adequate drainage of the excavation during installation and anchor the unit(s) to the concrete slab.
- ♦ Solutions such as sheet piling should be used to secure the sides of the excavation.
- ♦ A retaining wall may be necessary to ensure that the backfill does not move in a difficult installation.

4.4.1 Installation in difficult areas and sites

- ♦ Never use heavy clay soil for the top soil level. If the top soil to be used is predominantly clay then mix it with sand.
- ♦ In all difficult grounds conditions the base of the excavation should be constructed from concrete with a minimum depth of 300 mm.
- ♦ Roots and stones can result in damage to the tank wall and should be removed.
- ♦ The depth to the bottom of the excavation and the concrete base for the Primary Tank must allow an incline of 2% minimum for the wastewater inlet pipe from the property to the Primary Tank.

4.4.2 Installation in difficult ground conditions

- ♦ Once the base of the excavation is stable the installation can begin.
- ♦ Before connecting any pipe work or ventilation pipes ensure the units are perfectly installed and stable on the excavation base. Ensuring that all levels are correct is crucial if the wastewater is to flow efficiently through the system.
- ♦ Pay special attention to the rubber seals. The seals ensure that the system is watertight.

4.4.3 Backfilling in difficult ground conditions

- ♦ In all difficult ground conditions backfilling should be carried out to a level of 20 cm below the tank covers. Concrete should be used, compacted and applied in layers of 300 mm.
- ♦ A retaining wall may be necessary to ensure that the backfill does not move in a difficult installation. The thickness and structure of any retaining wall should be specified by a qualified engineer along with the method of construction and backfilling procedure.
- ♦ At the same time as backfilling around the Primary Tank and BIOROCK unit(s) all tanks should be gradually filled with clear water (increments of 300 mm)
- ♦ Once the backfilling is finished and compacted, check the levels of the tanks again
- ♦ The various lids or access covers for the system are installed just above ground level to provide easy access for maintenance.
- ♦ Position the hatches and secure them with the screws positioned on the sides.
- ♦ Backfilling to the surface is completed once all pipe work has been connected. With a maximum depth of 20 cm the backfill should consist of top soil without any stones or sharp objects. When building up the final level of backfill around the covers keep in mind any future settlement of the soil.



4.5 INSTALLATION UNDER ROADS, COURTYARDS OR STORAGE AREAS

❖ Installation conditions:

Roads, courtyards or storage areas: The installation will be carried out in accordance with the preceding paragraphs, taking into account the nature of the soil.



For an installation under roads, courtyards or storage areas, a distribution slab of reinforced concrete should be constructed and placed above the tanks

- ♦ The concrete slab must be constructed in such a way that it does not rest on the tanks
- ♦ The edges of the slab must rest on the surrounding ground; the ground must be stable. If unstable ground, specific foundations should be built
- ♦ These foundations, the thickness of the slab distribution, the access to the lids of the tanks, the unit and sampling pipe, the reinforcement and the structure of the slab, etc., will be specified by a qualified civil engineer, based on expected traffic loads and the nature of the soil
- ♦ The high air outlet pipes should preferably be installed outside the concrete slab area, if this is impossible then they should be anchored in the slab.

4.6 OTHER SPECIFIC CASES

4.6.1 Incline too steep (>5%)

A retaining wall may be necessary to ensure that the backfill does not move if the incline is too steep. The thickness and structure of any retaining wall should be specified by a qualified engineer along with the method of construction and backfilling procedure.

Generally, the backfill material must be compacted pea gravel or lean mix concrete applied in layers of 30 cm. (depending on ground conditions)



A detailed assessment must be carried out for all installations in difficult ground conditions. If you are not sure about the installation, always consult a local engineer



5 VENTILATION & WATER DISTRIBUTION



Never smoke in the vicinity of the installation or sewage works in general.
Never enter the tanks without taking the necessary safety precautions such as ventilation, air monitoring, air supply and other procedures as required.
Always have someone else on site if entering confined spaces.



Both the Primary Tank & ECOROCK-5000 unit(s) must be vented separately



Achieving efficient ventilation is always the responsibility of the installer as he is familiar to the implementation site and local conditions that may interfere in the system's venting.



Make sure that the ventilation works properly. Always check the efficiency of the ventilation through the system with a smoke test prior to backfilling.



If the site is not suitable for non-electric ventilation, electric ventilation should be installed



Use as few bends as possible
NEVER USE 90° bends
Only use 45° bends

5.1 VENTILATION OF THE PRIMARY TANK

A Primary Tank generates malodorous gases that must be removed by effective ventilation. The Primary Tank must have a ventilation system consisting of a low air inlet and a high air outlet. The distance between the air inlet and air outlet pipe should be as far as possible from each other.

- ♦ The high air outlet pipe should have a wind driven or electrical ventilator
- ♦ The wind driven ventilator must be located at least 400 mm above roof level, clear of all potential obstacles and located at least 1 m away from any windows or skylights
- ♦ We recommend a gradient of 1% to avoid any water settling in the air pipe



- ♦ Only use 45° bends (never use 90° bends)
- ♦ The ventilation pipes must have a minimum diameter of 100 mm
- ♦ The Primary Tank vent pipe must be independent of the properties soil vent pipe
- ♦ The water inlet pipe of the Primary Tank should be plugged or capped (blocked for air)
- ♦ Always check the ventilation with a smoke test in representative conditions (calm weather and storms are not representative conditions)

5.2 VENTILATION OF THE ECOROCK-5000 TREATMENT UNIT(S)

- ♦ The ECOOROCK treatment unit(s) has(ve) a separate ventilation system
- ♦ The vent pipe for the ECOROCK unit must be independent of the properties soil vent pipe and must not be combined with the Primary Tank vent pipe.
- ♦ The aeration of the both the upper level and the middle section of the treatment unit is combined
- ♦ The air intake is located at the front of the treatment unit
- ♦ The air outlet pipe should always be equipped with a wind driven or electrical ventilator
- ♦ The ventilation pipes must have a minimum diameter of 100 mm
- ♦ Only use 45° bends (never use 90° bends)
- ♦ Always check the ventilation with a smoke test in representative conditions (calm weather and storms are not representative conditions)

If the ventilation is not working properly:

- ♦ Check the ventilation system again by following the diagram
- ♦ Check if the pipe work is obstructed or disconnected at any stage
- ♦ Check if the air outlet pipe is positioned high enough
- ♦ Check that the wind driven ventilator has enough capacity, otherwise change to an electric Ventilator

5.3 WATER DISTRIBUTION PIPE



Make sure the BIOROCK® Media is saturated with clean water

- ♦ Check and adjust the water distribution pipe to ensure an even distribution across the BIOROCK® media
- ♦ Adjust the height/level of the water distribution pipes using the threaded supports
- ♦ The discharge angle can also be adjusted by twisting the pipes
- ♦ Make sure that the BIOROCK® media is completely saturated with water
- ♦ DO NOT completely fill the tanks with water before unit is backfilled
- ♦ DO NOT use dirty or contaminated water
- ♦ Check the connection from the Primary Tank outlet pipe to the BIOROCK treatment unit(s)
- ♦ There should not be any accumulation of water within the BIOROCK® unit
- ♦ Water should not accumulate on top of the BIOROCK® media
- ♦ The level of the BIOROCK® media must be just under the water distribution pipe
- ♦ Check that the water from the Primary Tank flows by gravity into the BIOROCK® unit (s)



5.4 BIOROCK® MEDIA

BIOROCK Media is an ideal carrier material for bacteria. The BIOROCK Media is clearly visible in the treatment unit. Under the water distribution system, the BIOROCK Media will have a grey colour.

The BIOROCK Media is highly resistant to degradation and remains extremely stable over the long term. It is an inorganic material which does not break down over time. It requires little maintenance: Scraping and scarification is not necessary. Its structure and composition ensures unsurpassed and unique surface treatment with exceptional purification results.

In normal use the BIOROCK Media should not be removed or replaced. The top layer of the BIOROCK Media may have to be rinsed after a period of time if contaminated with solids.

The BIOROCK Media is an ecological, recyclable material.



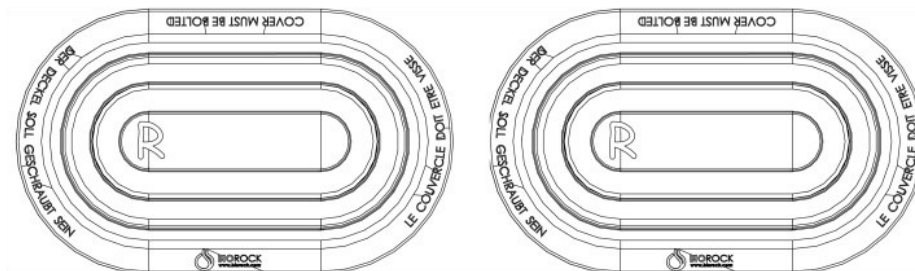
For your safety always contact BIOROCK or your BIOROCK distributor for replacement or re-arrangement of BIOROCK media bags.



Used BIOROCK media can be returned to your distributor or to BIOROCK for recycling.

5.5 SECURING THE LIDS

- ♦ The lids of the BIOROCK tanks should remain accessible for maintenance
- ♦ Always close and secure the lids after use using a screw driver.



**Always close and secure the lids
Always keep the lids accessible
Make sure the lids are air tight
The lids are for pedestrian use only**



6. STOPPING AND RESTARTING THE SYSTEM

The establishment of an efficient biomass varies. The system start-up period differs depending on the system size, its location, the temperature and especially the conditions of use.

For long periods of shutdown or non-use of the system (absence periods), no special precautions are required. The sewage system will re-start as facilities are used again and will not require any particular attention.

For absence periods exceeding six months, it is recommended to empty the Primary Tank and refill with fresh water.

If the unit is equipped with an electric ventilator, it is best to shut it down during the absence period and to check and clean it before the restart.

If a pump station is installed, it is best to commission it and clean it before the shutdown period.

The BIOROCK system remains efficient after a shutdown period.

7. CONFORMITY AND WORK COMPLETION

In all cases, the owner and the installer will jointly complete the installation checklist for BIOROCK Sewage Treatment Plants (Appendix 5) and send it back to the manufacturer at the address listed.

The document is attached to the user's guide. This completed document validates the warranty when received by the manufacturer.

8. RECOMMENDATIONS FOR USE AND MAINTENANCE

See the procedures in Part B of this Manual; User Guide, page 23-47.

9. COMPLIANCE WITH REGULATIONS AND STANDARDS

The ECOROCK-5000 units comply with all requirements of EN 12566-3 + A2, 12566-6 and the Construction Product Regulations.

Performance tests for the CE marking of BIOROCK® units were produced and validated by the European Platform notified as CERTIPRO (notification NB 1476) located in MOL, Belgium.



10. WARRANTY



10 years warranty on the BIOROCK® media ^{*1}

25 years warranty on the BIOROCK® tanks ^{*2}

*^{*1} The 10 years warranty shall only apply if the annual maintenance is carried out by a BIOROCK® approved installer or supervised by a trained BIOROCK® Certified professional*

*^{*2} The 25 years warranty shall only apply if the installation is carried out by a BIOROCK® approved installer or supervised by trained BIOROCK® Certified professional*

Manufacturer's Warranty - Terms and Conditions:

Content of BIOROCK warranty:

Every BIOROCK treatment plant leaving the production line is inspected and verified according to ISO 9001 standards. The guarantee covers the tanks, materials and parts.

As the operation of the system is linked to the use of the products and not the manufacturing, the warranty does not apply to the function of the plants.

If a defect in the manufacture of the product is acknowledged by the supplier, the guarantee is limited to the replacement of the defective parts, this excludes any other expenses. Defective equipment and associated accessories should will be made available to the manufacturer and repackaged in the original packaging if necessary.

The warranty is subject to installation and operation as per the manufacturer's instructions and in accordance with good installation practices. The warranty will not apply in the event of:

- Failure to comply with the basic design data for the wastewater treatment plant;
- failure to return the completed commissioning form / or failure to issue a valid notice of conformity when commissioning is complete;
- Failure to follow installation instructions detailed in the Installation Guide, for the primary tank and effluent filter (including the water tightness test) and the treatment unit;
- Failure to present or regularly update the maintenance reports by the user (the maintenance report can be found in the manual);
- Failure to comply with other requirements, norms, local regulations or common standards;
- Damage caused by any accidental or climatic events, beyond our control.

Activation of the BIOROCK warranty:

In order to activate the BIOROCK Warranty, the owner of the installed products must complete the approval certificate correctly (Appendix 5 "BIOROCK Installation and user guide"). This form must be completed by both the installer and person commissioning the system, it should then be returned to the address indicated on the document.

Length of the BIOROCK warranty:

Annual maintenance is a condition for the manufacturer's warranty. This must be carried out by a trained and qualified contractor. The maintenance must be carried out to the manufacturer's instructions as specified in the user guide.



The owner must complete the maintenance book and keep it up-to-date by adding any maintenance and commissioning activities carried out on the BIOROCK plant.

Attention: Sludge emptying documents - confirmation of emptying, receipts, dates and volumes etc issued by the contractor must also be retained. The maintenance book must be made available in the event of a complaint.

BIOROCK warranty:

- **10 years on the BIOROCK Media (biological part of the treatment plant).**
- **25 years on BIOROCK tanks**
- **2 years on electrical options, supplied by BIOROCK**

Condition of delivery: In the case of incomplete delivery (missing equipment or accessories) or damage observed on delivery, these remarks / observations should be listed on the carrier delivery note or bill. The carrier and the supplier must be informed within 48 hours or 2 business days.

Follow the maintenance instructions and visual controls to maintain a reliable and durable system. Please contact your dealer with any question.





B. USER GUIDE

ECOROCK-5000 & BIOROCK® Multirock systems *BIOROCK® Multiple Installations*



TABLE OF CONTENTS

1. SAFETY INSTRUCTIONS	29
2. SUSTAINABLE DEVELOPMENT	30
2.1 Useful information.....	30
2.1.1. Sustainability	30
2.1.2. Waste disposal	30
2.2 Polyethylene and PVC.....	31
2.2.1. Energy recovery	31
2.2.2. Material recycling.....	31
2.2.3. The BIOROCK® Media	31
3. OPERATING AND MAINTENANCE RECOMMENDATIONS	32
3.1 Primary Tank and Effluent filter	34
3.2 The ECOROCK Treatment Unit	36



1. Safety instructions

Related to the installation and operation of an ECOROCK treatment plant

- ☛ **NOTE:** Consult with certified professionals regarding all installation and maintenance work, and for all operations undertaken on this sewage treatment plant. Your distributor and/or your installer will advise you on how to set up a maintenance contract.
- ☛ **NOTE:** Household wastewater contains human faeces (excrement). This means that wastewater may contain very noxious pathogenic bacteria. Under certain conditions (for instance stagnant wastewater, high temperatures etc.) these noxious pathogenic bacteria may be present in large numbers. Therefore, always use plastic gloves and proper disinfectants if you come into contact with wastewater or with parts which have been in contact with wastewater. The term wastewater also includes the final effluent (the purified wastewater from the BIOROCK® System).
- ☛ **NOTE:** The effluent CANNOT be reused for any other purpose other than discharge into the surface water or infiltration into the soil. The water may contain traces of bacteria, which under certain circumstances (stagnant water, high temperature etc.) may grow in large numbers and be potentially harmful to human health.
- ☛ **NOTE:** The final effluent (the “clean” water from the System) is NOT drinkable.
- ☛ **NOTE:** Always keep the lid closed and open it only for inspections and maintenance work. Never leave the lids and inspection points unsupervised while open. Lids are for pedestrian use only.
- ☛ **NOTE:** Do not put your head directly into any septic tank or sewage treatment plant through the manhole even to “have a look” or in an effort to find the cause of a malfunction. Noxious gases may accumulate in the system and may interfere with respiration and cause nausea, dizziness and in very extreme cases loss of consciousness.
- ☛ **NOTE:** Do not install, repair, change or check electrical components yourself; this can be extremely dangerous due to the combination of electricity and water especially when using 230 Volt. Leave this task to a qualified electrician, who can install the system in accordance with local regulations. When using 12 Volt electrical accessories, there is no danger of electrocution, but contact a qualified electrician if in doubt.
- ☛ **NOTE:** Never smoke near the work area while the operations described in this manual are being carried out, and never enter the work area without having taken all the prior precautions for ventilation and atmospheric testing as prescribed in the applicable local regulatory provisions.
- ☛ **NOTE:** Any risks during the installation are related to excavation or handling of material. While installing the tanks, use a sling hung from the 4 corners of the upper part of the tank. Make sure that no one is in the maneuvering area, and do not position yourself under the load.



2. SUSTAINABLE DEVELOPMENT

In order to support sustainable development, BIOROCK has developed a sewage treatment plant with a very low carbon footprint. It does not need electricity, mechanical parts or chemicals to work.

Selecting a product that offers a sustainable solution to the problem of waste disposal is a key factor in protecting the environment. The construction market is becoming increasingly aware of the need for environmentally sustainable solutions to issues such as sewage treatment and the disposal of effluent from off-mains systems. There is a clear shift towards responsible and sustainable products. BIOROCK sewage treatment systems are the acknowledged leader in this rapidly changing market.

All materials used in the manufacture and assembly of the BIOROCK systems equipment are corrosion-resistant to ensure a long term installation. The main components are polyethylene (Tanks), PVC (piping) and the BIOROCK media. Nearly 100% of the components can be recycled.

2.1 USEFUL INFORMATION

2.1.1 Sustainability

Sustainable development is based on three factors: Protection of the environment, social progress, and economic development.

Both production methods and consumption must respect both human beings and the natural environment to enable all inhabitants on Earth to meet their basic needs (food, clothing, education, work, living in a healthy environment).

Education for sustainable development is fundamental: it is the main necessary step towards a general change in mindset and behavior. This change in mindset for each of us (citizens, businesses, local authorities, governments, international institutions) is necessary to address threats to the Earth (social inequality, industrial and health risks, climate change, biodiversity loss, etc.).

2.1.2 Waste disposal

Waste results from the operation of treatment systems and maintenance of drainage systems for sewage and rainwater. These are predominantly organic waste (sludge, grease, wastewater treatment plant waste, drain material, etc.) or mineral (sand treatment plant, sludge, sewage sands, etc.).

Sludge produced in the Primary Tank must be removed by a licensed contractor.

The used BIOROCK media can be returned to BIOROCK or to a BIOROCK Certified Partner for recycling.

The effluent filter for the Primary Tank can be disposed after rinsing.



2.2 POLYETHYLENE AND PVC

PE and PVC are recoverable using different processes

2.2.1 Energy recovery

Incineration leads to energy recovery. However it may generate pollutants and gas.

2.2.2 Material recycling

Recycling plastics of this nature (PVC, PE) into granules or powder which can be sold as an alternative to virgin material in manufacturing.

2.2.3 The BIOROCK® media

The BIOROCK® media is inert but if there is a need to replace some of the media the dirty bags (once removed) must be cleaned before recycling.

The used BIOROCK® Media can be returned to BIOROCK for recycling.

Always ask a professional waste disposal contractor to periodically remove sludge. Once removed, the sludge will be disposed safely at an approved facility.



3. OPERATING & MAINTENANCE RECOMMENDATIONS

An annual service and maintenance contract should be set up for your BIOROCK system. Contact your dealer if necessary or contact us for more details about the closest dealer to you.



Maintenance on Multirock installations:

Multirock installations are specific, especially when serving commercial applications (particular wastewater characteristics). To ensure long lasting efficiency of the system, Multirock installations should be visited and maintained on a more frequent basis than domestic installations.

A maintenance visit each quarter (every 3 months) by a Certified, trained BIOROCK Professional is mandatory for Multirock installations. A periodic service and maintenance contract should be set up by the user with this Professional.

BIOROCK highly recommends users to set up a maintenance contract with their local dealer or Certified Installer to ensure the long lasting efficiency of BIOROCK products. Completing the maintenance book together with a BIOROCK Certified Professional is a condition for warranty. However, should you be unable to get this service locally, BIOROCK can provide a maintenance planning schedule giving an overview of the maintenance procedures. This planning schedule will allow a professional in the wastewater industry to provide the maintenance service.

Please check with local authorities how often the primary compartment should be emptied as this should be in line with local regulations.

The summary below indicates the commissioning of your sewage treatment plant. Your sewage treatment plant can be free from any failures as the BIOROCK system does not require electricity. (In normal operation, and following the maintenance recommendations)

GENERALLY:

Every year: (Multirock: Each quarter)

- ✓ Visually check the water tightness of the complete system
- ✓ Check the ventilation
- ✓ Check if there are any smells exiting the tanks

PRIMARY TANK

Every year: (Multirock: Each quarter)

- ✓ Check the sludge level
- ✓ Empty the Primary Tank if the sludge level is > 50%
- ✓ Change the effluent filter if necessary or change after emptying the Primary Tank
- ✓ Take a sample of the effluent from the Primary Tank and check quality visually

ECOROCK-5000 UNIT(S)

Every year: (Multirock: Each quarter)

- ✓ Clean the water distribution pipe (rinse using a hose pipe)
- ✓ Check and re-adjust the water distribution pipe if necessary



- ✓ Check the first layer of BIOROCK® Media
- ✓ Rinse or replace the first layer of BIOROCK® Media if necessary
- ✓ Remove and clean the alarm
- ✓ Take a sample of the outgoing water (final effluent) and check for clearness and odour. Clearness means that the water contains few suspended particles. The colour may vary from neutral to dark yellow. The odour of the water will normally be neutral to light ammonia.

Neutral



Dark yellow



FLOW MANAGEMENT SYSTEM

For Multirock only, Each quarter

- ✓ Clean the Flow Management System
- ✓ If BIOROCK Flow Control Chamber (FCC) and Splitterbox (SB): Rinse using a hose pipe
- ✓ Check and re-adjust the float of the FCC if necessary
- ✓ Check equal distribution of the wastewater through the ECOROCK units



3.1 PRIMARY TANK AND EFFLUENT FILTER

For a non-BIOROCK Primary Tank please refer to the maintenance schedule from the manufacturer of the Primary Tank that you have purchased. However, should you be unable to get information, BIOROCK can provide a maintenance planning schedule giving you an overview of the maintenance procedures.

Please check how often you need to empty your Primary Tank in line with local regulations. Please check if the Primary Tank has the required efficiency that is required by BIOROCK. See page 9, Chapter 2.1.

MAINTENANCE GUIDE FOR THE PRIMARY TANK (PT) AND THE EFFLUENT FILTER (EF)

Sampling of the pre-treated waste water coming from the Primary Tank

Take your first sample 6 months after commissioning, then once a year, or at the same time as the Primary Tank is emptied.

- ♦ Check (visually) the pre-treated wastewater quality
- ♦ Take a sample (with rubber or latex domestic use gloves) of the purified sewage water in a clean glass.
- ♦ The color of the water should range from light brown to yellow, from turbid to very turbid, but very little deposit should show at the bottom of the sample after it has rested for twenty minutes
- ♦ The purified water may have a slight (septic) odor



If the water looks different or you find increased deposits in the pre-treated waste water, this may be caused by:

- ♦ Water flowing too fast through the PT, too short retention time (hydraulic overload). Check that no rainwater run-off system passes through the installation.
- ♦ The volume of the Primary Tank is too small to accommodate normal usage
- ♦ Incorrect disposal of harmful, toxic, anti-bacterial or non-biodegradable products into the installation
- ♦ You may need to call a certified septic tank cleaning company to empty the PT and to clean it (skimming off the fats and floating matter — the surface layer). Never completely empty the PT; always leave a layer of sludge at the bottom to ensure that it continues to function correctly after it has been emptied
- ♦ In all of these cases, you should consult the documents and user manuals provided by the tank manufacturer



If you notice any foul odors, these may be caused by:

- ♦ The ventilation system is not working properly
- ♦ The ventilation system is not airtight at the T-piece of the water inlet in the PT
- ♦ The internal waste water system in the house is not vented properly with a soil vent pipe
- ♦ The inspection seals or the seals on the Primary Tank are not air- or watertight
- ♦ Insufficient airflow through the ventilation system; ventilation pipes too small - diameter >100 mm, a badly positioned wind driven ventilator, etc.
- ♦ A block in the airflow in the tank itself, because the surface layer has become too thick (for example fats & floating matter) or a baffle wall that is too high.
- ♦ In all of these cases, you should consult the documents and user manuals provided by the manufacturer.



Effluent Filter cleaning and replacement

The BIOROCK effluent filter should be checked annually (Multirock: every quarter) and cleaned (rinsed) or replaced when required.

- ♦ Open the cover at the PVC pipe that provides access to the Effluent Filter
- ♦ Take the rod holding the Effluent Filter and lift it carefully to remove
- ♦ Beware of flying particles
- ♦ The Effluent Filter should be replaced when necessary, when its condition is no longer fit for efficient filtering of suspended solids.

Emptying of the Primary Tank

The first emptying of the Primary Tank takes place, when the sludge level reaches 50% of the Primary Tank volume, unless superseded by local regulations.

- ♦ Always use a certified septic tank emptier.
- ♦ Replace the Effluent Filter at least every two years.
- ♦ The frequency with which the tank is emptied may be adapted according to the nature of the operation and how many people live in the building. It must be emptied when the sludge level reaches 50%.
- ♦ The cleaning certificate, written by the certified septic tank cleaning company, must be retained by the owner in and placed in the maintenance guide.
- ♦ The septic tank emptier should pressure wash the sides of the tank and the Effluent Filter to remove the accumulated fats and other matter.
- ♦ The tanker, while emptying the Primary Tank, must not be parked any nearer than 4 meters (14') from the installation to ensure and maintain stability.
- ♦ Refill the Primary Tank with clean water after emptying before resuming normal operation.

Further information:

The quantity of sludge produced is influenced by how the unit is used (size, frequent overloads, type of waste water, routine maintenance). Each unit is different. This is particularly true for commercial applications.

ECOROCK-5000	Sludge production in Primary Tank		
Capacity in Person Equivalent	1x ECOROCK-5000 30 PE	2x ECOROCK-5000 60 PE	3x ECOROCK-5000 90 PE
Sludge production	5.475 Liters/year	10.950 Liters/year	16.425 Liters/year

We estimate that an installation of 5 PE will produce a maximum of +/- 900 liters of sludge in the first year. The quantity of sludge produced will reduce over the first few years: normally after the fourth or fifth year, the residual quantities will have decreased by 40%. When emptying, the cleaner must leave a few centimeters of sludge at the bottom of the tank; the bacteria that break down the sludge are specific and take a long time to develop.



3.2 THE ECOROCK TREATMENT UNIT(S)

The 10 years warranty shall only apply if the annual maintenance is carried out by a BIOROCK® approved installer or supervised by a trained BIOROCK® Certified professional

MAINTENANCE PLANNING FOR THE ECOROCK-5000 SEWAGE TREATMENT PLANT



**Only take a sample from running water.
Never use a sample from stagnant water**

Effluent sampling:

6 months after start-up, then every year

- ♦ Only take a sample from running water. Never use a sample from stagnant water
- ♦ Take a sample of the outgoing water (final effluent) and check for clearness and odour. Clearness means that the water contains few suspended particles. The colour may vary from neutral to dark yellow. The odour of the water will normally be neutral to light ammonia
- ♦ Sampling can be done via any sampling point or directly at the outlet of the tank
- ♦ Always wear rubber or latex domestic gloves when taking a sample
- ♦ The outgoing water should be clear. A little deposit might show at the bottom of the sampling glass after it has rested for twenty minutes
- ♦ The water shouldn't have a septic or nauseating odor. It may have the characteristic smell of fresh humus
- ♦ If the visual check seems to show a malfunction (turbid treated water, presence of deposits or suspended matter, nauseating or septic odor), take the sample to a certified laboratory for testing
- ♦ If the laboratory confirms a problem with the water quality check:
 - if the primary tank is functioning properly
 - the quality of the pre-treated water from the Primary Tank
 - if there are any fats or solids on the surface of the BIOROCK® Media
 - the water distribution in the BIOROCK unit(s)
 - if the ventilation of the Primary Tank is functioning properly
 - if the ventilation of the BIOROCK system is functioning properly
 - if the unit is correctly sized for its required capacity
 - the presence of harmful, toxic, antibacterial or non-biodegradable products in the installation



If you notice the presence of increased deposits (suspended matter) in the treated waste water or if the unit is clogged up:

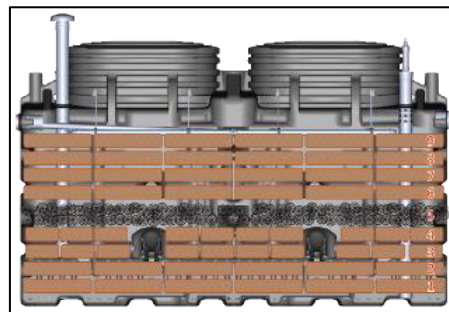
A prolonged overload of pollution in the installation, repeated misuse of the primary tank (late sludge removal, an inefficient effluent filter and neglect over several years) can lead to the saturation of the BIOROCK® Media in the bioreactor.



Cleaning or replacement procedure for the BIOROCK® Media:

The BIOROCK Media can be removed using a metal hook or a rake. The BIOROCK media can be returned to a local BIOROCK partner. BIOROCK will arrange media recycling after use.

- ♦ If the BIOROCK® Media is clogged, remove the bags of BIOROCK media until you get to clean bags
- ♦ If possible clean the BIOROCK® media with a normal water hose. Wash the bags in a basin of water, agitating them aggressively, so that all of the sludge that has accumulated in the bags is removed
- ♦ If it is impossible to clean the BIOROCK® media, replace with new bags
- ♦ Before returning the BIOROCK® media bags, clean the inside of the tank and if necessary the Aeration rings
- ♦ Carefully place the bags back in the unit as detailed below

**Build-up of the BIOROCK media from bottom to top:**

Layers 1 to 4 of BIOROCK® media 2x2	Layer 5	Layer 6	Layers 7 to 9
121 kg of BIOROCK media 20x20x20mm (average 122 bags)	42 kg of plastic aeration rings (average 594 rings)	39 kg of BIOROCK media 10x10x10mm (average 39 bags)	87 kg of BIOROCK media 20x20x20mm (average 88 bags)

While replacing the bags of BIOROCK Media, make sure that each layer of bags completely covers the surface of the unit, ensure that there is no free space between the bags. The bags of BIOROCK Media should always overlap each other. Ensure that the aeration rings are put back to the same position and height.

BIOROCK can quote media replacement and recycling through its network of distributors and installers. Contact us for your closest BIOROCK Certified Professional.



A well performing ECOROCK unit does not produce a bad smell, it should have a smell of fresh humus

Problems with bad smells are generally caused by a poor ventilation of the Primary Tank and/or Treatment Units

Check the alarm

To be done annually (Multirock: Each quarter)

Clean the float and the pipe with clean water.

Visually check the alarm positioning: ⇒ Lift lightly and let it go down.

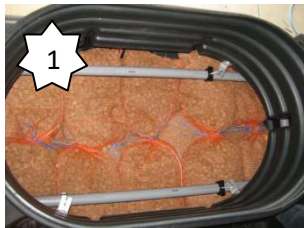
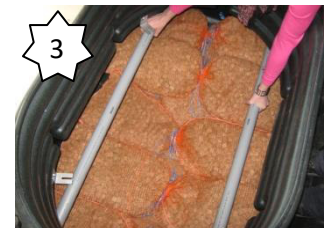


Check water tightness of the water inlet pipe and the water distribution pipe*To be done annually (Multirock: Each quarter)*

Visually check the water tightness of the water inlet pipe from the Primary Tank.

**Check that the water distribution pipe provides an equal distribution of water to the BIOROCK® media***To be done annually (Multirock: Each quarter)*

Clean the inside of the water distribution pipe with clean water using a hose pipe.



1. Unclip the water distribution pipe and remove the pipe system from the tank
2. Adjust the height/level of the water distribution pipes using the threaded supports
3. The discharge angle can also be adjusted by twisting the pipes

Check the BIOROCK media and its possible settlement*To be done annually (Multirock: Each quarter)*

- ♦ The BIOROCK Media may settle progressively as the water flows through it. This generally occurs after some years of usage.
- ♦ Should this occur, just shake the BIOROCK media bags manually and placed them back in the tank. Make sure that each layer of bags completely covers the surface of the Treatment Unit with no free space between the bags which should always overlap each other.
- ♦ If the inspection shows an accumulation of suspended solids at the top layer of BIOROCK media, then the BIOROCK media of the top layer may need to be cleaned more thoroughly. (see Ch. "Cleaning or replacement procedure for the BIOROCK Media")



Any long-lasting water accumulation on the surface of the bags indicates that it is necessary to clean at least the first layer of BIOROCK media.



The frequency of cleaning and / or replacement of the BIOROCK media bags depend on the quantity and quality of effluent leaving the Primary Tank. Checking the Effluent Filter and Primary Tank on an annual basis is very important. (Multirock: Each quarter)

**If you still notice the presence of fats:**

If flow difficulties persist after the above cleaning operations, check for an accumulation of fat in the Primary Tank and at the Effluent Filter.

**If you still notice the presence of fats:**

If flow difficulties persist after the above cleaning operations, check for an accumulation of fat upstream from the treatment unit(s).

In this case, the Primary Tank and the Effluent Filter efficiency must be checked.



C. APPENDICES

Appendix 1: Technical drawings of the various components

1.1 Drawing of an ECOROCK-5000 treatment unit	40
1.2 Aeration & Water distribution schematic of an ECOROCK-5000	41
1.3 Cross section of the layers of BIOROCK® Media in an ECOROCK-5000 unit	42

Appendix 2: Installation drawings of BIOROCK® Multirock installations

2.1 Drawing (Cross section) of 1x ECOROCK-5000 plant in dry ground conditions	43
2.2 Drawing (Cross section) of 1x ECOROCK-5000 in high ground water conditions	44
2.3 Drawing (Top view) of 1x ECOROCK-5000 treatment plant	45
2.4 Drawing of 2x ECOROCK-5000 systems	46
2.5 Drawing of 3x ECOROCK-5000 systems	47

Appendix 3: Technical drawings of the accessories

3.1 Drawing of a Flow Control Chamber	48
3.2 Drawing of a Splitterbox	49

Appendix 4:

MAINTENANCE & ACTIONS FORM	51
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Appendix 5:

REGISTRATION FORM FOR YOUR BIOROCK® PLANT	53
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1.1

ECOROCK-5000

Treatment Unit

Tank volume 5000 L

1	Water inlet
2	Water outlet
3	Air inlet
4	Air outlet
5	Overflow Alarm

Characteristics	Value	Unit
ECOROCK-5000 Treatment Unit		
Capacity in population equivalent	30	PE
Daily volume of wastewater	150	litres/day/PE
Daily hydraulic load	4.5	m ³ /day
Organic load per PE	60	gr. BOD ₅ /PE/jour
Organic load raw influent	up to 2.25	kg BOD ₅ /day
Specification		
Tank volume	5000	Liters
Overall length	3500	mm
Overall width	1150	mm
Total height of the tank	2175	mm
Overall height (+ventilation pipe)	2350	mm
Total weight (without water)	680	Kg
Pipe diameter	110	mm

Technical drawing of the ECOROCK-5000 Treatment Unit. The side view shows the unit's profile with dimensions: 2350 mm total height, 2175 mm height to the top of the tank, 2065 mm height to the top of the inlet/outlet pipes, 1930 mm height to the top of the air inlet/outlet pipes, and 1453 mm height to the top of the overflow alarm. The front view shows the unit's width of 1150 mm and depth of 260 mm. Labels indicate: 1. Level 0 : Ground level, 2. Maximum height of groundwater, 3. Backfill height 0.45 m max, 4. Water inlet, 5. Water outlet, 6. Air inlet, 7. Air outlet, 8. Overflow Alarm.

Technical drawing of the ECOROCK-5000 Treatment Unit. The top view shows the unit's length of 3500 mm and width of 1150 mm. The bottom view shows the unit's profile with dimensions: 2350 mm total height, 2175 mm height to the top of the tank, 2065 mm height to the top of the inlet/outlet pipes, 1930 mm height to the top of the air inlet/outlet pipes, and 1453 mm height to the top of the overflow alarm. Labels indicate: 1. Level 0 : Ground level, 2. Maximum height of groundwater, 3. Backfill height 0.45 m max, 4. Water inlet, 5. Water outlet, 6. Air inlet, 7. Air outlet, 8. Overflow Alarm.

ECOROCK-5000

Overall tolerance : 3%

UT-X5000

Nb. of PLAN

SCALE 1:20

DATE

SIGNATURE

APPROVAL

CHANGES

TITLE

DATE

SIGNATURE

APPROVAL

CHANGES

TITLE

DATE

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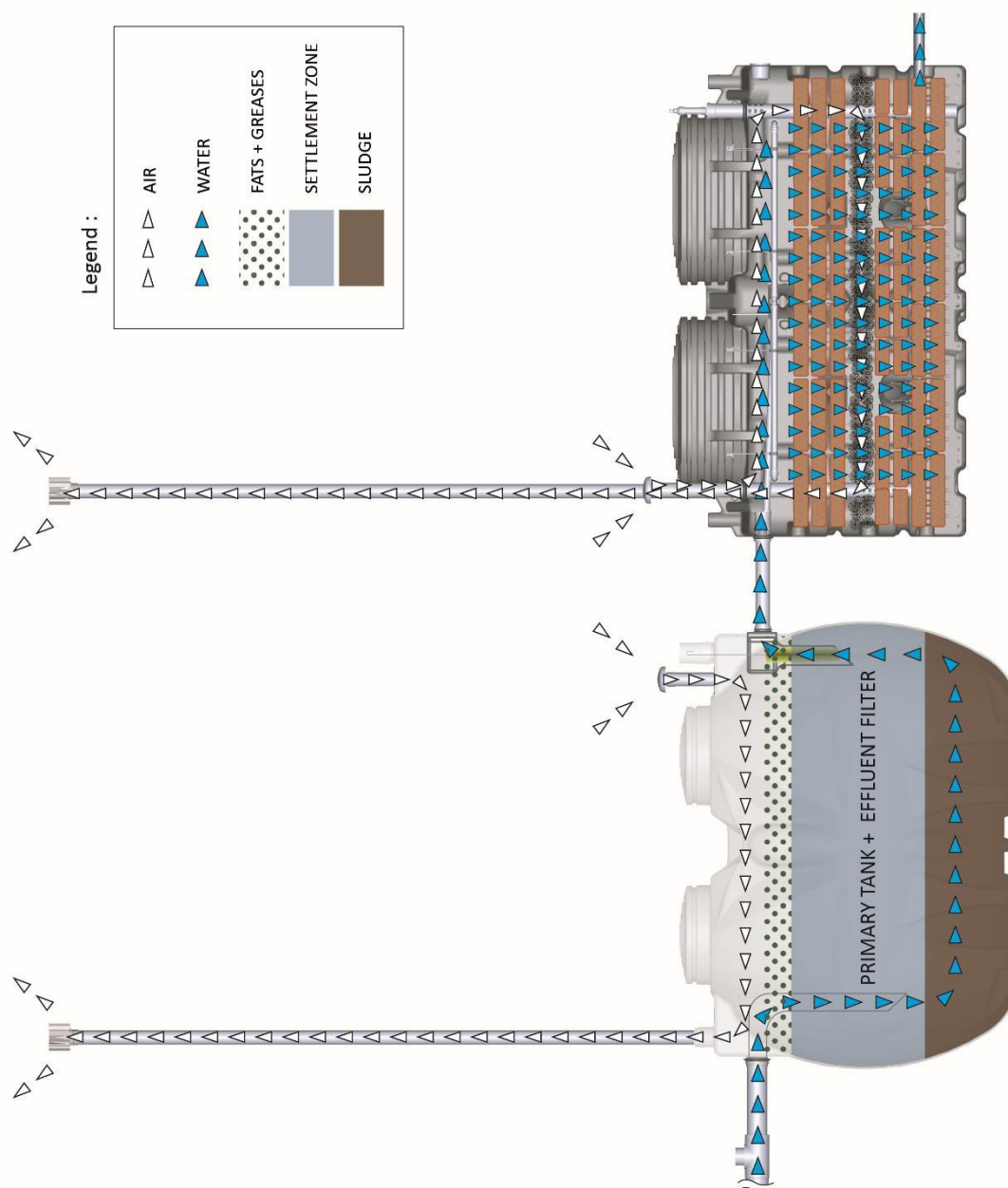
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APPENDIX 1

1.2

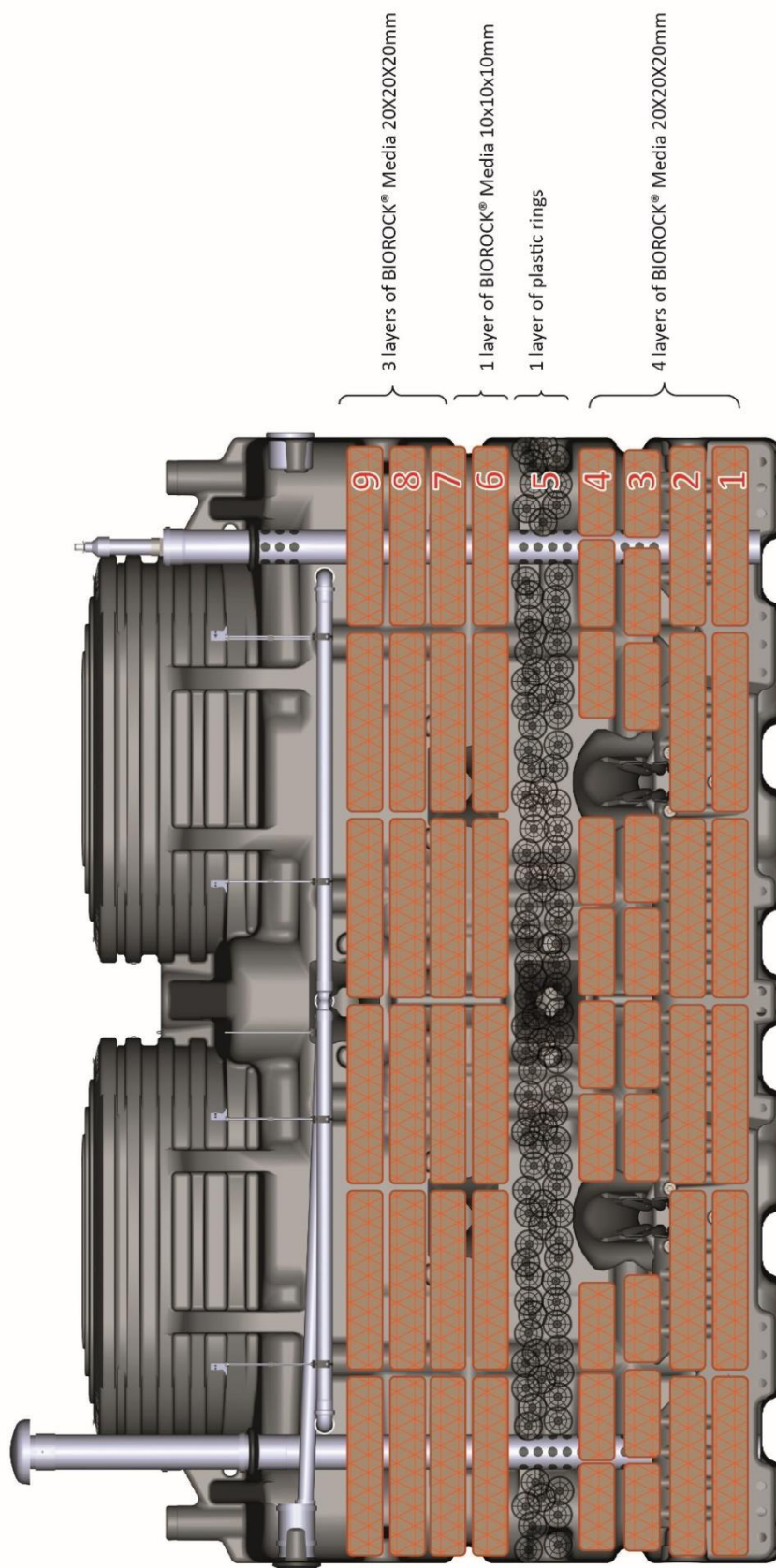
Aeration and water distribution scheme (without pumping well)



APPENDIX 1

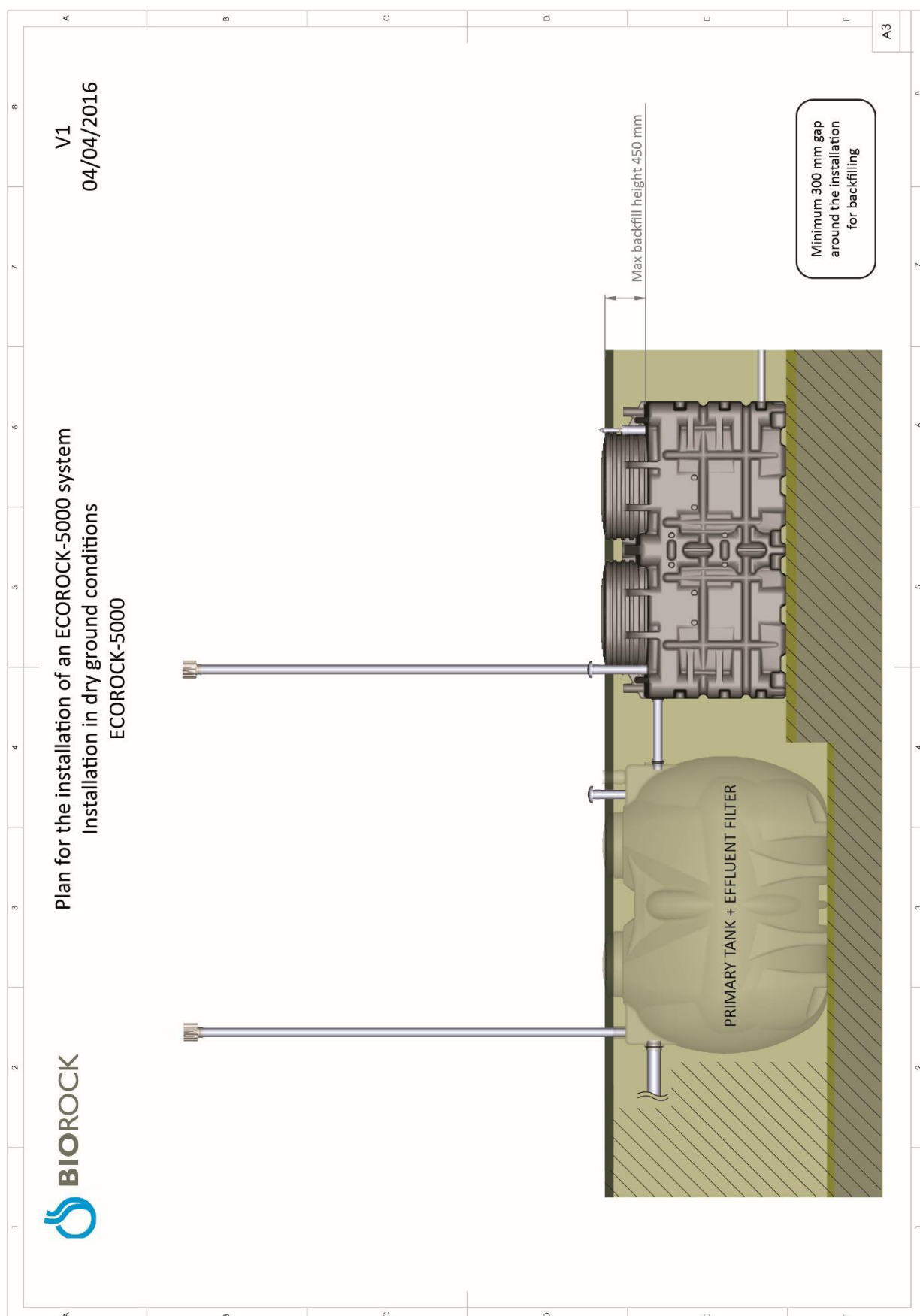
1.3

Drawing (Cross section) showing the layers of BIOROCK® Media in a ECOROCK-5000 unit



APPENDIX 2

2.1

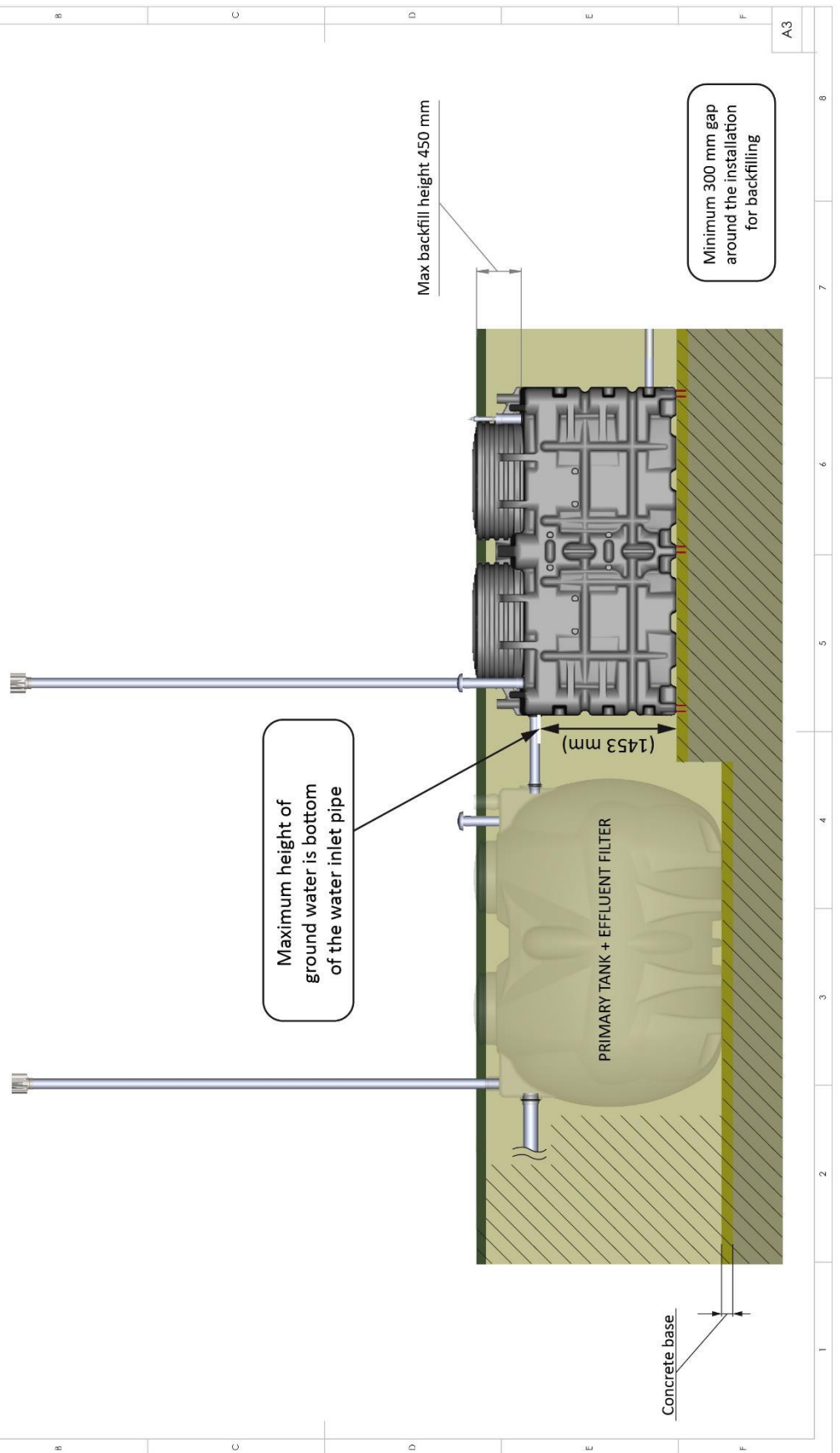


APPENDIX 2

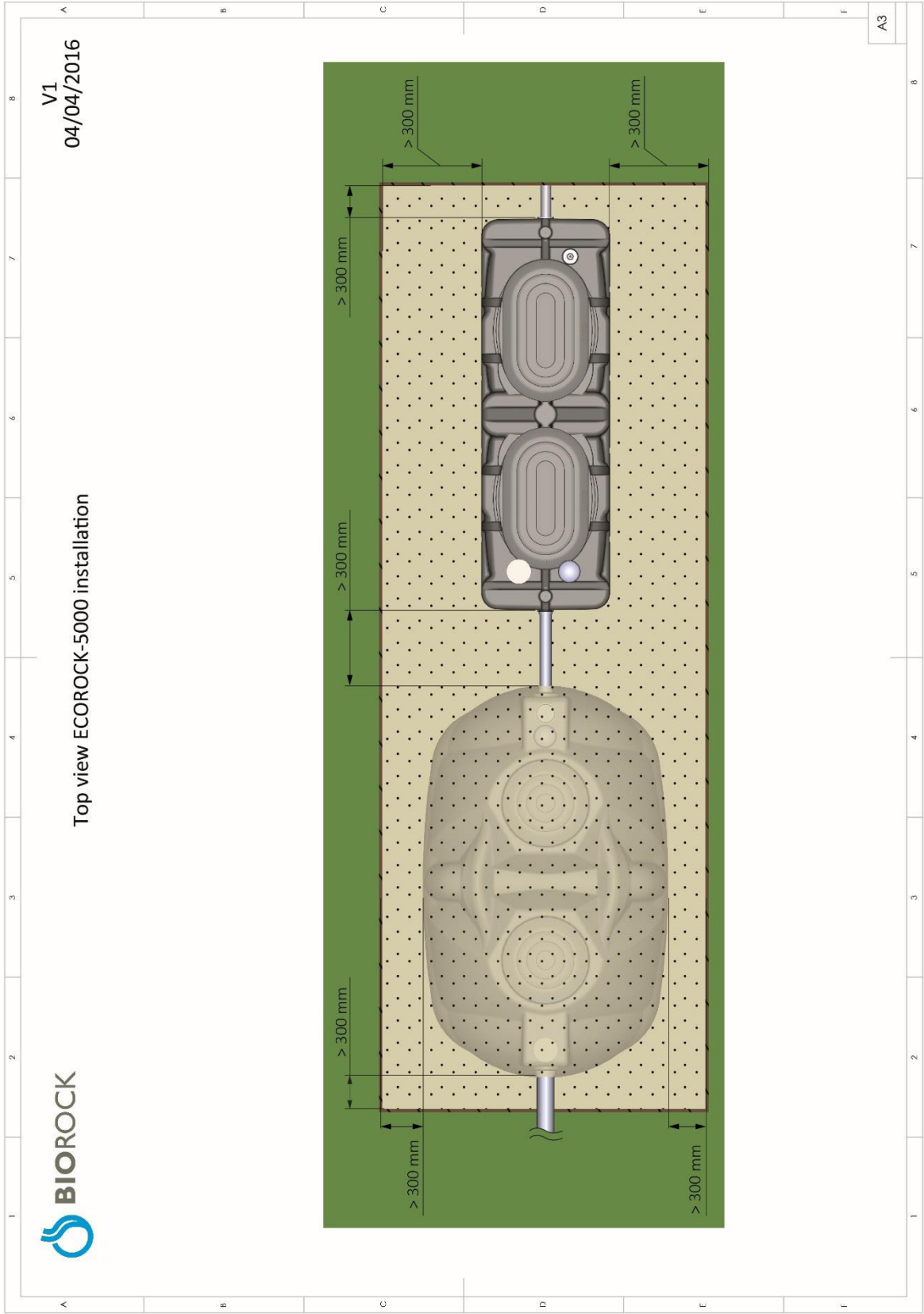
2.2

V1
04/04/2016

Plan for the installation of an ECOROCK-5000 system
Installation in high ground water conditions
ECOROCK-5000

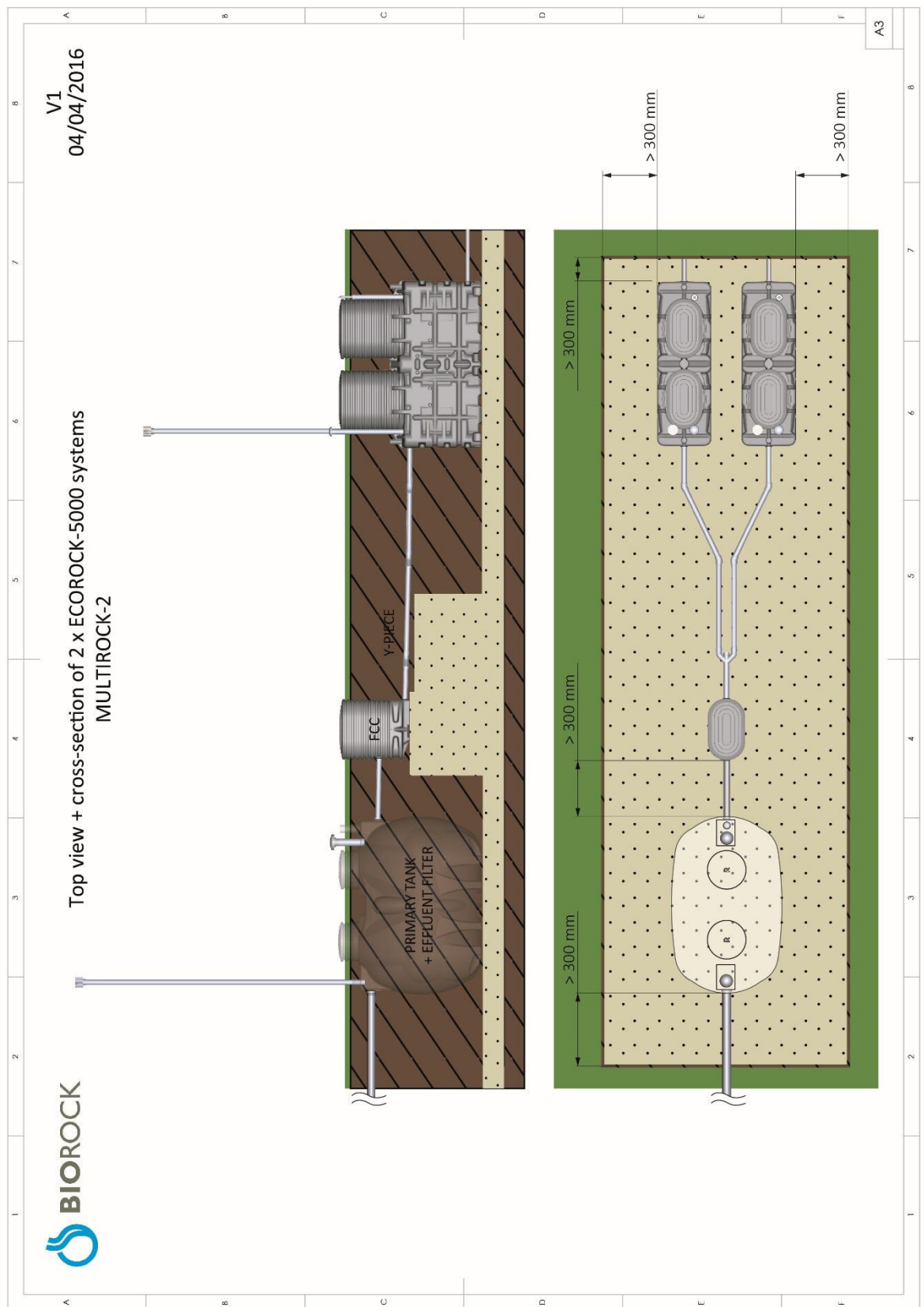


APPENDIX 2
2.3



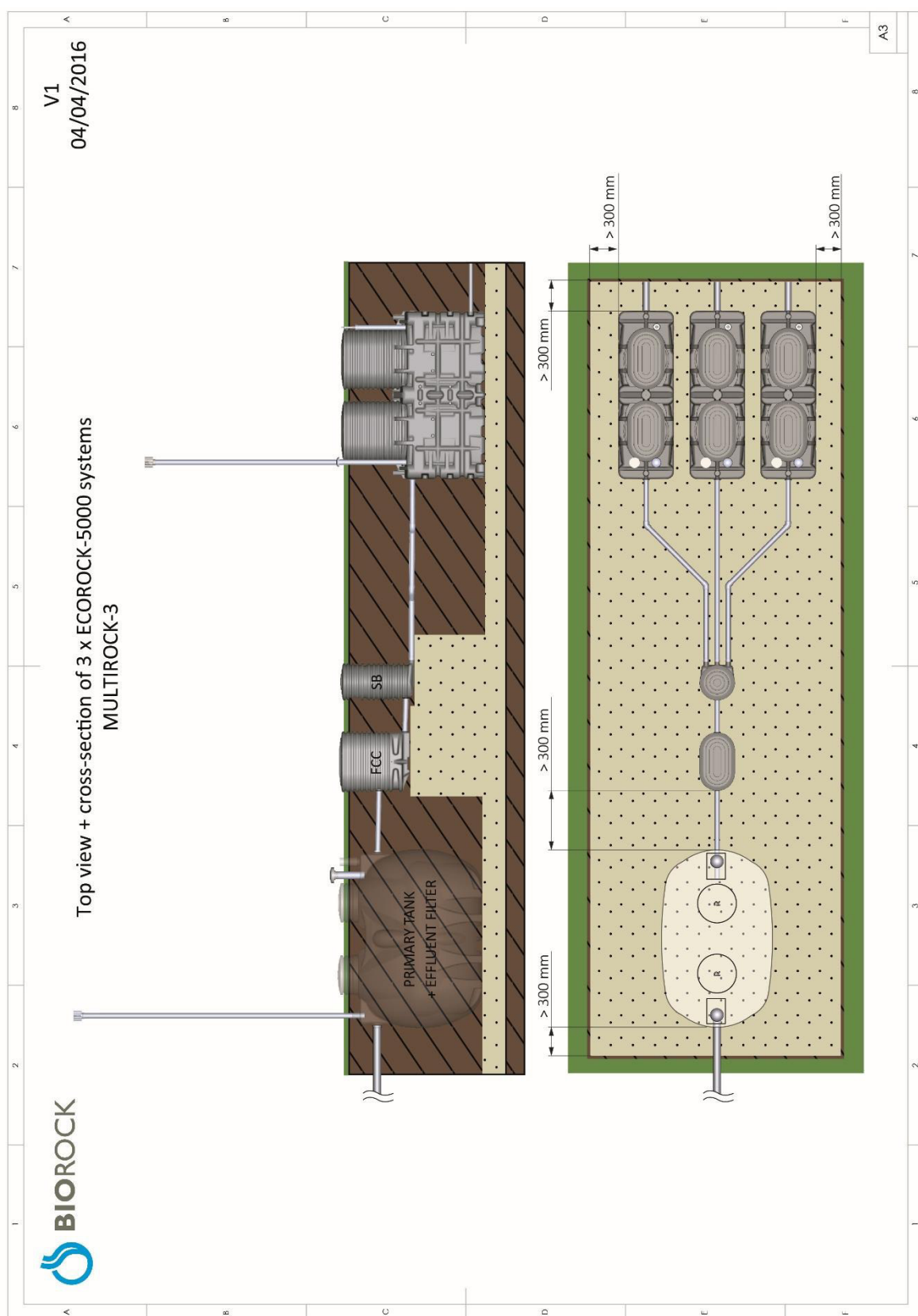
APPENDIX 2

2.4



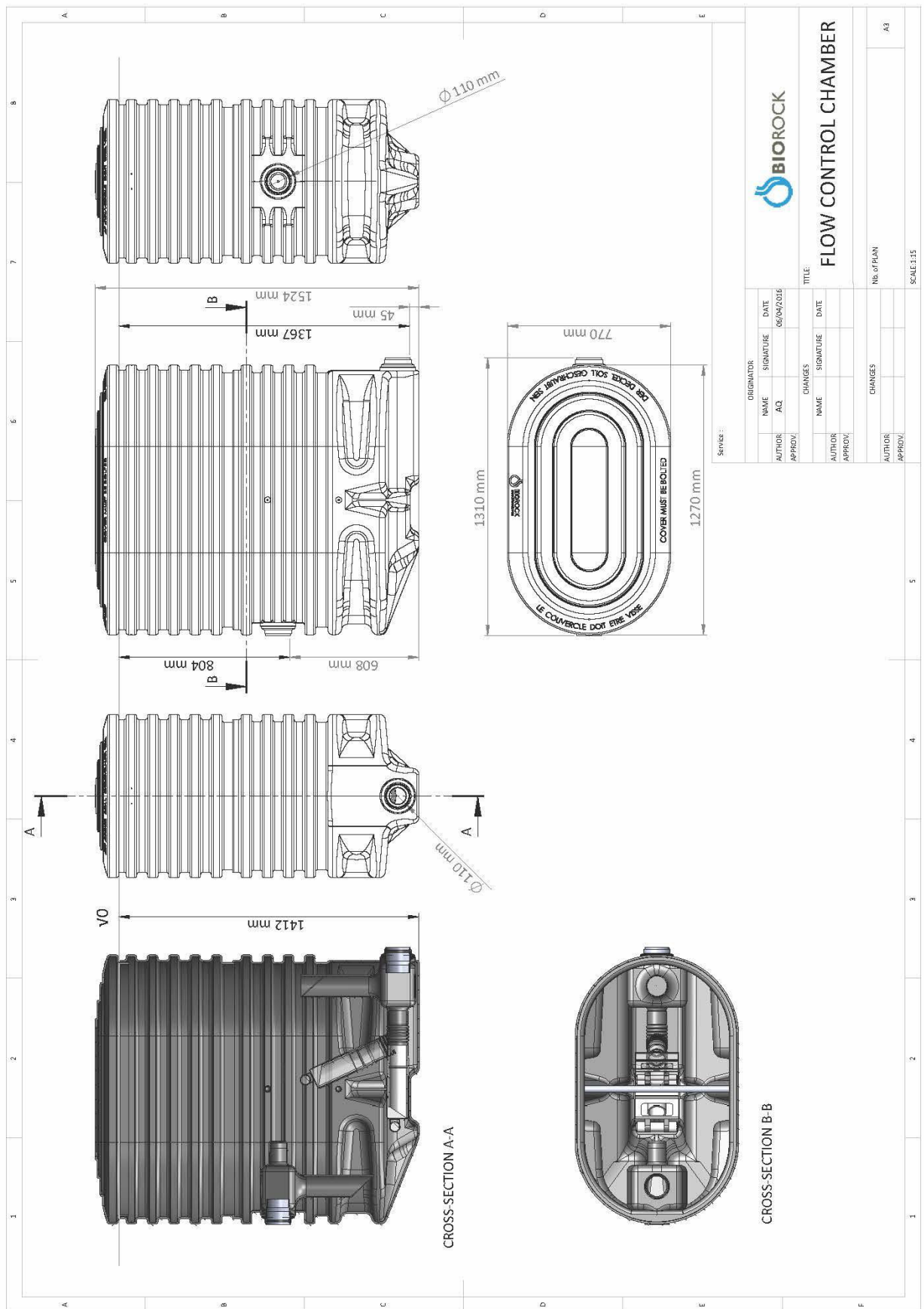
APPENDIX 2

2.5

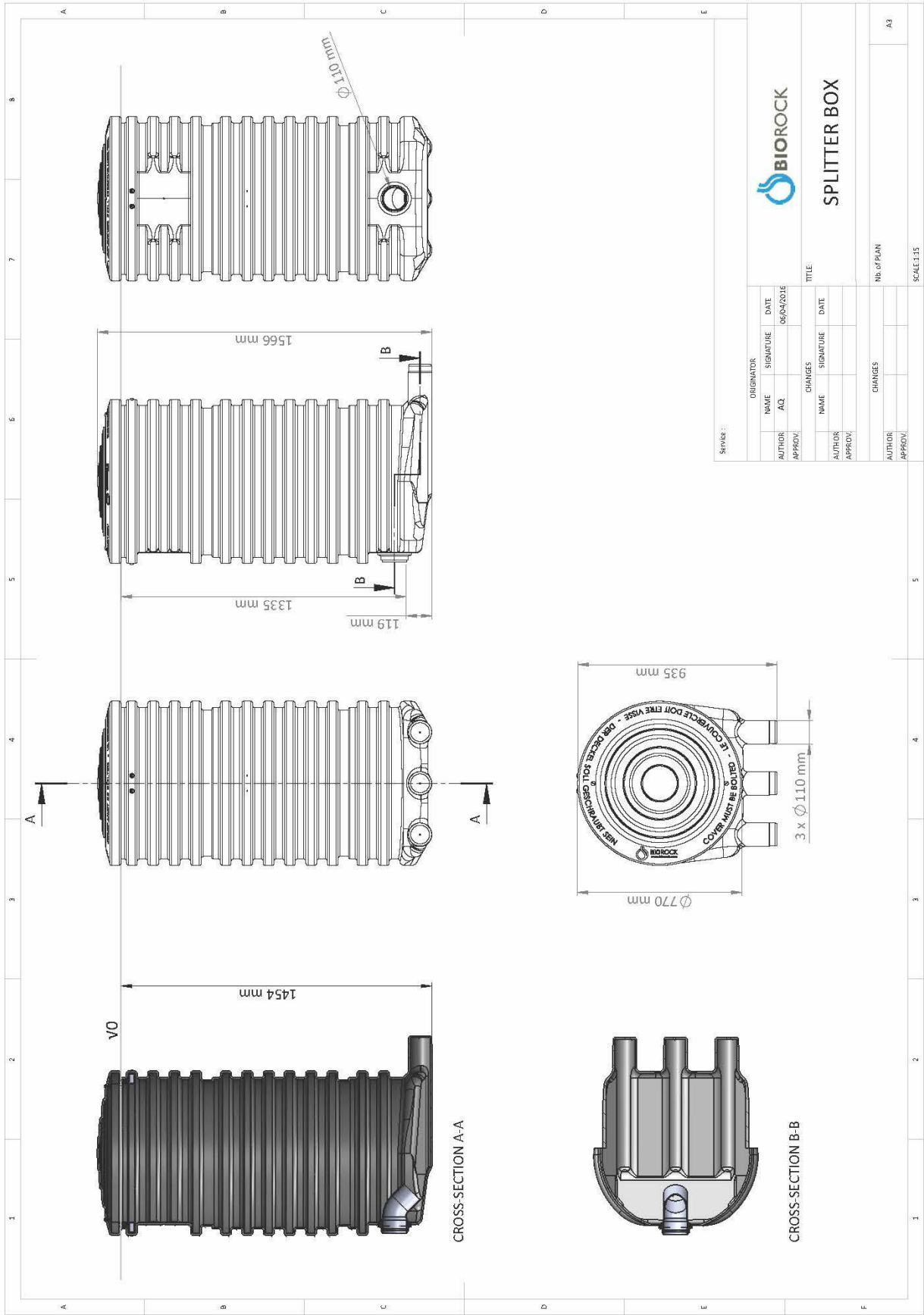


APPENDIX 3

3.1



APPENDIX 3
3.2





APPENDIX 4

MAINTENANCE AND ACTIONS FORM

To be completed – TO BE KEPT BY THE USER

DATE OF FIRST COMMISSIONING: / /

Product N° of tank: (see page 9 in the user's guide)

Warning:

Please keep sludge emptying documents and proofs validated by the contractor.

DATE	WORK COMPLETED	CONTRACTOR'S NAME	COMMENTS

If you have not subscribed to any maintenance agreement, please ask a trained, professional contractor to provide maintenance and any work required on your sewage treatment plant.





APPENDICE 5

ACTIVATION OF THE WARRANTY

(see our conditions)

Important Information: If this form isn't returned to BIOROCK within 120 days the installation of the system, there will be no warranty at the system

INSTALLATION FORM FOR A MULTIROCK SYSTEM

This form must be completed and returned to:

BIOROCK S.a.r.l.

4-5 Z.A.E. Le Triangle Vert

L-5691 ELLANGE (Luxembourg)

or by e-mail : info@biorock.com

PLEASE KEEP ONE COPY FOR YOURSELVES.

Type of installation:**Installation capacity :**

..... PE

Installation date :

.....

Commissioning date:

.....

DISTRIBUTOR :

NAME :

ADDRESS :

.....

Installer

NAME.....

INITIALS.....

Address

.....

.....

TEL. :

.....

E-mail.....

OWNER

Name.....

Initials.....

Address

.....

Tel.....

.....

E-mail.....

☐ New built home☐ Existing homeAdresse of the installation if different than owner

Name.....

Initials.....

Address

.....

Tel.....

.....

E-mail.....

☐ New built home☐ Existing home**Please indicate :**

♦ Nature of building: ♦ Number of rooms : ♦ Number of occupants :

Soil conditions: ☐ Dry ☐ High ground water ☐ Difficult ☐ On a slope ☐ Other:Discharge: ☐ Infiltration ☐ Water course ☐ Re-use ☐ Other:

Type & Capacity of the primary tank: Serial number:

Type & Capacity of the treatment unit: Serial number:

Ventilation: ☐ Winddriven ventilator ☐ ElectricalPump: ☐ After Primary Tank ☐ After BIOROCK Reactor**Declaration :**

The MULTIROCK® system is installed and commissioned in accordance with:

- The current legislations stating the technical requirements applicable to domestic sewage treatment plants in the territory where the system has been installed
- Installation, use and maintenance requirements of the Primary Tank and its Effluent Filter, indicated in the Instruction Manual as provided by your supplier
- Current installation, use and maintenance requirements of the MULTIROCK System

Signed at : on

Signatures :

The Owner :

Name of the responsible Authority:
(if applicable)

The installer:

V1 24-03-2017

