MINISTRY OF DEFENCE (DGQA)

STANDARD QUALITY ASSURANCE PLAN (REV 01)

AC STARTER/CONTROL GEAR

AC STARTERS/CONTROL GEARS ARE THE INTEGRAL PART OF MODERN WARSHIPS. AC STARTER/CONTROL GEAR PROVIDES NECESSARY FUNCTION FOR SMOOTH OPERATION AND ADEQUATE PROTECTION TO MOTORS IN THE EVENT OF FAULT. THERE ARE VARIOUS TYPES OF CONTROL PANELS USED FOR CONTROLLING AND PROTECTING MOTORS ONBOARD IN SHIPS AND SUBMARINES.

STANDARD QAP NO DGQA/DQA (WP)/AC STARTER-CONTROL GEAR/06/2016/REV 01
SEP 2021

Total Nos. of Pages: 82

ISSUING AUTHORITY

DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECT)
MINISTRY OF DEFENCE (DGQA)
'H' BLOCK,NIRMAN BHAWAN PO
NEW DELHI-110 011

RECORD OF AMENDMENTS

Sl. No.	Date of Amendment	Amendments	Authority	Remarks

MINISTRY OF DEFENCE (DGQA)

STANDARD QUALITY ASSURANCE PLAN (REV 01) FOR AC STARTER/CONTROL GEAR

STANDARD QAP NO DGQA/DQA(WP)/AC STARTER-CONTROL GEAR/06/2016/REV 01 SEP 2021

(S N Almanda)
Rear Admiral
ADGQA (WP)

Promulgated by:-

DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECT)
MINISTRY OF DEFENCE (DGQA)
'H' BLOCK, NIRMAN BHAWAN PO
NEW DELHI - 110 011

CONDITION OF RELEASE

1. This standard QAP has been prepared for use of the Indian Navy and of its contractors to follow the specified Quality Assurance procedure during the execution of the contracts. No alteration is to be made to this Standard QAP except by the issue of authorised amendment by DQA (WP).

2. It is to be applied as required in the Quality Assurance procedures covering manufacture of Control Panels (AC Starters) for IN Ships.

3. The website **htpp://www.dgqadefence.gov.in** may also be referred for other QA requirements.

4. The Standard QAP has been prepared on the basis of decisions made in Collegiate meeting held at DQA (WP) with leading manufacturers of Control Panels (AC Starters),representatives of professional directorate (DEE) and production directorates (DND and DSP). Any user of this Standard QAP either within DGQA / Indian Navy or in industry may propose an amendment to it with valid justification. Proposals not applicable to particular contract can be sent directly to DQA (WP), NewDelhi, and those directly applicable to a particular contract are to be dealt with using contract procedures.

5. DQA (WP) reserves the right to amend or modify the contents of this Standard QAP without consulting or informing any holder of this document.

6. When this Standard QAP is incorporated into contracts, users are responsible for their correct application and for complying with contractual and other statutory requirements. Compliance with Standard QAP does not of itself confer immunity from legal obligations.

7. Enquiries in connection to these requirements may be made from:

DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECT)
MINISTRY OF DEFENCE (DGQA)
'H' BLOCK, NIRMAN BHAWAN PO
NEW DELHI - 110 011

CONTENTS

STANDARDS INVOKED

Standards as mentioned in the SOTR and Approved Drawings.

SPECIFIC REQUIREMENTS

1. Testing of physical and chemical properties has to be done by NABL accredited lab. (Including firm's NABL accredited lab).

2. Make of the Items should be as per approved PIL/Bill of Material (BoM) or Naval approved sources

3. In case of bought out items, physical verification / function of item may be under taken during assembly of the equipment to avoid repetition.

4. Imported items will be accepted against following import documents: -

   (a) Bill of Lading.

   (b) Country of Origin.

   (c) Shipping Bill/ Air way bill.

   (d) Bill of entry to warehousing.

   (e) OEM Test Certificate/Quality Assurance Guarantee Certificate.

   (f) OEM's certificate confirming that spares are tested for fitment on main equipment for which spares are ordered i.e.PAC firm's confirmation certificate.

   (g) Firm's Guarantee Certificate as per SO. Functional test may be undertaken, if required, in addition.

5. Ingress protection testing will be as per approved drawings applicability and IP-56: for below deck installation, IP-57 for weather deck installation.

6. EMI/EMC test and ETT will be done at Government/PSU test centers or NABL accredited labs.

7. If Type Testing, EMI/EMC and ETT have already been done in earlier projects on identical units, it will not be done again & the reports of earlier tested units will have to be provided for review of Inspection Agency.

ABBREVIATIONS

VI	Visual Inspection
DI	Dimensional Inspection
LTC	Lab Test Certificate
STC	Supplier Test Certificate
CHP	Customer Hold Point-a point beyond which the vendor will not proceed without a written authority from QAO. The process / activity will be inspected by QAO.
IR	Inspection Report
RI	Remote Inspection
NABL	National Accreditation Board For Testing And Calibration of Laboratories
P	Perform
R	Review of certificate and records by QAO-a point at which client will review documentation records at an agreed time after completion of activity.
W	Witness
TC	Test Certificate
OEM	Original Equipment Manufacturer
FATs	Factory Acceptance Trials
ETT	Environmental Type Test
ESS	Environmental Stress Screening Test
EMI/ EMC	Electromagnetic Interference/ Electromagnetic Compatibility
NEC	Naval EMI/EMC Center
ASNT	American Society of Non destructive Testing
ATP	Acceptance Test Procedure
PO	Purchase Order
DBOM	Details Bill of Material
TSP	Technical Specification
SOTR	Specification of Technical Requirement
TNC	Technical Negotiation Committee
PCB/PWB	Printed Circuit Board/Printed Wire Board
UT	Ultrasonic Test

SCOPE

Scope of Quality Assurance: The scope of Quality Assurance will cover witness and review of all manufacturing activities during all stages viz. Raw Material, Stage including bought- out items, In-process Stage and Final Stage. The scope also covers the review and witness of Type test of equipment, wherever applicable.

The Standard Quality Assurance Plan contains comprehensive list of inspections and/or trials that is to be applicable for quality assurance of the equipment. In addition, quality assurance of equipment will also be governed by specific conditions laid down in SOTRs and 'Approved Drawings'. The inspections/ trials must be contemporary to latest technology/ techniques available in the industry at the time of placement of orders.

The following quality assurance activities will be carried out during the Quality Assurance of Equipment:-

(a) Visual Inspection.

(b) Dimensional Inspection.

(c) Review of Lab Test Certificates.

(d) Witness of in-house Lab Testing, if applicable.

(e) Witness of Endurance Trials & Tilt Test and Review of Shock Test reports for qualification of Type test, as applicable.

(f) Review of ETT, EMI/EMC and ESS reports, in addition to Pre ETT inspection and post ETT inspection of Unit, as applicable.

(g) Review of Draft documentation and witness/Stamping of final documentation, as applicable

(h) Issue of CHP clearance.

(j) Weight of the final assembly unit, Painting, Packing, Preservation and Marking

(k) Issue of Dispatch Clearance or Issue of Form-IV, as applicable.

(l) **Remote Inspection**:- All serial with 'R' and 'CHP for R' will be carried out remotely and Sr. no 7 be undertaken as per DQA(WP) policy no. 29814/MISC/DGQA/WP-TC, dt 24 Feb 21.

SYSTEM DESCRIPTION

1. Control Gears/Starters are the integral part of modern warships. Control Gears/Panels provide necessary function for smooth operation and adequate protection to motors in the event of fault There are various types of Starters/Control Gear such as DOL Starter, Reduced Voltage Starter (Star Delta or Auto-Transformer) and Soft Starter (Thyrister type or Magnetic type) used for controlling and protecting motors onboard in ships and submarines.

2. The AC Starters/control Gears are broadly classified under the following categories:-

(a) **Direct On-Line (DOL)**. In DOL system the voltage is directly applied at the motor terminals through simple switching device like contactor. During starting full voltage is applied across the motor terminal. At the start, relative speed between stator and rotor being almost equal to synchronous speed high voltage gets induced in the short circuited (*cage*) rotor circuit. Because of this, very high current flows through the rotor circuit which in turn reflects on the stator side. The high current produces severe Electrical and mechanical stresses on the motor as well as on the overall system It gives high starting torque of 1.8-2 times the full load torque. DOL starting is the simplest & most economical method but has a drawback of very high incoming currents of the order of 6-8 times the Full Load Current (FLC). The use of DOL starter is restricted to motors up to 10 KW rating.

(b) **Star Delta Starters**. Due to restriction in high incoming current during starting and its adverse effects on the supply system and increase in maximum demand, the motors of higher HP are generally started on reduced voltage using the Star-Delta Starter.

(c) **Soft Starters**. Soft starters provide smooth and step less starting to motors by varying voltage and presetting starting torque and starting current. Soft start and soft stop reduces mechanical shock and maintenance cost.

STANDARD QUALITY ASSURANCE PLAN

Part – I: General Information

1. The following generic information must generally be indicated on each QAP as its identity:

(a) Equipment Name
(b) Equipment Technical Details (as applicable)
(c) Purchase Order Reference
(d) Sub/Sub-Sub Orders reference (as applicable)
(e) Name of Main Indenter/ Ordering Authority
(f) Name of end user
(g) Name of Firm/Manufacturer
(h) SOTRs Reference
(j) Yard No./Name of Ship where to be fitted (if available)/End User
(k) References of relevant Drawings
(l) QAP No. & Date (as indicated by the firm)
(m) Contractual Delivery Date
(n) Inspection Authority
(p) Inspection Agency
(q) Quantity (as applicable)

	MINISTRY OF DEFENCE (DGQA)	AC STARTERS/CONTROL GEAR	PAGE	12
	DIRECTORATE OF QUALITY ASSURANCE (WP) NEW DELHI - 110 011	STANDARD QAP NO DGQA/DQA(WP)/AC STARTER-CONTROL GEAR/06/2016/REV 01	REV NO	01
			DATE	SEP 21

Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
1.0.0	**DOCUMENT VERIFICATION**							
1.1.0	Drawings (a)GA Drawings and DBOM (b) Manufacturing Drawings	Verification	100%	PO, SOTR, TNC Minutes and EED-Q-071(R4)	Same as reference document	List of Approved Drawings	CHP for R	Approval by Design Dte, Prof Dte, Insp. Authority, Command HQ, as applicable, to be verified.
1.2.0	Type Test Reports	Verification	01/ Type	PO, TSP/ SOTR & TNC Minutes	Equipment is Type Tested and reports are held	Type Test reports	R	**Shipyard Orders:** If equipment is not Type Tested or reports are not held, Type Test shall be undertaken as per SQAP. **DPRO/CPRO Orders:** Type Test shall be applicable, only if indicated in PO.
2.0.0	**RAW MATERIAL INSPECTION**							
2.1.0	Material/ Steel for fabrication	Material Identification stamping	100%	SOTR, TSP, TNC MOM, Approved GA Drgs & DBOM & Manufacturing Drgs	Conformity to specifications	IR	W	Sample to be drawn in presence of QA rep
		Physical & Chemical Properties	01 Sample per Heat			LTC (NABL Lab)	CHP for R	
2.2.0	**BOUGHT-OUT/ COTS ITEMS**							
2.2.1	Air Break Switch	Type No. Current Rating Voltage Rating	100%	SOTR, TSP, TNC MOM, Approved GA Drgs & DBOM & Manufacturing Drgs	Conformity to specifications	STC	R	
2.2.2	Air Circuit Breaker	Type No. Current Rating Voltage Rating	100%		Conformity to specifications	STC	R	
2.2.3	Air Break Contactor	Type No Current Rating Coil Voltage Auxiliary Contacts	100%		Conformity to specifications	STC	R	

Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
2.2.4	Bus Bar	Cross Section Conductivity Bend Test Tensile Test Chemical Composition	100%	SOTR, TSP, TNC MOM, Approved GA Drgs & DBOM & Manufacturing Drgs	Conformity to specifications	STC	R	
2.2.5	Cable (LFH Cable)	Voltage Grade, Toxicity Index Colour Nominal Cross Section Area Thickness of Insulation IR Value Conducting Resistance Thermal Endurance Test, Bend Test, Screen Solidity Test	100%	Make/Type as per approved drawings	Std. as Per Approved drawings	STC	R	-Only LFH Cables to be used for Power and Control Cable -Firms to submit Cable certificates conforming to LFH Property
2.2.6	Current Transformer	Type of CT (Insulation material used) Terminal Markings/Dimensions Polarity Ratio Burden (Not applicable for special purpose CTs) Knee pt. (Applicable for special purpose CTs Voltage) ALF (Applicable for special purpose CTs) ISF (Applicable for special purpose CTs)	100%	-do-	-do-	STC	R	
2.2.7	Control Transformer	Ratio Tapping Rating Terminal Markings	100%	-do-	-do-	STC	R	

STANDARD QUALITY ASSURANCE PLAN (REV 01) FOR AC STARTER/ CONTROL GEAR							Part –II	
Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
2.2.8	Busbar Support	Flammability Water absorption Density Tensile Strength Compressive strength Flexural Strength Impact Strength Breakdown Voltage Arc Resistance Dimension	100%	Make/Type as per approved drawings	Approved drawings	STC	R	
2.2.9	HRC Fuse & Fuse Base	Type No Current Rating Voltage Rating Continuity	100%	-do-	-do-	STC	R	
2.2.10	MCCB	Type No. Current Rating Voltage Rating	100%	-do-	-do-	STC	R	
2.2.11	MCB	Type No. Current Rating Voltage Rating	100%	-do-	-do-	STC	R	
2.2.12	Meters (Voltmeters, Ammeter, Frequency meter, KWH meter, Transducer etc.)	Range/Make CTR/PTR/Shunt Type of Movement Calibration/ Accuracy	100%	-do-	-do-	STC	R	
2.2.13	Neoprene Gasket/Conductive gasket/EMI shielding as applicable	Dimensions Hardness Flame Test as applicable	100%	Make/Type as per approved drawings	-do-	STC	R	

STANDARD QUALITY ASSURANCE PLAN (REV 01) FOR AC STARTER/ CONTROL GEAR							Part –II	
Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
2.2.14	Voltage Transformer/ Potential Transformer	Ratio Burden Accuracy Class Polarity No of Phases Voltage factor Insulation Level Functional checks	100%	-do-	Approved drawings	STC	R	
2.2.15	Relays	Model /Type No. Relay Details Auxiliary contacts Operational Checks	100%	-do-	-do-	STC	R	
2.2.16	Space Heater	Rating Wattage	100%	-do-	-do-	STC	R	
2.2.17	Thermostat	Range Rating	100%	-do-	-do-	STC	R	
2.2.18	Timer	Type No Voltage Rating Aux. Contacts	100%	Make/Type as per approved drawings	-do-	STC	R	
2.2.19	Miscellaneous Electrical items (Bulbs, Lamp Holder, Resistors, Actuators, Diodes, Bridge Rectifiers and Switch)	Make Rating	100%	-do-	-do-	STC	R	
2.2.20	Soft Starter	Make Type	100%	-do-	-do-	STC	R	
2.2.21	Core Balanced CTs	Make/ Type Rating Primary Operating Current CT Secondary Current	100%	-do-	-do-	STC	R	

STANDARD QUALITY ASSURANCE PLAN (REV 01) FOR AC STARTER/ CONTROL GEAR						Part –II		
Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
2.2.22	Cable Glands	Dimensional	100%	DGS/EED/VI/ 1535/R6	DGS/EED/VI/ 1535/R6	STC	R	Cable Glands manufactured as per specification "DGS/EED/VI/1535/R6" are only acceptable unless specified
2.2.23	Bare PCBs/PWBs	ESS Test	100%	-do-	As per extant policy (Para 3 of footnote relevant)	STC/NABL Report	R	
3	**IN PROCESS INSPECTION**							
3.01.	Fabrication viz Bending, Shearing and cut-outs welding	Visual Dimensional For welding Distance b/n welding Spots	100%	Approved drawings	Std. as Per Approved drawings	IR	CHP for R	
3.02	Surface, Preparation and Painting	Visual Shades Coating thickness Adhesion		-do-	Same as reference document	IR	CHP for R	
3.03	Wiring Continuity	Wiring Size Circuit Health	100%	-do-	-do-	IR	CHP for R	
4	**ASSEMBLY**							
4.01	Panel Assembly	Dimension Gland Plate Assembly Base Plate Assembly Panel Coupling Physical/ Visual for damage/dents corrosion Earth Bond test to be carried out if electric supply is provided to components fitted on panel door Mounting Arrangement of components Wiring arrangement and ferruling, Gasket fixing, Cable Gland and Tally Plate details	100%	Approved drawings	Same as reference document	IR	R	

STANDARD QUALITY ASSURANCE PLAN (REV 01) FOR AC STARTER/ CONTROL GEAR								Part –II
Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
5	TEST AND TRIALS							
5.01	Functional checks	Functional checks at No load & Full Load IR Test before and after HV Test HV Test Mili volt Drop Test on Power Circuit in excess of 100 A, Earth bond and Temperature rise undertaken as a (**Type Test**) (applicable for Panels with bus bars) Ingress Protection IP-56: for below deck installation IP-57 for weather deck installation and (as per Drawings/Requirement)	100%	Approved drawings	Same as reference document	IR	W	-Full load test by secondary Current Injection Method. - Temperature rise test should be undertaken as part of Type Test. Maximum current value to be passed in the bus bar during temperature rise test should be as per approved drawings.
5.02	Integration Trial	All Protection Mechanism (Overload, Under Voltage, Over Voltage, Single Phasing, Reverse Phasing AND Thermistor Protection) and Protection under stall condition of AC Motor are to be carried out as per IHQ MoD(N)/DEE Policy EE/01/1-67/Power-18 date 15 Jul 10.	100%	Approved drawings	DEE Policy NO.	IR	W	Starter motor integration trials to be conducted at OEM's/ Integrator premises as per IHQ MoD(N) Policy no.EE/01/1-67/Power-18, 15 Jul 10. (Only for new construction ships)
5.03	ETT & EMI/EMC reports	Availability & verification	Prototype sample	SOTR/PO/approved drawings/ EED-Q-071(R4)	Same as reference document	Type test reports	CHP for R	Para 2 of footnote relevant.

Sl. No	Material/ Component/ Quality Activity	Characteristic/ Type of Check	Quantum of Check	Reference Document	Acceptance Criteria	Format of Record	Action by QAE	Remarks
6	**DOCUMENTATION**							
6.01	Documents for Operation, Maintenance and Repair		100%	PO	JSS 0251	-	CHP for R	
7	**WEIGHT, PAINTING, PACKING & PRESERVATION**							
7.01	Weight of the final assembly unit		100%	Approved Drawing, SOTR/PO	Approved Drawing, SOTR/PO	IR	CHP for W	
7.02	Painting,		100%	Approved Drawing, SOTR, Paint Plan/DGS251	Approved Drawing, SOTR/PO	IR		
7.03	Packing		100%	Approved Drawing, SOTR/PO	Approved Drawing, SOTR/PO	IR	CHP for R	
7.04	Preservation and Marking		100%	Approved Drawing, SOTR/PO	Approved Drawing, SOTR/PO	IR		

NOTE: -

1. Type Test, EMI/EMC and Environmental test in accordance with EED-Q-071-(R4) is to be carried out after QA agencies, clearance and sealing of equipment. Post ET and EMI/EMC, ETT checks will also be conducted by QA agencies. If Type Testing, EMI/EMC and ETT has already been done in earlier projects on identical units, it will not be done again & the reports of earlier tested units will be provided for review of Inspection Agency. **In case of any difficulty/discrepancy in carrying out the above, matter be referred to IHQ MoD (N)/DEE within 10 days of receipt of approved QAP under intimation to HQ DQA (WP).**

2. EMI/EMC test and ETT will be done at NABL Lab. EMI/EMC Acceptance Test Plan is to be duly vetted by NEC Mumbai. Original Cable to be provided by the Firm for conduct of EMI/EMC tests.

3. ESS test (Thermal Cycling, Random Vibration and Burn in/Endurance) as per DQA (N) policy vide letters 66301/Policy-07/DQA (N)/QA-07 dated 09 Aug 16 and 66301/Policy07/DQA (N)/QA-10 dated 14 Jun 2013.

4. Equipment & Accessories to be supplied should conform to specifications.

5. Starter cum Control Panel is to be procured /manufactured only from Naval approved vendor as mentioned in IHQ MoD(N)/DEE Compendium of Vendors 2015 No. EE-50-30(REV-2) dated 29 Jun 2015.

6. Conformal coating of PCBs to be done as per DQA(N) policy letter 580930/DQA(N)/EL dated 17 Feb 14.

7. Type test and Routine test of AC Starter and Control Gear are to be carried out as per EED-Q-071 (R4) and IHQ MoD(N)/DEE policy note no. EE/03/5124 dated 20 Aug 19 & EE/03/5124, dated 17 Sep 19.

8. COTs items as applicable as per approved BOM/PIL.

9. Dust Protection (Part of Ingress Protection) is to be undertaken at CQAE(WE) Bangalore or any other NABL accredited Lab as per IHQ MoD(N)/DEE policy note no. EE/03/5124 dated 01 Mar 21.