# MINISTRY OF DEFENCE (DGQA)

# STANDARD QUALITY ASSURANCE PLAN (REV 01)

# FOR AC MOTOR

MOTORS ARE AN INTEGRAL PART OF MODERN WARSHIPS. THEY PROVIDE REQUIRED MOTIVE POWER FOR PROPULSION AND WORKING OF VARIOUS EQUIPMENT FITTED ON BOARD SHIPS AND SUBMARINE. THERE ARE TWO TYPES OF MOTORS VIZ. AC & DC MOTORS OVER A WIDE RANGE OF RATINGS AND FRAME SIZES USED ONBOARD IN SHIPS AND SUBMARINES. THIS SQAP IS FOR ALL AC MOTORS TO BE USED IN THE INDIAN NAVY.

STANDARD QAP NO DGQA/DQA (WP)/AC MOTOR/05/2016/REV 01
|| Aug 2020

Total Nos. of Pages: 18

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(REVISION 01) FOR AC MOTOR

## STANDARD QAP NO DGQA/DQA (WP)/AC MOTOR/05/2016/REV 01 Aug 2020

(A GEORGE)
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 Motor (AC Motor) for IN Ships.

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

3. The Standard QAP has been prepared on the basis of decisions made in Collegiate meeting held at DQA (WP) with leading manufacturers of AC Motor 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), New Delhi, 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 undertaken 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 applicable IP rating.

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.

## ABBREVATIONS

| | |
|---|---|
| VI | Visual Inspection |
| DI | Dimensional Inspection |
| LTC | Lab Test Certificate |
| STC | Supplier Test Certificate |
| CHP | Customer Hold Point |
| IR | Inspection Report |
| NABL | National Accreditation Board For Testing And Calibration of Laboratories |
| P | Perform |
| R | Review |
| W | Witness |
| TC | Test Certificate |
| OEM | Original Equipment Manufacturer |
| FATs | Factory Acceptance Trials |
| ETT | Environmental Type Test |
| EMI | Electro Magnetic Interference |
| EMC | Electro Magnetic Compatibility |
| ASNT | American Society of Non destructive Testing |

# 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 Non-destructive Testing viz. UT.

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

## SYSTEM DESCRIPTION

1. An **electric motor** is a machine that converts electrical energy into mechanical energy. In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy.

2. Electric motors find their applications in industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives etc. The AC electric motors can be powered by alternating current (AC) sources, such as from the power grid, inverters or generators. General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use. The largest of electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 MW. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on.

3. Devices such as magnetic solenoids and loudspeakers that convert electricity into motion but do not generate usable mechanical power are respectively referred to as actuators and transducers. Electric motors are used to produce linear force or torque (rotary).

4. The AC motors are mainly used for Capstans, Davits, AC Plants, Various Pumps, Ventilation Blowers, Frequency converters, Hanger Shutter, Accommodation ladder etc. Indian Naval Ships mostly use three phase squirrel cage induction motors of rating up to 160 KW.

# 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)

# STANDARD QUALITY ASSURANCE PLAN

**Part – II:**

| Technical Inspection & Trials in the form of QAP |
|---|

| SL. NO | MATERIAL/COMPONENT/ DRG.NO/ QUALITY ACTIVITY | QTY | CHARACTERISTIC/ TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENTS | ACCEPTANCE CRITERIA | FORMAT OF RECORD | ACTION BY QAE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 1. | DRAWINGS | | | | | | | | |
| 1.01 | Drawings & documents | | GA drawings and detailed bill of material (DBOM) | 100% | PO, SOTR, TNC Minutes and EED-Q-071(R4) (Which ever is relevant) | Same as reference document | List of approved binding drawings | CHP for R | Binding drawing & Binding data, duly approved by Design authority, Professional & Inspection Authority (or by Command for MO orders) to be verified |
| 2. | MATERIAL INSPECTION | | | | | | | | |
| 2.01 | (a) SS Shaft<br>(b) Structural Steel for Plate | | Physical & Chemical Properties | Sample | ASTM A479/478M Approved Drawings | Material Grade std as Per Approved drawings | LTC (NABL Lab) | CHP for R | Sample to be drawn in presence of QA rep |
| 2.02 | (a) SS Shaft<br>(b) Structural Steel for Plate | | UT | 100% | -do- | -do- | Certified by ASNT level –II Personnel | R | |
| 2.03 | (a) Stamping<br>(b) Copper Wire | | (a) Visual Inspection<br>(b) Verification of dimension, Mechanical, Chemical, Thermal and Electrical properties. | Sample | -do- | -do- | STC | R | |
| 2.04 | (a) Bearing Make/ Type<br>(b) Shaft Seal<br>(c) Misc Items viz. Cable Gland, Cooling Fan etc. | | (a) Visual Inspection<br>(b) Verification<br>of dimension, | 100% | As per PO/Approved drawings | -do- | STC | R | |

## STANDARD QUALITY ASSURANCE PLAN (REVISION 01) FOR AC MOTOR (Part-II) 14

| SL. NO | MATERIAL/COMPONENT/ DRG.NO/ QUALITY ACTIVITY | QTY | CHARACTERISTIC/ TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENTS | ACCEPTANCE CRITERIA | FORMAT OF RECORD | ACTION BY QAE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 3. | **STAGE INSPECTION** | | | | | | | | |
| 3.01 | Rotor & Stator | | (a) Visual Inspection/ Dimensional Inspection<br>(b) Calculation Of Air GAP | 100% | Approved Drawings | Approved Drawings | Inspection Report/STC | W | If the Motor manufacturers have automatically data logging machine for rotor balancing then reports are to be as "Review" otherwise rotor balancing is to be as"Witness" by QAE rep at Firm's. |
| 3.02 | Motor BOM | | Visual Inspection/ Dimensional Inspection | | | | | | |
| 3.03 | Rotor | | Balancing | | | | | | |
| 4. | **TEST & TRIALS** | | | | | | | | |
| 4.01 | Type Tests | | (a) Insulation Resistance (ambient & hot)<br>(b) Winding Resistance (Hot & Cold)<br>(c) Temp rise<br>(d) Load Test at 100%,75% and 50% Determine efficiency & Pf<br>(e) Starting Torque<br>(f) Pull Out Torque<br>(g) Starting Current and run up time<br>(h) Reduce Voltage Test<br>(j) Over Speed at 115% for 15 minutes<br>(k) Withstand Voltage<br>(l) Oscilographic Record of Starting Current at Full Load/No Load at Normal/Reduce Voltage<br>(m) Phase Balance at Full Load and No Load Conditions<br>(n) Momentary Over-Load Test at 110% for 15 Sec.<br>(p) Thermister Resistance (Ambient, Cold & Hot)<br>(q) Hot Spot Sensing<br>(r) IP( As applicable)<br>(s) Direction of Rotation<br>(t) Earth Bonding<br>(u) Speed Regulation Test<br>(v) External Magnetic Field | One Motor of each Frame size per Lot | Major | EED-Q-071-(R4) and Approved Drawing | Type Test Report | W | Starting Current and Run Up Time testing is required to be undertaken with actual load. However in absence of actual load at OEM premises, the testing may be undertaken with simulated load and endorsement in the Inspection Note is to be made to prove the acceptance testing parameters with actual load during onboard trials by OEM. |

| SL. NO | MATERIAL/COMPONENT/ DRG.NO/ QUALITY ACTIVITY | QTY | CHARACTERISTIC/ TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENTS | ACCEPTANCE CRITERIA | FORMAT OF RECORD | ACTION BY QAE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 4.02 | Routine Tests | | (a) No Load Test<br>(b) Over Speed Test At 115 % for 15 minutes<br>(c ) Short Circuit Test/Locked rotor Test At 25% of rated voltage or rated full load current<br>(d) Phase Balance At No Load<br>(e) Starting Torque<br>(f) Space Heater (Where Ever Applicable)<br>(g) Direction of Rotation | All Balance Motors | Major | EED-Q-071-(R4) and Approved Drawing | Routine Test Report | W | EED-Q-071(R4) and its subsequent revision is to be complied |
| 4.03 | General For All Motors | | (a) Insulation Resistance (ambient & hot)<br>(b) High voltage test<br>(c ) Noise level test<br>(d) Vibration test<br>(e) Bearing check/-SPM<br>(f) Dimensional check<br>(g) Weight checks<br>(h) Terminal / name plate check<br>(j) Earth bonding<br>(k) Space heater (wherever applicable)<br>(l) Withstand Voltage | All Motors | Major | EED-Q-071-(R4) and Approved Drawing | Routine Test Report | W | |

| SL. NO | MATERIAL/COMPONENT/ DRG.NO/ QUALITY ACTIVITY | QTY | CHARACTERISTIC/ TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENTS | ACCEPTANCE CRITERIA | FORMAT OF RECORD | ACTION BY QAE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 4.04 | Integration Trial | | Protection Mechanism to be check as per IHQ MoD(N)/DEE Policy EE/01/1-67/Power-18 dt 15 Jul 10. | One Motor of each Type with respective Starter/Control Panel | Major | DEE Policy | IR | W | Starter motor integration trials to be conducted at motor manufacturer place as per IHQ policy EE/01/1-67/Power-18 dt 15 Jul 10. **Only for new construction ships.** |
| 4.05 | Environmental Type Test & EMI/EMC reports | | Availability & Verification | Prototype sample | PO & SOTR/TNC Minutes/JSS 55555 /and Approved drawings used during type test for similar Motor | PO & SOTR/TNC Minutes/JSS 55555 /and | Type test /ETT/EMI /EMC reports | CHP for R | -EMI/EMC Acceptance Test Plan duly vetted by NEC Mumbai.<br>-Reports be reviewed if Frame Size is already tested for ETT & EMI/EMC. |
| 5 | **DOCUMENTATION** | | | | | | | | |
| 5.01 | Documents for Operation, Maintenance and Repair | | Availability & Verification | 100% | PO | PO | - | CHP for R | All Documentation are to be made as per JSS-0251 |

| SL. NO | MATERIAL/COMPONENT/ DRG.NO/ QUALITY ACTIVITY | QTY | CHARACTERISTIC/ TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENTS | ACCEPTANCE CRITERIA | FORMAT OF RECORD | ACTION BY QAE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 6. | PAINTING, PACKING & PRESERVATION | | | | | | | | |
| 6.01 | Painting, | | Visual Inspection & DFT | 100% | Approved Drawing, SOTR, Paint Plan/DGS 251 | Approved Drawing, SOTR/PO | IR | CHP for W | |
| 6.02 | Packing | | Visual Inspection | 100% | Approved Drawing, SOTR/PO | Approved Drawing, SOTR/PO | IR | | |
| 6.03 | Preservation and Marking | | Visual Inspection | 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) are to be carried out after QA agencies, clearance and sealing of equipment. Post ET and EMI/EMC, checks will also be conducted by QA agencies. 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 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 and ETT test will be done at NABL Lab. In case of non-availability of NABL lab QAE rep should witness.
3. Equipment & Accessories to be supplied should conform to specifications.
4. 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.
5. Type test and Routine test of AC Motor 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.

## Legends

| | | | |
|---|---|---|---|
| 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. | | |
| 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. | | |
| P | Performed By | IR | Inspection Report |
| OEM | Original Equipment Manufacturer | UT | Ultrasonic Test |
| V | Verification | ATP | Approved Test Plan |
| W | Witnessed By | SOTR | Statement of Technical Requirement |
| MTC | Material Test Certificate | TNC | Technical Negotiation Committee |
| LTC | Lab Test Certificate | STC | Supplier's Test Certificate |
| DFT | Dry Film Thickness | | |