SG60KTL Anti-Corrosion

Version	Date	Author	Approved by
V10	Aug.15.2017;March.1.2018	Li X	Zheng W

1.Introduction

This document describes the design of corrosion protection of SG60KTL inverter;

Sungrow string inverters are tested in according with IEC60068-2-52 salt mist test and Japanese Industrial Standard JIS H8502-1999-Methods of corrosion resistance test for metallic coatings.

SG60KTL can be installed and operated without affecting its warranty in the environment in according with ISO 9223 corrosivity class C4.

2.Corrosion Protection

2.1. Practices Overview for Corrosion Protection

Corrosion protection shall not be considered an end in itself, but part of the product development, manufacturing and utilization, a good corrosion protection is combination of both active and passive protection.

Fig.-1 below gives an overview of the methods, measures, and procedures of corrosion protection

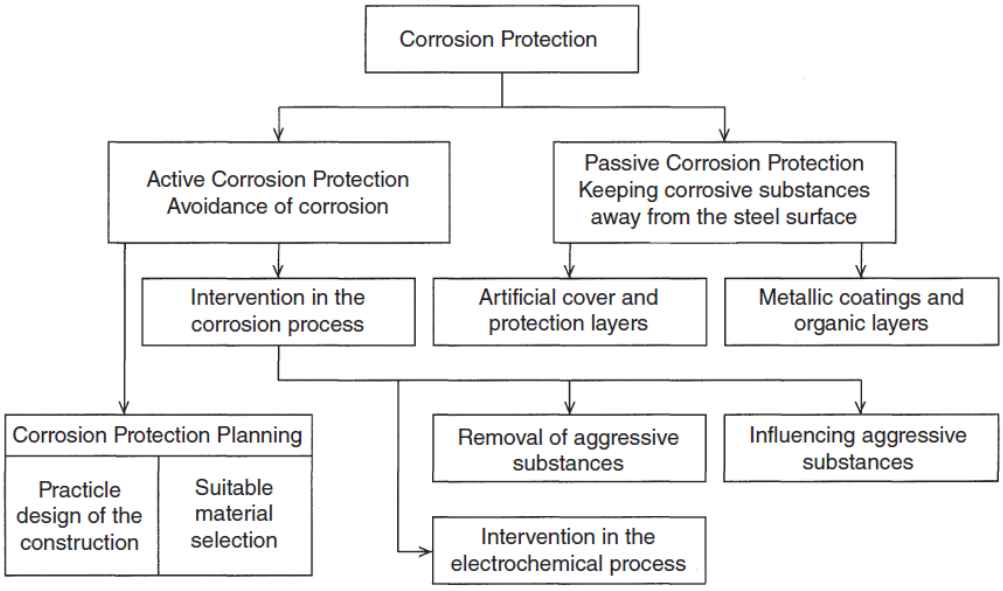


Fig.-1 Overview of corrosion protection

Source from Handbook of Hot-dip Galvanization. Edited by Peter Maaβ and Peter Peiber.

2.2. Corrosivity Class

Classification of environmental conditions acc. To ISO 9223,(similar classification can be found in ISO 12944-2)

	Corrosion rate for the 1st year exposure (g/m²)				Example of typical environments
	C-Steel	**Zinc**	**Copper**	**Aluminum**	**Outdoors**
C1	⩽10	⩽0.7	⩽0.9	Negligible	Dry or cold zone, atmospheric environment with very low pollution and time of wetness, e.g. certain deserts, Central Arctic/Antarctica.
C2	10<r<200	0.7<r⩽5	0.9<r⩽5	r⩽0.6	Temperate zone, atmospheric environment with low pollution (SO_2<5μg/m³), e.g. rural areas, small towns. Dry or cold zone, atmospheric environment with short time of wetness, e.g. desert, subarctic areas
C3	200<r⩽ 400	5<r⩽15	5<r⩽12	0.6<r⩽2	Temperate zone, atmospheric environment with medium pollution (SO_2: 5μg/m³ to 30μg/m³) or some effect of chlorides, e.g. urban areas, coastal areas with low deposition of chlorides. Subtropical and tropical zone, atmosphere with low pollution
C4	400<r⩽ 650	15<r⩽30	12<r⩽25	2<r⩽5	Temperate zone, atmospheric environment with high pollution (SO_2: 30μg/m³ to 90μg/m³) Or substantial effect of chlorides, e.g. polluted urban areas, industrial areas, coastal areas without spray of salt water or exposure to strong effect of deicing salts. Subtropical and tropical zone, atmosphere with medium pollution
C5	650<r⩽ 1500	30<r⩽60	25<r⩽50	5<r⩽10	Temperate and subtropical zone atmospheric environment with very high pollution (SO_2: 90μg/m³ to 250μg/m³) and or significant effect of chlorides, e.g. industrial areas, coastal areas, sheltered positions on coastline
CX	1500<r⩽ 5500	60<r ⩽ 180	50<r⩽90	r>10	Subtropical and tropic zone (very high time of wetness), atmospheric environment with very high SO2 pollution (higher than 250μg/m³), including accompanying and product factors and/or strong effect of chlorides, e.g. extreme industrial area, occasional contact with salt spray.

2.3. SG60KTL Protection Against Corrosion

The degree of protection provided by the SG60KTL enclosure is IP65 in according with IEC60529.

The materials: Aluminum alloy and stainless steel, which has outstanding anti-corrosion performance.

1) Materials

Parts	Materials
Fans Holder Heat sink	Aluminum Alloy
Bracket Screws Bolts Inverter Cabinets	Stainless steel

2) Enclosure Coating

A layer of protective coat is applied on the enclosure of the SG60KTL inverter for corrosion protection, meanwhile offering good light and weather resistance.

The surface is specially treated before coating to strengthen the anti-corrosion protection of the enclosure and the performance of the coating to be applied.

Powder Chemical type	TGIC Free Polyester
Way of Coating	Electrostatic spray
Thickness	60~120μ m

3) PCB Conformal coating

All PCBs are applied with a protective chemical **coating** or polymer film typically with 25-250μm to act as protection against moisture, dust, chemicals, and temperature extremes**.**

2.4. Salt-Mist Test in accordance with IEC Standards

1) Test Procedures

Severity descriptions according to IEC60068-2-52: Environmental Testing-Part 2: Tests-Test Kb: Salt mist, Cyclic (Sodium chloride solution) are summarized as below,

Severity(1): four spray periods, each of 2h,with a humidity storage period of seven days after each.

NOTE- The humidity storage period should be suitably reduced so that the spray period plus storage period is seven days.

The Severity (1) corrosion test lasts 28 days with four testing cycles. During each cycle modules are sprayed for 2 hours with a 5% Sodium Chloride Solution

Test procedures of Severity(1)

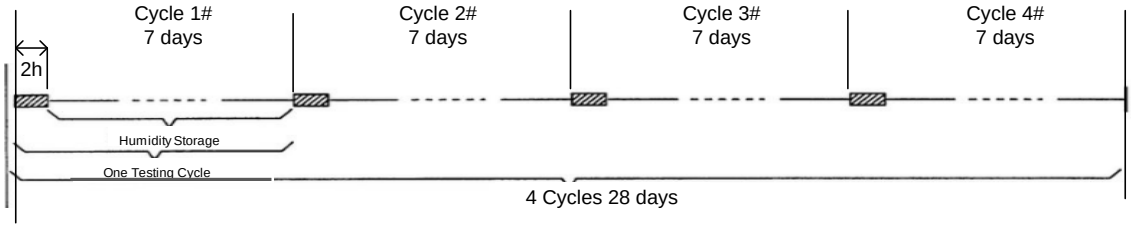


Fig-2 Test procedures of Serverity (1) according to IEC 60068-2-52

Severity(2): three spray periods, each of 2h,with a humidity storage period between 20h and 22h after each.
Severity(3): one test cycle consisting of:

four spray periods, each of 2h,with a humidity storage period between 20h and 22h after each; afterwards one storage period of three days under a standard atmosphere of testing at 23 ℃± 2 ℃ and 45% to 55% humidity

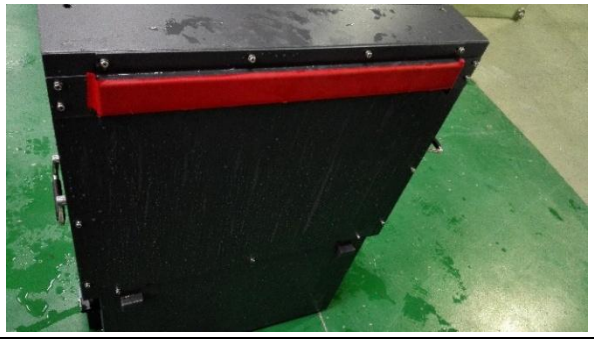
Severity(4): two test cycles as specified in severity(3)
Severity(5): four test cycles as specified in severity(3)
Severity(6): eight test cycles as specified in severity(3)

Generally, Severity (1) should be used to test the products which are exposed to the marine environment for much of their operational life (e.g. ship radar, deck equipment). which is used for the salt mist test of the SG60KTL; the test conditions and test apparatus are compliant with the IEC standard IEC60068-2-52

2) Test Conclusions

Test Items	Results	criteria	Conclusions
Salt Mist	No signs of corrosion were found on the exterior parts of the inverter, e.g. inverter handles, air inlet mesh, screws etc. No signs of corrosion were found in internal chamber, e.g. electronic components, cable connectors, screws etc. See pictures in the Appendix for details	No sign of corrosion on any parts of the inverter	Pass

3) Appendix-Test Details

Appearance		No sign of corrosion, rust or obvious defects found on inverter
Appearance & External Screws		No sign of corrosion, rust or obvious defects found
Air inlets & Handle		No sign of corrosion, rust or obvious defects found
External Screws & Mounting ears		No sign of corrosion, rust or obvious defects found

2.5. Sungrow Additional Enhanced Salt-mist Test

The additional Enhanced Salt-mist test was conducted on request to verify the performance of corrosion protection of sungrow string inverters;

The test conditions are far severer than the severity (1) test of IEC60068-2-52, since a simulated respiration procedure is introduced to simulate the respiratory effect of the constantly changing environment

The enhanced test procedures are in accordance with Japanese Industrial Standard JIS H8502-1999;ISO 14993:2001-Corrosion of Metals and Alloys-Accelerated Testing Involving Cycle Exposure to Salt Mist,"Dry" And "Wet" Conditions

SG33K3J was chosen to be tested, which is designed for Japan market, where the inverters are more likely installed and exposed to the marine environment;

All other Sungrow string inverters have the same design for corrosion protection as that of SG33K3J

Testing lab is accredited by ISO/IEC 17025 independent test laboratory Approval

A2LA certificate No. 2774.01

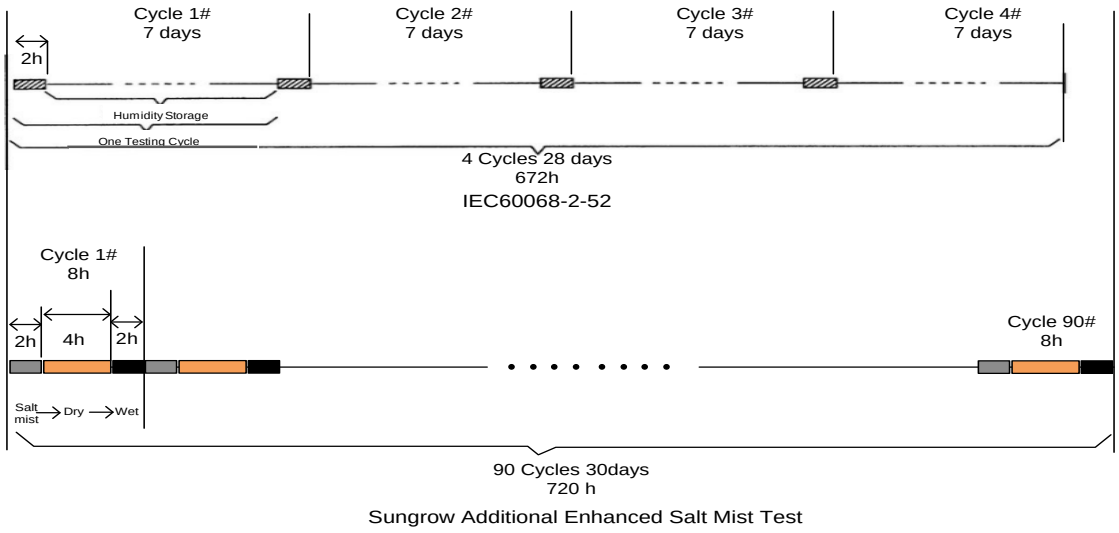


Fig-3 Test procedures of Sungrow additional salt-mist verification test

1) Test procedures

Step 1: Salt spray (Temperature 35℃+/-1， salt concentration, 50+/-5g/l), 2hours

Then move the inverter to step 2 within 30mins

Step 2: Dry (Temperature: 60℃+/-1, humidity 20-30% RH), 4 hours

Then move the inverter to step 3 within 30mins

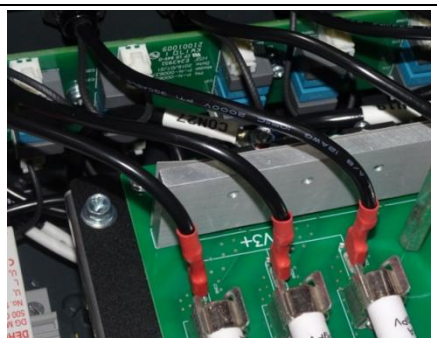
Step 3: Wet (Temperature 50℃+/-1, humidity 95% RH), 2hours

Note: 8 hours per cycle, 90 cycles in total

2) Test Conclusions

Test Items	Results	criteria	Conclusions
After 90 cycles	After test, there was no evident corrosion for the surface of the EUTs checked by naked eyes. (visual acuity≥1.0)	No sign of corrosion on any parts of the inverter	Pass

3) Appendix-Test Details

<table>
<tr><td>After 90 cycles</td><td colspan="2">  Inverter samples in the Salt-mist Chamber</td></tr>
<tr><td>Appearance & handle</td><td>  </td><td>  </td></tr>
<tr><td>External Screw & nut</td><td>  </td><td>  </td></tr>
<tr><td>Internal Screw & net</td><td>  </td><td>  </td></tr>
<tr><td>Internal PCB & Mechanical parts</td><td>  </td><td>  </td></tr>
</table>

4) Appendix-3rd party test report

DEKRA IST Reliability Services Limited
System Reliability Engineering Department
No.351, Kunjia Rd., Kunshan City, Jiangsu China
Tel: 86-512-57639600 Fax: 86-512-57639639
http://www.dekra-ist.com

Report No. : DK1706010004A
Page : 1 of 17

SALT SPRAY TEST REPORT

Company : Sungrow Power Supply Co., Ltd.

Address : No.1699 Xiyou Rd., New & High Technology Industrial Development Zone, 230088, Hefei, P. R. China

Sample model : SG33K3J

Date of received : May 29, 2017

Date of tested : May 29, 2017 ~ June 29, 2017

TESTING LABORATORY IS ACCREDITED BY:

ISO/IEC 17025 Independent Test Laboratory Approval

A2LA Certificate No. : 2774.01

WE HEREBY CERTIFY THAT:

The test shown in the attachment was made in accordance with the procedures indicated. We assume full responsibility for the accuracy and completeness of these tests and vouch for the qualifications of all persons taking them.

	Name	Signature	Date
Testing Engineer	Bill Zhang	Bill Zhang	July 04, 2017
Reviewed	Peter Duan	Peter Duan	July 04, 2017
Manager	Yenchi.chen	Yenchi Chen	July 04, 2017

Notes :

1. This report will be invalid if duplicated or photocopied in part.
2. This report refers only to the specimen(s) submitted to test, and is invalid as separately used.
3. This report is invalid without examination stamp and signature of this institute.
4. The tested specimen(s) will be preserved for thirty days from the date issued, if not taken back by the applicant.

SUMMARY OF TEST

After test, there was no evident corrosion for the surface of the EUTs checked by naked eyes. (visual acuity≥1.0)

The pictures shown above are parts of the original report, contact Sungrow local technical support of original report if needed.

www.sungrowpower.com

SUNGROW
Clean power for all