वैमानिकी दर्पण

7th Edition

DGAQA MAGAZINE ON AVIATION QUALITY ASSURANCE

ENSURING FLIGHT SAFETY THROUGH QUALITY ASSURANCE

आज़ादी का अमृत महोत्सव

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Articles/ suggestions may be sent to Senior Editor on email ID- dirtc.dgaqa@gov.in.
Every Article forwarded may be accompanied by a brief bio data and passport size photograph of the author.

Message from Director General, AQA

सत्यमेव जयते

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महानिदेशक

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Director General

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31 Dec 2021

NEW YEAR MESSAGE

On the eve of New Year 2022, I extend greetings to all DGAQA personnel & their families and wish a Happy, Healthy and Prosperous year ahead. My warm greetings to our esteemed DGAQA veterans and their families and wish them to remain active and strong.

2. During the year going-by, we have expanded with addition of 5 new work centres namely Chennai, Kasaragod, Panchkula, Mamun & Missamari thereby extending our footprints further across our country. As part of the Central Vista Project, HQ DGAQA moved to a new building at KG Marg with all sections now co-located. Notwithstanding the COVID limitations, the training for the very first batch of CES Gp 'A' officers was conducted successfully during March to July 2021 through resident programs at Bangalore & Pune. Further, release of Revised DDPMAS-21 during Aero India 21 by Honourable RM, Successful conduct of DGAQA Exhibitions at ALISDA, AQAW(A) Khamaria, and other work centres at Nasik, Kanpur etc as part of 'Azadi ka Amrit Mahotsav', Formulations & Release of QA/QC guidelines for newly formed DPSU's post OFB Corporatization, Release of First Admin & Accounts Directive, Conduct of Audit of FE's by cross functional teams, Success of our quarterly technical magazine 'Vaimaniki Darpan' etc are few of the major achievements during the year 2021.

3. DGAQA officers have demonstrated their professional excellence and our esteemed organization is considered as role model for others to imbibe. Our QA methodology and the best practices being followed are duly recognized and appreciated amongst various stakeholders. I call upon all of you to continue achieve further heights of excellence in your respective work areas.

Jai Hind !

(S.Chawla)

THE IMPORTANCE OF DESIGN IN ENSURING RELIABILITY OF SYSTEMS IN AEROSPACE APPLICATIONS

Shri P K Sethi
DG(Retd.), DGAQA

INTRODUCTION: The design and development of the Hydro-Mechanical system for a missile was initiated in the early nineties and manufacturing started around mid nineties at HAL (AD). Two accessories viz Boot Strap Hydraulic Reservoir (BSHR) and Servojack were important accessories of the HM System.

During the initial phase of the project both the accessories were found to present problems after integration with the missiles . The defects reported were of a serious nature which could affect the reliability of the Hydro Mechanical system. The defective items were sent back to HAL (AD) for necessary investigation. Detailed study of the manufacturing, assembly and rig testing was carried out at HAL(AD) in coordination with DGAQA. These aspects did not reveal any deviations.

It was opined by DGAQA that only aspects of design were left out. These needed to be studied and examined. The studies revealed that some features needed a **design change**. These design changes were proposed, discussed, tried out, limited qualification tests carried out successfully and then changes implemented. The problems being experienced were resolved. The exercise thus revealed the importance of the design stage in ensuring quality and reliability of systems so important in the aerospace industry.

This paper brings out the problems encountered and the changes in design of the system of the BSHR and servojack which resolved the problems.

1. The Bootstrap Hydraulic Reservoir

The Boot strap hydraulic Reservoir (BSHR) had a HP cylinder and a LP cylinder with a level indicator and an LP relief valve. On the piston head was mounted an “O” ring to prevent leakage.

Bharat Dynamics Ltd reported that during periodic checks and retro-fitment of Equipment at the depot leakage of oil from the LP side was observed. This would obviously result in a malfunction of the weapon system.

The units were sent to HAL (AD) for defect investigation. During strip examination the O ring on the LP cylinder was found to suffer from spiral cuts. This was discussed at length in the TCCM meetings and the following checks were decided to be carried out-

1. Eccentricity of components.
2. Clearances for fitment of O ring
3. Surface finishes.
4. Inadequate or improper lubrication.
5. O-ring hardness.
6. O-ring sizes.
7. Installation.

It was decided to carry out limited qualification tests on a representative item after the above areas were addressed satisfactorily. During the LQT tests the unit suffered from leakage from LP side after some endurance cycles. The unit was strip examined and the spiral cut on the seal was observed which was similar to the failures observed in the units received for investigation.

The spiral failure of the seal needed to be eliminated and DGAQA was of the opinion that the only area left was the design since manufacturing, inspection and assembly had already been addressed.

Material on seal design were referred for study by DGAQA in order to find a solution. A reference on dynamic seals stated ‘O’ rings are most suitable

for small diameter, short stroke applications and moderate pressures. Another reference mentioned that " O ring seals used in long stroke, large diameter seals are more susceptible to spiral failure."

In the case of the BSHR the cylinder diameter and stroke would be classified as large diameter and long stroke. It therefore was obvious that the seal needed a redesign.

A booklet dealing with avoiding compression set, spiralling, extrusion/nibbling problems in O-Rings was found which brought out that in practice some sections of the O-ring slide and others roll simultaneously. Since the O ring is round it has a tendency to roll and will do so unevenly when torsional stress is not uniform over the seal's circumference. It also mentioned about The AGT unique geometry(T section) to prevent rolling or spiralling.

This aspect was brought to the notice of Project Director who then decided to have a "Design Review Board Meeting". Presentations were made by HAL on the design, manufacturing and Quality aspects. The alternate design of the seal (T seal in place of O ring) was projected by DGAQA to prevent spiral failure. The board decided that initially one piston head with O ring and one PTFE back-up in the existing groove and a PTFE slide (Teflon ring) in an additional groove would be assembled in a unit and the BSHR would be subjected to qualification testing.

It was further decided to procure T seals with back up rings and modify the piston to use a PTFE guide and the T seal with 2 backing rings . This was to be kept ready for qualification testing.

The first BSHR with "O" ring was subjected to qualification test but the spiral failure was observed as in earlier cases.

The BSHR fitted with the T seal was then subjected to detailed qualification test. All the tests were successfully cleared and **the modification using the T seal was approved for use in future. It was also decided to retrofit all existing BSHRs with T seals.**

No further problems of spiral failures were reported after the implementation of the design change.

2. Servojack – The servo jack is a very important item of the Hydro-mechanical system as it plays a vital role in the control of the missile.

The servo jack is defined as a hydraulic cylinder mounted with a two stage servo valve which directs the flow proportional to a +ve or –ve current to the either side of the cylinder and the cylinder linear position is sensed by a rectilinear potentiometer which is coupled to the output piston. Actuators move the control surface and they function in the position control mode i.e. the position of the piston is proportional to the input current. The actuator is double acting. The servo valve directs the flow to either side of the piston rod depending on the sign of the input signal. The cylinder end is connected to the missile frame and the rod end is connected to the control surface. The potentiometer is a feedback element which gives the position of the piston rod.

The cylinder was machined out from an Aluminium alloy forging and the body was given protective treatment by anodising.

The necessary performance testing of the servo jack was to be done at HAL (AD) after integration of servo valve and potentiometer and thereafter the unit was to be despatched to BDL for integration with the weapon system.

During checks at the assembly stage performance related problems were faced by the integration agency . In order to overcome the problem a team of officers visited the servo valve manufacturer . The problem of malfunction of the servo valve was pinpointed to the presence of metal particles in the servo valve. A master actuator at the factory end was used and integrated with the fresh servo valves and the results were found to be satisfactory.

The focus then shifted to our own factories. A high level team from DRDL visited HAL(AD) and discussed the issue of oil contamination. It was pointed out that the QT/AT document mentioned that oil cleanliness should be better than class7. This was being adhered to. It was then decided that the rig oil contamination be maintained to better than class3 and return oil contamination to be better than class5.

In addition to the above the checking of the cylinder bore surface finish and concentricity values were to be recorded. The holes connecting the cylinder to the servo valve were to be examined for quality of finishing. The above measures were introduced.

But the problem of malfunction still continued to be reported by the integrating agency.

In the next batch of production of actuators at HAL(AD) the bore of the actuators had inadvertently been made oversize and a concession for acceptance in as is condition sought for was not agreed upon.

On a chance reference to a design document of actuators used by an engine manufacturer it was found mentioned that " All SCS jacks (Body) used in Civil and Military engine application are in Aluminium which is hard anodized. No problem has been reported due to this treatment."

The exact amount of oversize was studied and it was then decided to salvage the cylinders by hard anodizing and subject the worst case to a limited qualification test. The batch was cleared for acceptance when LQT was completed satisfactorily.

The servo jacks were despatched to BDL and a feedback of performance was sought .No problems were reported by BDL . This gave enough confidence that the issue of metal particle generation had been overcome.

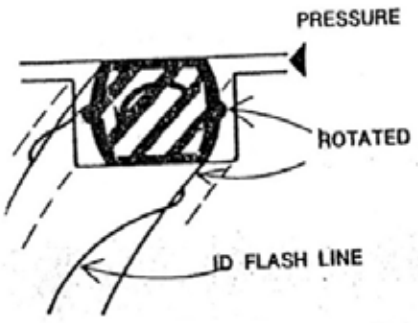
TCCM chairman was then requested to consider the incorporation of hard anodising as a permanent feature in the design document by introduction of the design modification. This was agreed to by the committee.

No problems were reported thereafter by the integrating agency.Thus the problem of malfunction of the servo jack was overcome by a design modification.

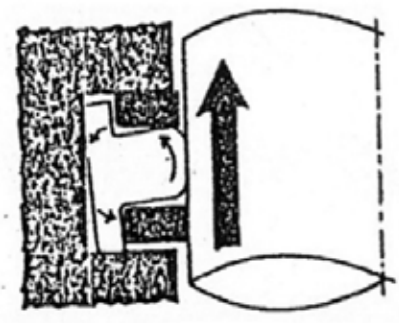
3. Feedback on BSHR and Servojack during actual usage–In a subsequent TCCM meeting the chairman appreciated the efforts and contributions made by HAL(AD) and MSQAA for the successful flights of missiles where the performance of hydraulic systems have been excellent . He also placed on record on behalf of the TCCM appreciation of the contribution by CRI DGAQA by way of design changes to BSHR and Servo jack of the hydraulic system which resulted in improved quality and reliability of the missile system."

Conclusion:- The above two case studies have brought out the importance of the part Design plays in the achievement of Quality and reliability of Aerospace systems. Small changes in design can often bring about dramatic improvement in product quality and reliability. This is exactly what the Quality Lever emphasises.

Acknowledgement:- The author wishes to thank ADG (N&CZ) and RD,AQA and Shri Devendra Yadav, Scientific officer of ORDAQA for the help in respect of information provided when sought for in connection with this paper.



Mechanism of Spiralling of O-Ring



The Locked T-Shape Sealing element preventing Spiralling

About the Author:
Shri P K Sethi, Director General (Retd.) DGAQA joined DAQAS Service in Aug 1977 and superannuated in Nov 2010.

LAPSES OBSERVED ON OUTSOURCED AIR ARMAMENT STORE

Shri Debasish Dutta
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Tail Units are sub part of Bomb which provides aerodynamic stability while bomb are being released from aircraft. Here I will highlight one of the lapses on the part of vendor for an item named Closing Disc, a sub parts of Tail Unit, which has been observed during spot check and same I felt needs to be brought to the notices of all concerned for being more vigil during inspection.

Brief Description Retarded Tail Unit & its sub part Closing Disc :

Closing Disc is assembled at the base of the Tail Unit to retain the parachute inside. RTU is meant for high speed, low level lay down mode release of the bomb. It provides necessary safe separation distance between the impact point of bomb and the delivery aircraft. The closing disc comprises of circular pan, plunger housing, plungers, cam disc and springs. Arrangement ensured simultaneous movement of all the three plungers during locking and unlocking of closing disc. In the unlocked condition the springs remain slack and plungers are withdrawn in the housing. In locked position plungers are extended fully into the holes on the tail cone rear ring. On withdrawal of arming wire, the plungers are withdrawn in the plunger housing and closing disc is ejected out of the auxiliary parachute and deploy the main parachute. The main parachute upon deployment retards the bomb.

Lapses Noticed:

While surveillance check on Retarded Tail Unit of a bomb at the parachute assembly bay, it has been noticed that no's of nuts of retaining spring of closing disc were loose. While going through the specification it is seen that application of thread locking solution i.e. Locktite on nuts and screw while assembly / engagement has been mentioned. The mentioned Closing Disc is a vendor supplied (outsourced) product and also as being a non critical store, inspection responsibilities lies with QC, OFDC.

What may happen due to looseness of nuts :

The lapse has serious operation connotation, since over a time during aircraft flying due to vibration, inadvertent dislodging of the spring may take place and closing disc may ejected which may lead to failure of mission / operational requirement. It may also lead to Foreign Object Damage (FOD) to the aircraft.

Remedial Action:

- Ordnance Factory Dum Dum (OFDC) was asked to conduct a onetime check on all the closing discs received from vendor / firm.
- OFDC was also instructed to take necessary rectification on closing disc which were already dispatched to Air Force bases.
- QAP amendment suggested for the classification of items as critical.

CONCLUSION & RECOMMENDATION:

Ensuring safety and security of locking is the most essential part for any aviation store is concerned. All people associated, need to go through the drawings/specification thoroughly irrespective of critical/non critical store. Imparting of on job training, flight safety & flight mission awareness among employees needs to be enhanced. Supervision and accountability also to be ensured.

About the Author:
Shri Debasish Dutta , SSO-I joined Service in Jan 2002 and superannuated on 31 Dec 2021.

RELIABILITY AND MAINTAINABILITY IMPROVEMENT FUEL BOOSTER PUMP FOR CHEETAH/ CHETAK/CHETAL PROJECT

Shri Biswajit Chaudhuri
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Hindustan Aeronautics Limited, Barrackpore Division is the ROH agency of 400 strong Cheetah/ Chetak/Cheetal Helicopter Fleet of the Indian Defence services. It undertakes the task of repair & overhauling of Chetak/Cheetah/Cheetal fleet of Army, Air Force, Navy and Coast Guard.

Maintaining an aged fleet like Cheetah/Chetak is always a challenging task and it requires constant monitoring of the fleet performance and take necessary measure to maintain its reliability.

The Division carries out defect investigation on prematurely withdrawn suspected components to ascertain the root cause of failure and initiate remedial measures. The investigation team comprises of technical representative from users, member from DGAQA, Shop, DLE and QA representative from HAL.

Based on no. of occurrence and having history of failure through DI and PWR in last three years, few components were selected for process quality audit by OAQA, Barrackpore to suggest remedial measures so that no. of DI/PWR are reduced. One of such component is Fuel Booster Pump.

In Fuel section at HAL,BKP , there are Repair/ Overhaul facilities of Fuel Booster Pump. Fuel Booster Pump is one of the important LRUs which is supplying fuel (ATF) to the ignition system. If it fails to work, low pressure warning light in the cock-pit will alarm and mission will be aborted.

ISSUES/DEFECTS REPORTED :

i) Pump is not operating/intermittent operation.

ii) Fuel low pressure warning light ON or flickering.

iii) Booster pump produces unusual noise.

REASON/CAUSE OF DEFECTS :

Long storage (Few cases, 8 to 16 Yrs), however unit found Functional intermittently.

Before installation, if it is long stored, the pump should undergo functional test with kerosene for 30 minutes. The Pump should not run in dry condition.

Repeated dry run/ use beyond TBO causes wear out of the Carbon Brush, which leads to intermittent operation/non-functioning.

REMEDIAL MEASURES:

The FBP, after removing from storage, should be immersed in kerosene oil and run for 30 minutes, before fitment on Helicopters. The same is reflected in storage/overhaul manual to prevent deterioration of pressure seals but overlooking of the same, the pumps are directly fitted to Helicopters and non-functioning of the pumps leads to loading the component on DI by users. OAQA,BKP proposed, the same may be reflected in log card also, as a cautionary note (For USERS).

Dimension checks of Carbon brushes started whenever it is loaded for ROH and replaced accordingly(For OEM).

The failure of Fuel Booster Pump has come down progressively but is still under monitoring of OAQA Barrackpore.

Conclusion:

The above study and outcome will result in reduction in the time and cost of Overhaul thus contributing in a big way towards achieving the Overhaul target in a lesser time period ultimately meeting the requirements of the end user as per the planned schedule and also a big saving to the state exchequer.

About the Author:

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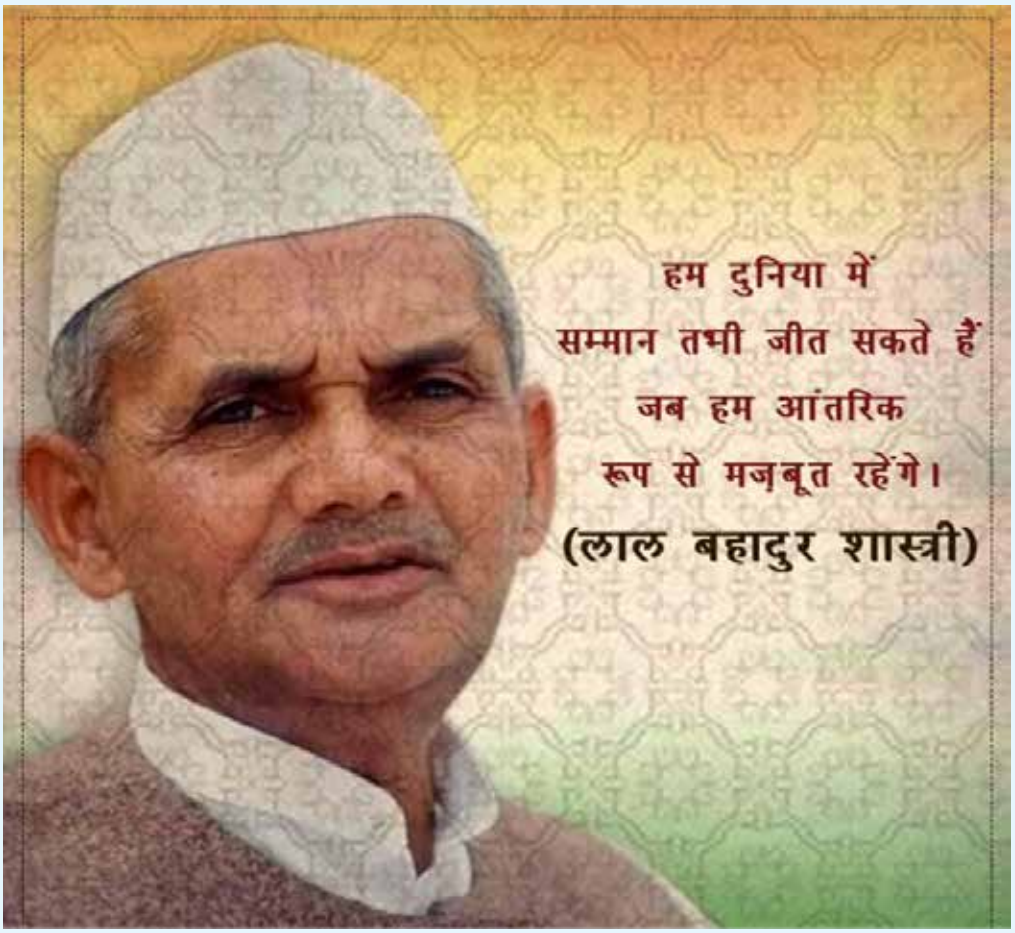

25 Years

(1996-2021) Rewind 2.....My QA Path

Flight Hangar : Jaguar Aircraft Project

Shri A Chandrasekaran
Dir (A/c & AeroMed)
HQrs New Delhi

In continuation to my first article in this series, this episode fully covers the Jaguar Manufacturing Project. Despite not being a regular article writer, I have written so many QA letters to the Quality Control Dept of the Main contractor. Many of these QA letters (Level 1 enforcement action as per AFQMS 2018) focussed on Spot checks and Surveillance observations to highlight poor workmanship, inadequate infrastructure, deviation in procedures and inadequate inspection. I would write these letters whenever I observed deviations from the standard procedures or anomalies in the manufacturing process to raise awareness. This inspired the Shop and QC personnel to follow the procedures as accurately as possible.

As I learnt from my previous tenure in Aero engine project, DGAQA Officers are expected to carry out more Surveillance Inspection, Spot checks , Quality Audits and Re-verification Stage memo irrespective of the type of the projects dealt - Components/ Assembly/Aircraft. As the customer representative and QA authority tasked with assuring the build Quality of Airborne Stores produced by DPSUs with the expectation is on the DGAQA officers to ensure that Quality is maintained in all aspects of the project.

During my tenure at Bengaluru, I looked after the manufacturing of Jaguar and Hawk projects. Surprisingly after my initial posting at Aircraft group for three months, I was posted to Aero engine division, Bengaluru since I had an extensive experience working with engines in Koraput. It would have been an easy job if I had continued in engine division, but I had strong determination to work in Aircraft manufacturing area to diversify my knowledge, so I went and told my CRI(Aircraft) to continue in Aircraft project and acquire diversified experience in my career. Then I met DDG (SZ) as well and my request to work in Aircraft manufacturing was accepted. A few weeks later, my CRI asked me how I felt about this division compared to Koraput. I replied that it appears to be alright. With a smile he said “Go in deeper” and that gave me a different signal.

Jaguar Projects (2003-2006)

Jaguar DARIN II Upgrade was under full swing when I joined my duty at OCRI(Aircraft) in Aug 2003. The concurrent design and production for Jaguar DARIN III was in progress. I had been assigned the Structure, Equipping, Final assembly and flight hanger areas.

Being vigilant always, I conducted a lot of surveillance inspections to bring the system in place and make contractor QC to work/active. I am happy to share some of those vital observations which I can recollect now.

One day, I was walking outside the Jaguar hangar and I saw an ejection seat (pilot life saving seat) transported in a platform truck (Jumbo) without any protection which may get damaged and fail to perform its intended role. I interacted with them and noted the details of the seat and advised them to move the seat in packed condition.

Another day, I saw painting of Jaguar fuselage

Structure being carried out in jig installed condition which will affect the interchange ability of other structures by ingress of paint dust particles inside the Jig points. I interacted with them and stopped the activities further. Advised them to recalibrate the Jigs before loading another structure build.

Another day, while going through a structural shop, I heard rivet over bucking sound. I went near the rivet operation area and found that those heat rivets were used beyond the stipulated time period. The heat treated rivets to be used within two hours after removing from deep freezer if it is stored for better endurance life. Advised shop/QC personnel to strictly adhere to the process.

These are some instances of deviations in the procedure during build stage of Aircraft and considered as surveillance/vigilant inspection. QA letters were issued to QCD for corrective action. Such letters raise awareness of deviations in the procedure and makes it easier to improve the system/culture and thus improves Quality of products.

During re-verification stage memo, DGAQA observations are considered as Inspection lapses made by QC inspector. Receiving observations from DGAQA will encourage QC inspectors to carry out adequate inspections before clearing it to the next stage.

In many aircrafts, I found Foreign Object Debris (FODs) such as Nut, Bolt, drill bit, masking tape, locking wire, screw driver etc., during re-verifications by DGAQA before first flight test. After scrutiny, I observed this is due to holding excess fasteners apart from kit parts,, holding unspecified tools, leaving the wire lock bit after wire locking etc by the operator. I observed it after the shop and QC carrying out FOD inspection. To prevent FODs like this during manufacturing of an Aircraft, I decided that awareness should be created among all Shop and QC personnel. I asked the Main contractor to collect FODs at every FOD stage and display them in the display board, to increase awareness among shop personnel, streamline the kit part system, avoid mistakes & change the culture.

During QA activities at the Painting shop, Shop and QC inspectors were often not able to distinguish the various paint defects as there were no pictures in their documents, so I displayed the painting defects as per standards at the painting hangar as part of Quality improvement.

There was a Quality issue about fuel leakage from undercarriage area of Jaguar reported from Operating Base as well as flight hangar of the Contractor premise, my spot check brought out that there was inadequate application of PRC sealant at inaccessible area inside the wing fuel tanks and instructions were issued to the shop and QC personal to apply the sealant with proper tool to obviate such defects. I repeatedly advised the shop and QC personnel to follow the safety procedures to achieve desired product Quality.

Preservation and Storage of Seals & Sealants and further exercising of LRUs during shelf life have its importance for the assigned life to be achieved post delivery of the product. I conducted periodic spot checks and Quality Audits at Store area also frequently to keep the system in place to achieve the desired product Quality.

One day, the aircraft was ready for ferry and QC approached me for issue of F.1090, I asked the QC inspector to show the FDR certificate to verify its serviceability. He said the certificate is yet to be received from FTC. I asked him repeatedly to furnish it for issuing ferry 1090. Later on, I found that FDR was unserviceable as per certificate issued by FTC. So, Ferry was delayed by one more sortie to accept the aircraft with serviceable FDR by ferry pilot. This is what QA ensures the product Quality at every stage with proper verification of document though Pilot accepted the aircraft with Nil snag. It gave me further more confidence in verifying the documents and evidence before clearing the aircraft.

As I learnt and believed in my past experiences, Spot checks and Surveillance Inspection are independent and two eyes of QA Specialist to observe the non conformance in the processes, infrastructure deficiencies, unauthorised activities etc. to ensure the defined procedures followed with defined infrastructure.

Let us see once again in the next episode with manufacturing of AJT Hawk Mk132 Project.

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LOCAL PUBLIC EXHIBITION TO COMMEMORATE AZADI KA AMRIT MAHOTSAV




ALISDA, Bengaluru


ORDAQA, Kanpur

LOCAL PUBLIC EXHIBITION TO COMMEMORATE AZADI KA AMRIT MAHOTSAV




AQAW(A), Khamaria, Jabalpur


OADG, Nasik

Brake Control Hydraulics Engine and Electrical Monitoring Systems Automated Test Equipment

BHEEM Integrated Test Setup

Shri T Ravi Kumar, SSO-I
ORDAQA(HAL), Hyderabad

BHEEM is an Avionics LRU (Line Replaceable Unit) to perform the following types of functions:

- Control Functions.
- monitoring Functions.

CONTROL FUNCTIONS:

(a) Brake Management Control System (BMS) Function

(b) Nose Wheel Steering Control (NWS) Functions

MONITORING FUNCTIONS:

- Engine Monitoring
- Electrical Monitoring Functions
- Under Carriage Monitoring Functions

ORDAQA SUGGESTIONS ON TEST FACILITY

Since the LRU is safety critical equipment, ORDAQA suggested to test the LRU with Automated Test Equipment (ATE) which has a Real Time Operating System (RTOS) and capable of simulating various phases of flight and systems, that are being monitored and controlled by BHEEM. The testing should be fully automated and has to carry out full hardware & software functionality tests of BHEEM and generate necessary reports. The BHEEM ATE was designed and developed by SLRDC Division, M/s HAL (Hyderabad).

ORDAQA CONTRIBUTION DURING DEVELOPMENT OF ATE:

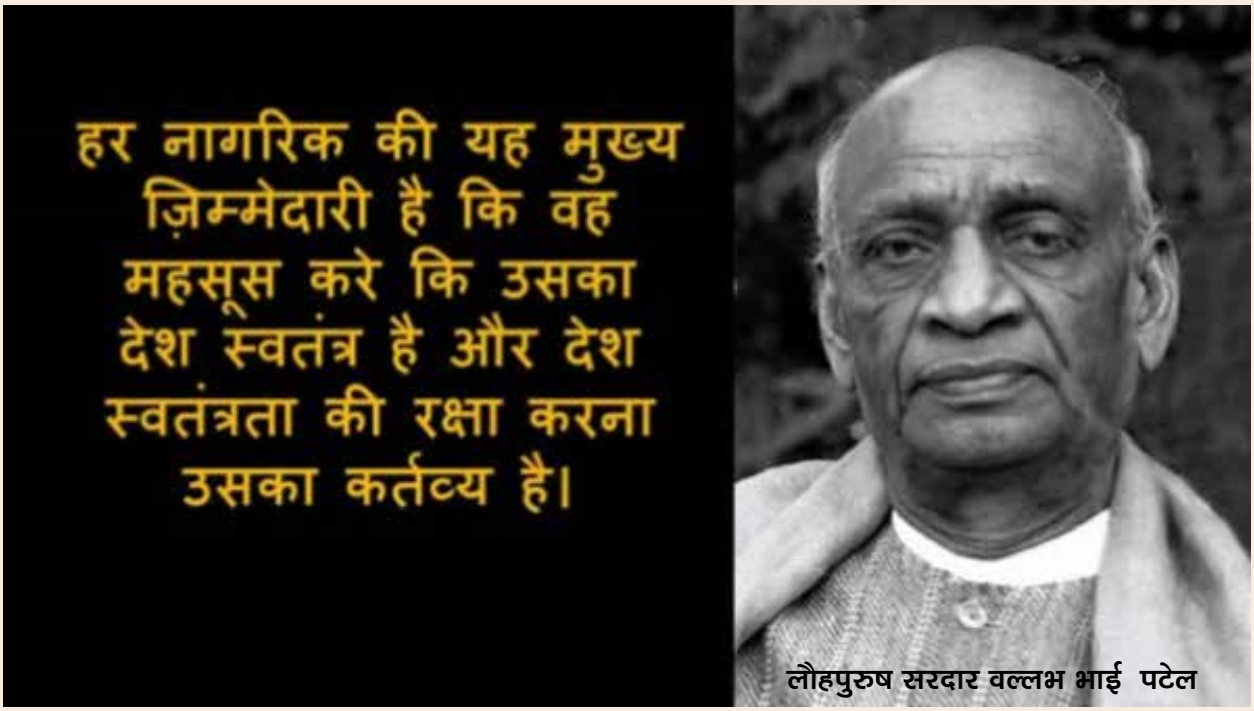
ORDAQA is involved in all phases right from the beginning through thorough checks, verification and validation of new ATE . The following improvements were incorporated based on the suggestions given by ORDAQA :

- ATE shall have a feature of automated self test for monitoring the health of ATE.
- The ATE shall have a GUI (Graphical User Interface).
- A Bus Controller to display two channels for simultaneous monitoring and display of the BHEEM.
- A full authority digital electronic control (FADEC) simulator to act as a remote terminal (RT) for simulating the Engine parameters. It will send and receive the data from/to BHEEM. In the same system, Engine Fuel indicator simulator software also been implemented, to receive the data from BHEEM and display the critical parameters on the monitor.
- ATE should contain circuit breakers, toggle switches and indicators for indicating Cockpit conditions/warnings.

- ATE contains field programmable gate array (FPGA) design for high reliability and channel re-configuration. ATE shall have proximity sensor for sensing for BHEEM LRU.
- ATE equipped with Un-Interrupted Power Supply for continuous operation.
- Single ground return point (SGRP) grounding scheme should be implemented.
- Implementation of Proper color coding for internal wiring of ATE for easy identification and tracking.
- A BOB (Break out Box) is to be provided as part of ATE to monitor the signals from the BHEEM or feed the signals to the BHEEM.

As suggested by the ORDAQA (Hyd), HAL (Hyd) has taken into consideration of the above improvements, features and the same has been successfully implemented in new automated test facility for complete aircraft simulation. The ORDAQA was involved in the development right from the design to final set-up stage. The system was cleared for Production/ROH of BHEEM units.

About the Author:-
Shri T Ravi Kumar, SSO-I is posted at ORDAQA(HAL), Hyderabad and joined DAQAS Service in 2009.



लौहपुरुष सरदार वल्लभ भाई पटेल

अमूल्य विचार:
जिन्दगी में रिस्क लेने से कभी मत डरो, या तो जीत मिलेगी और यदि हार गए तो सीख मिलेगी।

QC & QA REFORMS POST OFB CORPORATISATION

Shri Sanjay Gaur
Dy. Director (Armament)
HQrs New Delhi

Introduction:-

With the Govt Emphasis on "Make in India" & "Atamnirbhar Bharat" programs, the thrust is on to develop and manufacture sophisticated defence Equipment/Armament stores indigenously. The Future role of Public and Private Sectors in supply of Aeronautical stores is bound to grow and so as the challenges to the QA function in general for the Regulatory agency like DGAQA. In order to manage the current and future challenges of stringent Quality Assurance requirement for Military Aviation field, it is mandatory that the Functioning of the DGAQA is to be transformed to make it more efficient, effective, and accountable for its mandated QA function, in line with the International Practices.

This Article is an attempt to suggest the Road Ahead and reorganise the DGAQA to bring a paradigm shift in the future role of DGAQA from Inspection based approach to QA/Regulatory based approach by giving more autonomy to OFB (Now new corporate entities) QC in their day to day activities through DGAQA- AFQMS Model.

QC & QA Structure- Post OFB Corporatisation

In order to develop the Defence Industries ecosystem in the country and instilling transparency, accountability and efficiency in the operation of the OFB, the Cabinet Committee on Security (CSS) had approved to convert Ordnance Factory Board in to 100% Govt Owned seven Corporate Entities registered under the companies Act 2013. The structure of various factories under these seven entities is given in the Figure. Based on the above, there is need that the QA agency should also align their QA structure & QA methodology post corporatisation of OFB. It is the need of the hour that the DGAQA should transform its function from direct inspection to role of regulator and should focus on intensive QA activities. The Responsibility of Quality of the Product should rest with the Manufacturer with strengthening of QC Organisation of the respective Ordnance factories.

QC & QA Methodology in Past:

Armament, explosives and initiating mechanism and its sub system were initially produced inside Ordnance Factories and independent personnel were deployed to assess the quality of the product by undertaking 100% Physical inspection. With the Technological advancements over the years, technology of inspection was transformed from basic inspection to gauging, sampling, NDT methodology, Quality control etc. During all such period, it was found that the manufacturer was reluctant to take the responsibility for the quality requirements desired in the product. Therefore the concept of Independent Quality Control and Quality Assurance were instituted in late 90's. However, Ordnance Factories being the production agency were basically inclined and concentrating on the manufacturing & Production aspects and did not concentrate on Quality Functions, as it was

generally assumed to be taken care by the Third Party/ Independent Quality Assurance Organization i.e. DGQA, DGAQA, & DGNAI.

Existing Role of DGAQA in Ordnance Factories:

At Present DGAQA extend its QA coverage through its 13 Field Establishment to 21 factories (Out of 41 Ordnance Factories) of OFB dealing with the Military Airborne stores being supplied to the Users services.

Based on the Rajadhyaksha Committee recommendation, the QC function/Inspection responsibilities in respect of Army Stores at Ordnance Factories were handed over to OFB from DGQA. Similarly, on the same line it was also proposed to transfer inspection responsibility of Air Armament stores from DGAQA to OFB. Based on the above decision, Initial Trial SOP on TOIR (Transfer of Inspection Responsibility) was jointly released by DGAQA and OFB in the year 2006 and subsequently it was refined from time to time based on the feedback/issues raised during its implementation. Finally, the Order for TOIR implementation was issued by MoD in January 2017.

Vide above MoD order, the inspection responsibility of all input/Raw material and non- critical stage inspection of Air Armament store has been transferred from DGAQA to OFB. The above decision was taken keeping the view that the manufacturer should take the responsibility for the quality of the stores/products sub contracted by them and QA agency should focus on critical intensive QA function on Airborne stores.

QC & QA Methodology (As per TOIR):

(a) QA at Input Material Stage : Earlier, as already stated above, DGAQA used to inspect the Parameters/properties of all input material right from their Raw/crude stage. Later based on the recommendations of Rajadhyaksha Committee, the inspection responsibility of input material shifted to the Manufacturer i.e. Ordnance factories.

(b) QA at Manufacturing Stage : Being the Flight safety critical stores, as per earlier mandate, DGAQA used to involve/provide QA coverage at the mutually agreed and defined inter stages (based on criticality) during manufacturing as per the approved QAP. Further, it was decided that the QC function during the In process inspection will be carried out by the OF QC personnel and DGAQA will focus on QA function with Control Point Checks on certain critical stages with surveillance/Audit at other places. Further based on SOP on TOIR from 2006 onwards, the stages were further reviewed and responsibility of In Process inspection/ inter stages inspection of Non- critical was shifted to OF QC and DGAQA involvement was restricted to Joint inspection/Control Point inspection at mutually decided critical stages only. On all other stages transferred to OF QC, DGAQA under takes Quality Audit and Surveillance.

(c) QA at Final Stage: The responsibility of the final Inspection and acceptance of the stores has always remained with the DGAQA since beginning. During the Final Inspection, The OF QC submits the final product to DGAQA along with Quality Conformance Certificate (QCC), certifying that the submitted product is as per the Technical and contractual requirements. All the test reports, QC documents right from Raw Material stage, NDT Test reports, Sub Assy/Assy details with QC endorsement are submitted to DGAQA for document verification. After Document audit by DGAQA, the sampling inspection, such as visual, proper assy checks, Testing (if required) is carried out as per the mutually agreed QAP and ATP documents. On Satisfactory results, the Inspection Note is issued by DGAQA.

Though the TOIR implementation has been able to transform the Functioning of the OFB to some extent and creating awareness and sense of accountability towards the quality requirements of the Air Armament products manufactured by the Ordnance factories. However, in order to sustain in the competitive ever changing dynamic environment for Military aviation stores, it is mandatory that OFB needs to up-grade its QMS and QA Methodology to align it to the International Practices.

Proposed QA Methodology- Road Ahead - Post OFB Corporatisation

Since, 41 Ordnance Factories have been corporatized in to seven 100% Govt Owned corporate entities; the role of DGAQA would also be transformed in order to align to the new structure.

The following QA methodology at New Corporate Entities is suggested to bring a paradigm shift in the future role of DGAQA from Inspection based approach to QA/Regulatory based approach through DGAQA AFQMS Model and giving more autonomy to the OFB (Now new corporate entities).

(i) Up gradation of QMS: New corporate entities should align its Quality Management System to

AS9100 international standard in line with other DPSUs viz. HAL, BEL, BDL DRDO Labs etc. Currently OFB is having ISO 9001 certification which is very generic in nature.

This will enable corporate entities (OFB) in meeting stringent quality requirement and hence supply better quality product to meet higher customer satisfaction as also enable export of armament stores.

(ii) Transformation from TOIR to AFQMS concept: As part of a continual reforms, the new corporate entities should transform its existing QA methodology from TOIR to DGAQA-AFQMS model as being done at other DPSUs, DRDO Labs, Oil Refineries etc.

This will enable Ordnance factories QC Organisation more autonomy through approval of personnel and enhanced delegation.

The QMS system will be audited and approved by DGAQA.

(iii) Transformation of Ordnance Factory to 4.0 Industry concept through the intelligent networking of machines and automation of processes.

This will enhance efficiency & Productivity

DGAQA will play advisory/Hand holding role.

(iv) Issue of QAP: Each manufacturing units of Corporate should prepare Quality Assurance Plan (QAP) in consultation with respective DGAQA FE's for the product range and level of involvement of QC and QA.

DGAQA organizations shall perform regulatory function through audit / surveillance mode and limited involvement at critical stages & Final acceptance of products.

The QAP will be reviewed and approved annually for the production year by DGAQA based on the maturity level of QC organization.

(v) Establishment of In-House Test Infrastructure: Each Factory under their Corporate heads should have requisite in house test facilities as per the governing documents / specifications viz. Proof Range, Static & Dynamic Test facilities, Standard rooms etc on the similar lines as existent with other DPSUs.

The test infrastructure available with DGAQA shall be utilized for confirmatory test / third party verification / Pvt vendors inspection clearance etc.

(vi) Self Certification Policy: As regards to Green Channel Policy of MoD, for issue of self certification, it is brought out that the airborne stores do not come under its purview. Since, these stores have flight safety implications. However, under DGAQA-AFQMS, enhanced delegation towards self certification is granted to the firms based on their maturity level and already provisioned for certain category of stores viz. ATF at Oil Refineries.

(vii) Design Office Approval for Certification: Airworthiness Certification process of Military Aviation/Air Armament Stores is governed by MoD document-DDPMAS-2021. OFB should develop & strengthen their design deptt and seek CEMILAC Certification/Approval of their designer in different areas of production viz. structure, Hardware, system etc.

Conclusion:

The majority of Airborne Armament stores produced by Ordnance Factories are Flight Safety and Mission Critical. The Flight Safety consideration envisages that stringent Quality Norms/requirements for Military aviation stores are in line with the Internationally Accepted standards/Practice. Any Leniency/compromise in the Quality of these products has an catastrophic flight and safety implications.

In the current shift resulting in Corporatisation of OFB into seven corporate entities, it would be prudent that the tried and tested model of DGAQA Regulatory Function i.e, AFQMS and AS9100 be implemented in the newly formed corporate entities. The same will not only result in uniform QA regulatory approach throughout all the DPSUs but will also provide more autonomy to the OFs in their day to day functioning. The DGAQA through AFQMS Model will progressively ensure enhanced delegation to these corporate entities over a period and involvement of DGAQA agency will be 10-20% that too only at critical stages.

About the Author:-

Shri Sanjay Gaur, Dy. Dir (Armt.) is posted at HQrs, New Delhi and joined DAQAS Service in Aug 2009.

Changing Requirements of Inspection Specification and Documentation for Defence and Aerospace Systems Under Self-Reliance Drive

Shri Biswajit Choudhury
SSO-I, ALISDA Bengaluru

The self-reliance drive in defence sector is fast spreading across the country. The DPSU (Defence Public Sector Undertakings) have started outsourcing parts and components to Micro Small and Medium Enterprises (MSMEs). Big conglomerates have started entering the defence manufacturing market by bagging contracts on aircraft, helicopter and missile systems and the trend is definitely going to create huge competiveness among the industries and strong business culture in the country resulting in bothquantity and quality.

The changing environment and growing response from all stakeholders is the indication that self-reliance drive is destined to transform the defence manufacturing ecosystem in the country. But, it will depend on the following key factors:

- Long term commitment from the government
- Spear-headed innovation and manufacturing technologies from the industries
- Skilled human resource from academia
- Effective quality management system under supervision of regulatory agencies
- High level of nation building team spirit and
- Sound global supply chain management with effective collaborations.

Since military aviation systems around the world are shifting towards automation and digital controls, the use of embedded software and data transfer has become common feature. Similarly, the status monitoring methodologies for critical weapon and warfare equipment are also changing rapidly due to change in data transmission techniques. As a result, the reliability measures are demanding new ways of dealing with Quality and Reliability needs. Quality assurance methodologies with new inspection specifications, Quality Management System (QMS) criteria and documentation techniques are equally evolving in order to deal with the changing needs.

Inspection specification is the specification that defines the criteria on the basis of which the inspection is to be performed. It is about identifying and capturing the attributes related to parameters, functions, process, product properties, test method, test profile etc. including verification of limits, tolerances and target values. All these attributes form important quality characteristics as a set of specifications to enable logical progress during any design and manufacturing activities. These are the mandatory requirements of a product to substantiate for conformance to Drawings, Bill of Materials (BoM) and other manufacturing processes to ensure that the product meets functional, environmental and safety criteria. Creating inspection specification means identifying the attributes and capture them in Quality Assurance Plan (QAP) so that all the stages of assembly, testing and verification right from raw material to final acceptance are strictly followed. The procedure required to carry out activities for verification of inspection specification during development phase is known as Qualification Test Procedure (QTP) and during production phase for delivery of the product to the User is known as Acceptance Test Procedure (ATP). If the quality issues are not addressed by creating, verifying and documenting the relevant Inspection specification appropriately, minor issues in the beginning can lead to larger issues in later stages. Therefore, it necessitates formation of structured Inspection Matrix and detailed Test Procedures supported with effective non-conformity management system.

In the changing scenario where MSMEs are participating in manufacturing of parts and sub-assemblies for a variety of defence systems, preparation of Quality Assurance Plan for each item becomes mandatory and the need for categorising the items as Indigenous, Bought–Out, Commercially of The Shelf (COTS), Military of The Self (MOTS) etc becomes mandatory as part of inspection specifications. Approved BoM and all types of drawing like GA ((General Assembly) Drawings, Mechanical

Drawings, Electrical/Electronics/PCB Drawings, Internal Wiring Drawing, Bare Rack Drawing and Cable Routing Drawing needs to be reflected in QAP as part of strategic QA approach even for all systems and sub-systems including embedded stores. The need to verify details of Application Software, Firmware, Testing Software and Operating System Software should also be spelt out clearly as part of inspection specification.

Separate process flow diagram for each sub-system and system in respect of mechanical, electrical and electronic items needs to be included in QAP so that the inspection matrix for Quality Control, Quality Assurance, Project, Vendor etc can be identified distinctively by use of codes such as I for Inspect, P – Perform, R – Review, V – Verification, W – Witness etc.

A separate Clause / Para stating the conditions for Batch Qualification Testing (BQT), Delta QT (DQT), Incremental QT(IQT) and other test requirements needs to be included in QAP to specify the condition in case of following circumstances:

- First Production model of each vendor
- Major change in the design of assembly / sub assembly / sub systems/system.
- Process change in manufacturing of the assembly/subassembly/ sub systems/system.
- Change of vendor / locality / facility
- When there is break in the manufacturing of by the vendor for more than one year etc.

The QTP and ATP must specify Test setup, Test Severities, Test Procedure, Test Results and Acceptable Limits for each item. A separate Para containing the performance test procedure should be added to specify PREET, INSET and POET as explained below:

Pre Environmental Test (PREET)- PREET are common for all the environmental tests and are conducted before the specified environmental test.

In-Situ Environmental Test (INSET)- INSET is conducted during the Environmental Test as applicable. This test may differ from PREET / POET and in some cases may not exist.

Post Environmental Test (POET) - POET are common for all the environmental tests and are conducted after recovery of UUT from Environmental Test. If POET has been carried out after a particular Environmental Test, same may be treated as PREET for the subsequent Environmental Test if it has to be continued.

For effective inspection specifications, the following points need also to be included in QAP, QTP and ATP as mentioned:

- List of test equipment, test cables, test jigs, testing software and accessories along with their make, model and quantity to be used during the conduct of various Environmental and Non – Environmental tests in relevant QTP and ATP.
- Record of calibration details for the test equipment being used should be made mandatory as part of test procedures (QTP & ATP).
- The sequence of the tests that need to be followed during the entire test activities of the Unit Under Test (UUT) should also be depicted in the form of flow chart to avoid ambiguities (QTP & ATP).
- Special safety and security requirements need to be mentioned in QAP of the UUT for adherence by all agencies.
- The steps and formats to be followed for Failure Reporting and Corrective Action System (FRACAS) should be spelt out clearly during approval of QAPs.
- Standard rejection management procedure should be included in QAPs for all Sub-systems and Systems.

World class quality under the on-going self-reliance drive in defence sector is need of the time. Self-reliance drive will surely emerge as a historic event by writing the success story of the nation if world class quality is achieved in our products and services. Such strategic quality assurance approach will definitely bring a new era in domestic defence manufacturing as well as export activities.

About the Author:

Shri Biswajit Choudhury, SSO-I is posted at ALISDA, Bengaluru and joined DAQAS Service in July 2009.

Appointments, Promotions and Superannuations during Oct–Dec 2021

Shri Aneesh Babu P

Shri Aneesh Babu P took over the charge of Regional Director ORDAQA, Bengaluru on 01 Oct 2021. He joined DGAQA in DAQAS Cadre in Jan 2001.

Shri K Premanand

Shri K Premanand took over the charge of Regional Director ORDAQA, Kirkee on 01 Oct 2021. He joined DGAQA Service in Dec 1996.

Shri Rajesh Yadav

Shri Rajesh Yadav took over the charge of Director Tech-Coord & CS HQrs New Delhi on 01 Nov 2021. He joined DGAQA in DAQAS Cadre in Mar 2001.

Shri G K Chaudhary

Shri G K Chaudhary took over the charge of Director(Admin) HQrs New Delhi on 13 Dec 2021.

Shri Bane Singh

Shri Bane Singh Regional Director ORDAQA, Korwa superannuated on 31 Oct 2021. He joined DGAQA in DAQAS Cadre in Apr 1999.

Smt Seema Suri

Smt Seema Suri Regional Director ALISDA, Bengaluru retired from service on 30 Nov 2021. She joined DGAQA Service in Jan 1988.

Shri A G Abhyankar

Shri A G Abhyankar Director OADG, Nasik superannuated on 31 Dec 2021. He joined DGAQA in DAQAS Cadre in Aug 1993.

SUPERANNUATIONS:

Sl. No.	Name of the Officer	Designation and FE/ Unit	Retired on
1	Shri Debasish Dutta	SSO-I, Dett. AQAW(A), Dumdum	31 Dec 21
2	Shri S Seshagiri Rao	SSO-II, ALISDA, Bengaluru	31 Dec 21

New Joinings/ Appointments:

Name of Officer	Designation	Date of Joining	FE / Unit
Shri Rakesh Kumar	ASO	01 Dec 2021	Admin I HQrs New Delhi
Smt Kumari Rashmi	SSA	22 Oct 2021	Accounts Section HQrs New Delhi

वै. गु. आ. मनि. में आजादी का अमृत महोत्सव

Lecture on FOD Management : Prevention and Control as per International Guidelines at HQrs, New Delhi.

Lecture on Presentation Skill & Personality Development at HQrs, New Delhi.

Lecture on DGAQA SOP for Assessment and Registration of Firms & Approval of Test Labs to Firm Representative at ALISDA, Bengaluru.

Debate on having Common Entrance Tests for Admissions across Indian Universities at OADG, Koraput.

Oath Taking on the occasion of National Unity Day at ORDAQA(Overhaul), Bengaluru.

Run for Unity on the occasion of National Unity Day at ORDAQA(Engine), Bengaluru.

Photo Gallery of DGAQA

माननीय सचिव रक्षा उत्पादन श्री राज कुमार द्वारा वै. गु. आ. मनि. की वार्षिक पत्रिका "वैमानिकी" का विमोचन

Felicitation to Shri Raj Kumar, Secretary (DP) by DGAQA on his Farewell.

Visit of CEO MiG Complex Nasik Sh D. Maiti, CEO(MC) to DGAQA.

Farewell of Dr Arvind Director(Admin) at DGAQA HQrs New Delhi.

Puja at DGAQA New Office, K.G. Marg New Delhi.

This magazine can be viewed on DGAQA website at https://www.dgaeroqa.gov.in/ under 'Media' menu.
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