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ROLE OF QUALITY ASSURANCE IN REVAMPING BASE OVERHAUL (BOH) QUALITY OF TANKS FOR INDIAN ARMY

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ABSTRACT
The Indian army had introduced several modern state of the art battle tanks for use during warfare. These tanks are due for Base Overhaul (BOH) after a period of fifteen years. Regular maintenance and overhaul activities are required for proper functioning of these heavy equipment. It was incumbent upon the ministry of defence to set up the Base Overhaul (BOH) facilities for equipment, soon after their induction, so that the facilities are available by the time the first overhaul is due. The workshopfor overhaul and maintenance of tanks at HVF, Avadi, Chennai was sanctioned by the Ministry. Subsequently after successful first overhaul of Tank T-72, Second overhaul of Tank T-72 is being progressed along with Pilot overhaul (POH) Tank T-90.

The aim of the project is to assess Supplier fragility assessment of HVF Supply chain. Supply chain beyond financial fragility and failure had to be reviewed by HVF. HVF should follow modern strategy and ensure that robust risk governance is in place. HVF was facing significant challenges to resolve the problem of non-conforming input material conundrum. HVF has been inundated with RFR issues due to input material & Manufacturing process flaws. Non-conforming stock piles in filtered into the production line and augmented various quality issues of production line.

Keywords:
Base Overhaul , Product Audit, Process Audit, Quality Audit, Inventory System Improvement

INTRODUCTION

Quality of input material has persistently remained the source of majority of quality and reliability issues and it requires sweeping institutionalized measures to address the problem. The problem can only be brought under control by meticulously following the QA standards, satisfactory application of all specified tests, which include type approval/validation. In-house Quality assurance of Overhaul tanks has been perennial problem due to varying workmanship skill sets and inconsistent supply of input materials from various sources.Acceptance tests and periodic tests, strengthening of contractual provisions to safeguard the interests of the end user, empowerment of procurement/acceptance teams through institutionalized QA activities.The factory was continuously upgraded with state of the art plant & machinery. With ToT for the tank T-72 having been absorbed in 1988, progressively production of T-72, followed by T-90 and their respective variants commenced in the subsequent years.Control Points at respective production stages have been designated based on the acceptance criteria for QA checks in the governing Ty specification and relevant ToT documents provided by the OEM. Control points/check points are reviewed periodically in consultation with HVF, based on inputs of deviations and non-conformities noticed during qualityaudit. Surveillance checks are carried out in various stages of production to ensure implementation of remedial measures taken by HVF to resolve non-conformities and adherence to process parameters.

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EFFECTIVENESS OF CONTROL AND SURVEILLANCE POINTS AND RELEVANCE OF EACH CONTROL AND SURVEILLANCEPOINTS

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Relevance of control points checks:-

- QA check at control point is an important activity of overall QA plan evolved for acceptance oftanks.
- QA checks at specified control points determine the overall quality built in to the product by the manufacturing agency and overall effectiveness of their in-house QC setup.
- It enables respective QA agencies to ensure necessary compliance from the production agency for the product manufactured to the governingspecifications.

TRACEABILITY, DISPOSAL AND ACCOUNTABILITY OF REJECTED STORES

Route-cards are maintained for each equipment along with serial no, details of supplier and year of manufacture of various assemblies/subassemblies. Details of serial no of items in each lot of Sale Order are not uploaded in NQDBMS for verification, during audit of documents at each stage of production process. Items found defective during fitment in the equipment are removed and replaced with another item. However, no records are maintained for disposal of the defective items. Records of nature of rectification carried out must be maintained in the Route-cards.HVF need to formalize SOP for disposal of non-conforming stores especially the ones beyond their stipulated shelf-life and declared unfit for use inproduction.

SHOP-FLOOR ACTIVITIES

Equipment should be manufactured / overhauled as per Process documents, by usage of trained manpower and competent QC staff. Areas that merit attention are :-

- Adherence to ToT Documents: Adherence to the process documents and usage of recommended Jigs/ Fixtures / Special Tools by trained manpower.
- Calibration: Periodical calibration of test cell equipment, jigs, fixtures, gauges and other measuring instruments.
- Test Cells: Validation report of Test cell by OEM (M/s ROE) is yet to be furnished by EFA. Periodic Maintenance, calibration and up gradation of test cells as per ToT Documents to accurately check and validate all performance parameters listed in the test schedule.
- Process Control: Processes at various stages of manufacture/overhaul must be, as per specified process documents. Deviations in the processes results in RFRs and affect reliability of equipment.
- Liquidation of NCs: Observations/non-conformities noticed during process audit must be resolved in a time bound manner to avoid deviation in processes in shop floor.
- Traceability: Items found defective during production process/testing, should be segregated and the cause for defect must be ascertained. Proper record should be maintained for disposal of such items and repair, if any carried out, must be recorded for audit.
- QA/QC by EFA: QA/QC staff of EFA should carryout effective checks of input material and also during various stages of production, for checking conformance to the specifications and processes. Effectiveness and competence of the staff would reduce RFRs and reliability of the equipment.
- Build-up Card & Inspection Records: Build-up Card and inspection records must be maintained and updated immediately after QC checks by EFA. Checks/Cross checks by QC staff of EFA must be done effectively as per technical documents and recorded. This would reduce RFRs during QA checks.
- Network Quality Database Management System (NQDBMS): Build-up Cards must be maintained and

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inspection records prepared immediately after QC checks by EFA. To begin with, Build-up card for each engine manufactured/overhauled and data of critical assemblies including test records must be uploaded in NQDBMS, to monitor whether the process is within control limits.

METHODOLOGY

The details of various steps involved in supplier quality assurance are:

- Define the product's qualityrequirements
- Choose the most reliable suppliers that fit the production needs
- Identify and evaluate available suppliers for the necessaryparts
- Conduct joint qualityplanning
- Establish cooperation and collaboration during relationshipperiod
- Validate compliance to requirements andregulations
- Certify qualifiedsuppliers
- Conduct quality improvementplans
- Develop and implement supplier ratings-scorecards

The details of various steps involved in supplier quality assurance are:

- Conduct of shop floor QLM's to arrest workmanship issues at assembly stage.
- Periodical interaction in shop-floor for addressing quality issues in production
- Formation of failure review board for subsystems and CAPA to be implemented
- Process audit and Product Audit to be carried out as per Structured Programme. Non-conformities observed during the audit were communicated to shop floor for remedial measures. In addition, need based audit was also carried out based on high frequency defects.
- Suggestion of remedial methods

RESULT AND DISCUSSION

The following are the high frequency defects during the production year. The following defects were analysed using Quality Control tools and based on the criticality of itemssurveillance audit is carried out to check conformance.

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Table 1: High Frequency Defects during the productionyear

Nature of Defect / Item / Assy	**Action taken after initiatives**
Engine failure	Oil leak was observed from bottom of the UCC and cylinder Block DI team was formed and it was observed the cause of failure is due to improper Gasket used in Assy of Engine of Installation of LH and RH cylinder Block.
Gear box (LHS &RHS) failure	Pulling of Tank in one side while Dynamic Test.Joint DI team has been formed and the team is under investigation for the root cause. However, the preliminary investigation revealed that the chemical composition of Packing Ring, Circlip used in Gear Box found variation with respect to specificationrequirements.Further,theHardnessofBallsusedin Bearings have found less than the requirements.
IGB failure	Oil leak from the Driven Gear, Starter Generator mode not working, Oil leak noticed from Oil seal mounted for Fandrive.
RPM Gauge/ Tachometer fluctuation	Excess flickering of needle than the specified limit.
DMs (LHS & RHS) failure	Booster Pressure not developed during static test. Joint DI was formed .Cause of failure was identified by the team and CAPA implemented.
Coolant temperature sending unit	Erratic readingJoint DI was formed .Cause of failure was identified by the team and CAPA implemented by firm.
Engine Oil temperature sending unit	Erratic reading.Joint DI was formed .Cause of failure was identified by the team and CAPA implemented by firm.
Sediment release valve	Leak & malfunction. Joint DI was formed .Cause of failure was identified by the team and CAPA implemented.
Engine hour meter	Needle struck up noticed during Static/ Dynamic test Joint DI was formed .Cause of failure was identified by the team and CAPA implemented by firm.

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Top rollers	During running trial, rim was noticed crack.Firm has made the item's rim casting process in place of forging. Allthe lot has been rejected and quarantined.
Driver HPCS water tank	Mounting stud of tank was found broken. Firm has fitted with hollow type stud instead of solid type and also mounting of stud in the tank not as per drawing.

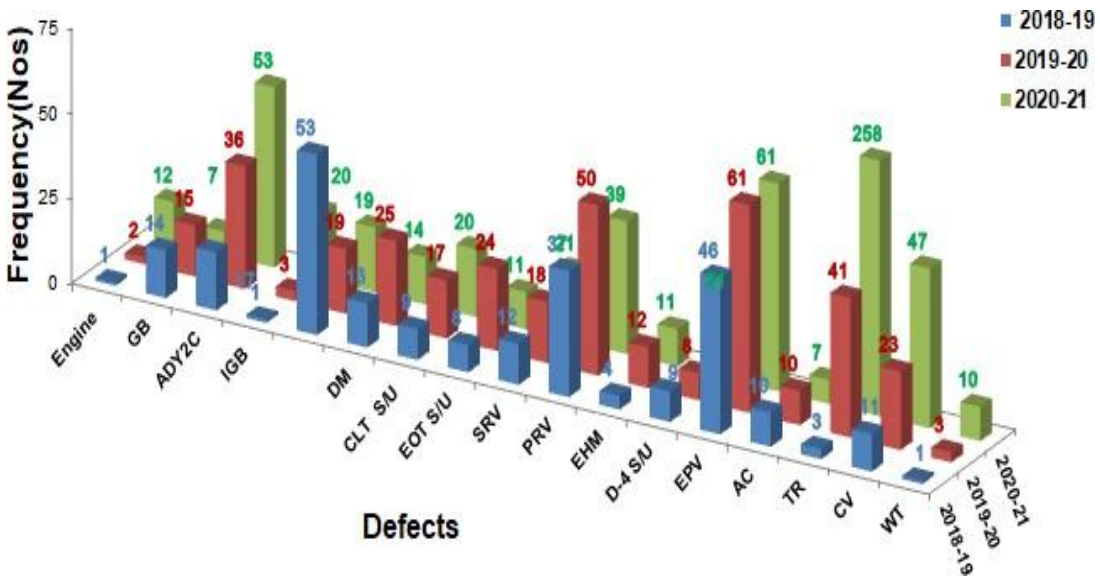

Fig. 1: Summary of High Frequency Defects

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Table 2: Pareto Chart Table

S. No	Name of Defect	Rejections	Cumulative Rejection	Cumulative Rejection %
1	Running Gear Sub Sys	65	65	12.33%
2	Engine Sub Sys	63	128	24.29%
3	Gear box Sub Sys	60	188	35.67%
4	ADY-2C	53	241	45.73%
5	Sediment Release Valve	43	284	53.89%
6	Distributor Mechanism	40	324	61.48%
7	Pressure Reducer Valve	36	360	68.31%
8	Rubber seal	35	395	74.95%
9	RPM Gauge	35	430	81.59%
10	Fan Friction Clutch	25	455	86.34%
11	Engine Hour Meter	22	477	90.51%
12	Cooling System	20	497	94.31%
13	Hydro Pneumatic Cleaning Sys	15	512	97.15%
14	Air Cleaner	15	527	100.00%

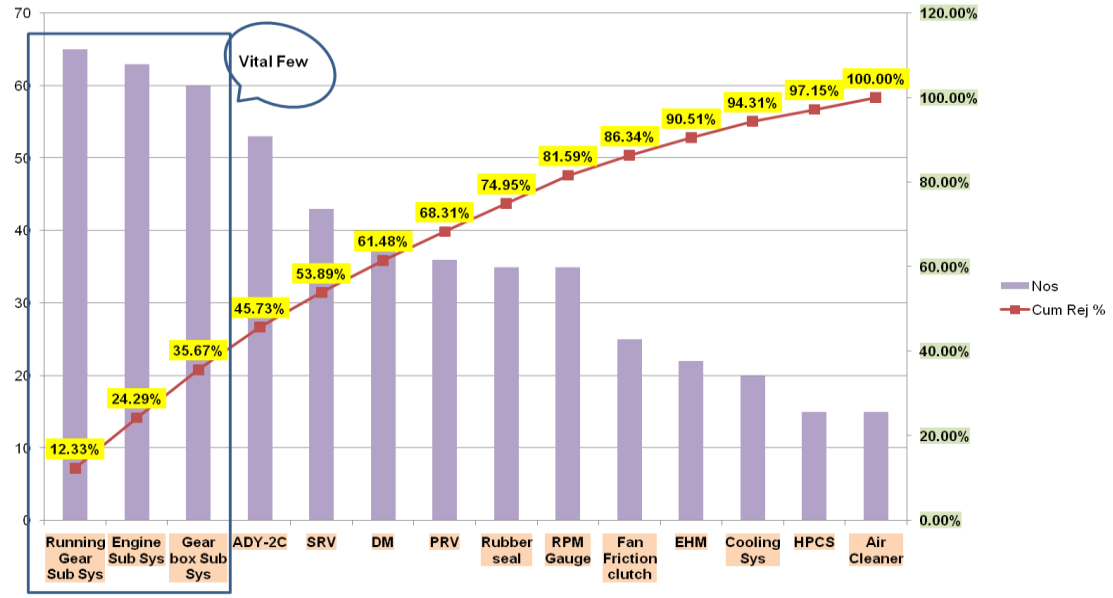

Fig. 2: Pareto Chart of High Frequency Defects

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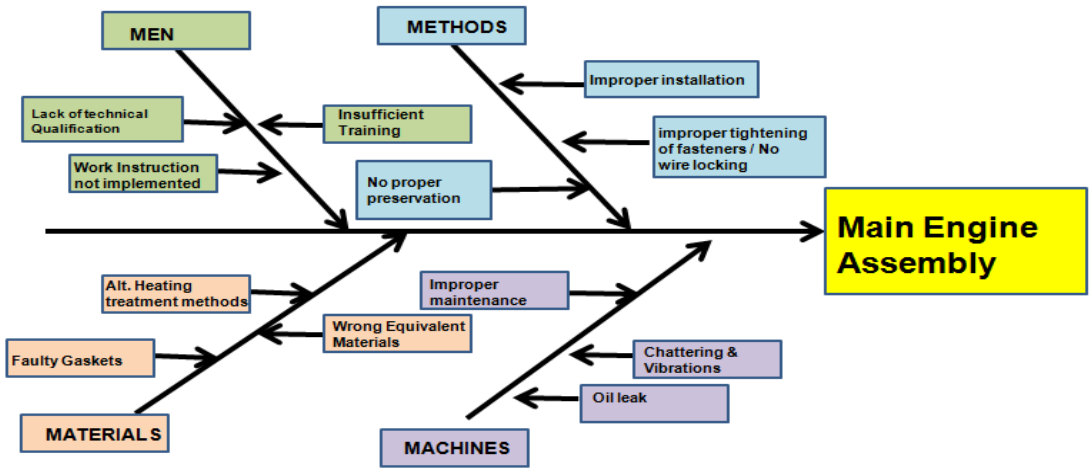

Fig. 3: Cause and Effect diagram for Main Engine Assembly

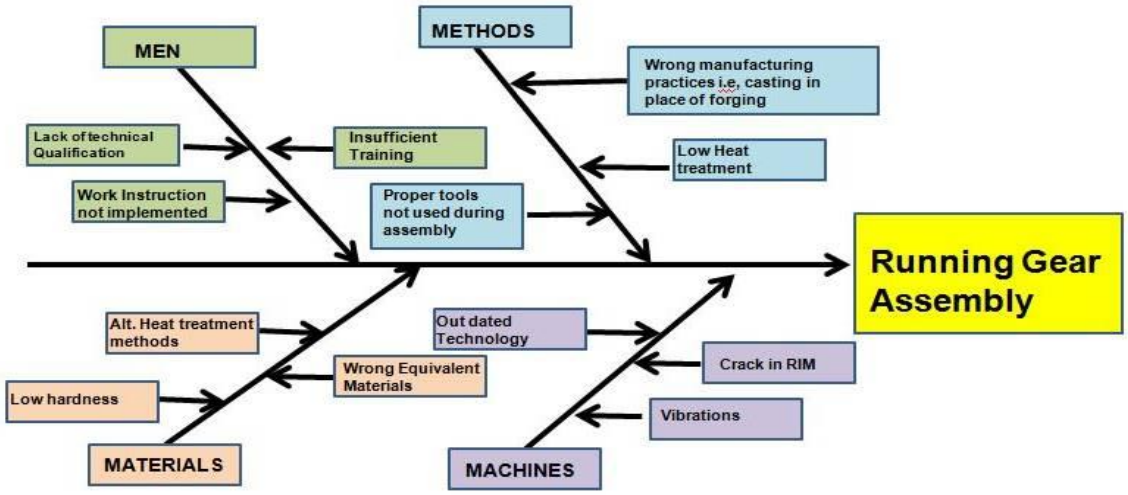

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Fig. 4: Cause and Effect diagram for Running Gear Assembly

CONCLUSION

It is evident from the above that the use of various Quality tools like Pareto chart, Cause and effect diagram had led to significant number of defects occurring in the various assemblies of the vehicle which in turn had improved productivity and it has also enhanced the customer satisfaction. Study was conducted to implement quality control tools and techniques at Heavy Vehicle Factory, Avadi. The newly manufactured products are now considerably defect free.

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