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**901. Quality - Definition**

Quality is one of the main core strategies of a world class organization and an integral element of their structure and culture. Depending upon the context, quality has different connotations and is understood as non-inferiority or superiority of something in business, engineering and manufacturing. It is a perpetual, conditional and subjective attribute.

ISO-9000 defines Quality as a Degree to which a set of inherent characteristics fulfils the requirement. Definition of quality as given by some management experts is as below:

- Philip B. Crossby - Conformance to requirements
- Joseph M. Juran - Fitness for use
- Genichi Taguchi - (a) uniformity around a Target Value (b) The loss product imposes on society after it is shipped
- Peter F Drucker - Quality in a product or service is not what the Supplier puts in but what the customer gets out and is willing to pay for.

Edward Demming the Quality Guru states - Cost goes down and productivity goes up as improvement in Quality is accomplished by better management of Design, Engineering, Testing and by improvement of Process. In the manufacturing industry - Quality drives productivity.

**902. Quality & Process**

Quality of a product is directly linked to process. ISO - 9000 system lays down the general requirement for establishing processes which institutionalise Quality Management and expects an organization to establish, document, implement and maintain a Quality Management System and continually improve its effectiveness.

This is sought to be attained by:

- a. Identification of the processes needed for Quality Management
- b. Determine the sequence and interaction of these processes
- c. Determine the criteria and methods to control the operation of the processes
- d. Ensure availability of information and resources necessary to support
- e. Monitor, Measure and Analyze the process
- f. Implement Actions necessary

Some of the best plants in the world recognize seven values that should serve as a basis of operations to attain Quality:

- a. Quality is the responsibility of every employee and team
- b. Quality improvements result from management leadership
- c. Quality should be viewed from the customer's perspective
- d. The focus of quality improvement must be on each job, at each step in the process
- e. No level of defect is acceptable
- f. There must be commitment to continuous improvement and the seven steps process to continuous improvement
- g. Quality improvement reduces costs.

**903. Quality Management Techniques:**

Some of the techniques / strategies that can be made part of process / process control are:

- a. Statistical Process Control (SPC) by Periodic measurements of attributes /variables and documentation at different stages of manufacture.
b. Total Quality Management (TQM) - by Integrating all sub-systems with focus on Quality.
c. Quality systems like ISO - 9000 to attain consistency and predictability.
d. Total Productive Maintenance (TPM) to ensure reliability of Tools & Equipment used and systems.

CWMs/Divisional In charge for maintenance of Rolling Stocks shall make a time bound plan and introduce selected few/all of the above practices.

As a part of compliance of statutory provisions relating to protection of environment, the practice of obtaining accreditation for an Integrated Management System (IMS), which addresses the ISO 9000 for quality, ISO 14000 for environment and ISO 18001 for Occupational Health and Safety (OHSAS) has come into practice particularly for production units, and workshops.

904. Quality Standards

For every job/Purchase a specification number /drawing number/BIS Etc standards are prescribed- defining the quality standard to be met for the individual Job. For a process as a whole acceptance level standards/percent defective standards must be fixed by IR. Likewise QAP and overall defects standard shall be laid down for each job, starting initially with 3 Sigma level. This should be part of process charts.

The drawings and Specifications for critical items, besides providing dimensional tolerances, should indicate —LOT Acceptance Levels —based on Total defective percentages. This must be undertaken by the design offices of the manufacturing units.

905. Origins of Defects

a. Defective Design
b. Quality of inputs
c. Defective workmanship
e. Management’s-commitment to quality.
f. In process audit
g. Inspection & quality of output

Quality of output gets controlled automatically, once the above factors are controlled and there may not be any need for finished product Inspection - which in any case is like a post mortem.

906. Defective design

Quality has to be built in at the stage of design of the product. Design cannot be a standalone effort - but needs integration with manufacture and even a customer interface (customer can be next stage user) Techniques below are adaptable:

a. Design for manufacture and Assembly (DFMA)
b. Concurrent Engineering
c. Quality Function Deployment (QFD)

Design - Manufacturer - User interface should be in place in all the PUs / Workshops.
907. Quality of Inputs

This is one of the major sources of Defects in a manufactured / assembled product. ISO-9000 system has laid down elaborate procedure for input control. Accordingly, it has been laid down in the vendor approval system under “Rules for entering into supply contract” that:

a. All suppliers should have certified Quality System - the rest should be weeded out.
b. Suppliers who are manufacturers should have an in house QAP system
c. They should maintain and produce on demand Quality documentation to the buyer.

The following additional measures should be taken to improve the quality of material inputs.

a. Traceability of important components to the supplier should be ensured by making suitable provision in drawings to stamp at a location on the component the manufacturers name, batch number and date of manufacture where the marking shall not get obliterated by wear and tear or failure.
b. Vendor approval and enlistment system should be transparent, well documented and standardized by respective vendor approval agencies of Railways.
c. For procurement of important items with restriction on vendors, following steps should be adopted.
   - Evolving product specification and Quality Assurance Plan for all important items for which RDSO is the nodal agency.
   - In order that there is unitary control between vendor enlistment, PUs as nominated by Railway Board, should be the nodal centers for vendor approval for important coaching and loco items – based on RDSO formulated Quality Assurance Plan and check lists, restricting the vendor approval by RDSO, only to important wagon Items alone.
   - RDSO should bring out inspection protocol and check lists for all important items for use by the inspection agencies. Third party inspections of products can be executed on the basis of RDSO check lists.

  d. Continuous vendor evaluation especially with reference to quality has to be evolved.
  e. Regular vendor review.

f. For selected PU/RDSO restricted items periodic Quality Audit at Vendors’ premises should be mandatory and may be outsourced as indicated in rule for entering to supply control.

908. Defective Workmanship ~

a. This can occur due to lack of Skill / Training. Skilled artisans need regular training & evaluation.
b. Certification of worker training and evaluation should be done as a part of training.
c. Enforcement of adherence to work instructions by Supervisors.
d. Periodic calibration of machines/ gauges / toolings to be mandated and documented.
e. Calibration documentation to be updated
f. Proper system for maintenance of M&Ps must be set including techniques like TPM—to ensure equipment reliability

909. Process Defects

This is the essence of Quality. Even with everything else being proper, process unreliability would ruin Quality. Process control measures – statistical / non-
statistical is essential for quality adherence. Processes need a review and recast keeping Quality as focus and process reliability has to be ensured through regular validation. The process should target quality standards like Six Sigma / Zero Defects.

The in-charges of PUS/Workshops/LCDS should enlist support of process evaluation and certifying agencies to revamp the process, train Managers and Supervisors in process control and process reliability.

While procuring Machinery & Plant- the accuracy, tolerance levels and reliability expected has to be factored in the specification formulation instead of merely looking at Quantitative output of machines.

910. Management Commitment to Quality

Quality is a culture, a philosophy, a belief, which is achieved though a structured system commitment, which has to start from Top.

ISO quality systems make it clear that a pre requisite is management commitment. This has to be demonstrated by calling for periodic reports on Quality and demonstrating Zero Tolerance to Qualitative Deficiencies.

Periodic Quality workshops have to be held and the Management should lead the quality drive. CMG,DMG and WMG meetings should do detailed Quality Analysis - shop wise.

911. In process audit

In any Quality System - ultimately the aim is self-inspection. This needs total involvement of the Supervisors in the entire process - starting from the design, to final output. In process audit has to be the function of the Supervisor and should include functions like ensuring proper up-keep of machines and tools, gauges, quality records, attendance of staff at work spot, housekeeping, availability of tooling's, ensuring usage of proper tooling's, jigs & fixtures by works and adherence to correct work practice and work instructions.

The supervisor should not allow work to proceed to the next stage - without ensuring adherence to Quality at each stage. Record keeping and accountability at each stage of the process is also to be ensured, to trace back any quality issue at a later stage.

912 Inspection & Quality of output

Output quality can be assessed by an inspection plan - while it can be enforced only through an In-process Quality Assurance Plan. Quality of the output is just a validation of the process reliability.

Output inspection has to be generally non-destructive and normally follows a sampling plan. The selected samples need to be subjected to

a. Metallurgical / Chemical checks
b. Physical checks

Usage of properly calibrated testing equipment is essential. The efficiency depends on the skill and commitment of the Inspectors who should act without bias or fear. It is advisable to have a documented inspection chart like the one at Annexure - 10.1

All elements that need to be tested as per specification / drawings / inspection standards should be tested and documented and the results communicated to process and control section to take remedial measures.
913 Inspection and Measurement of Quality

As explained, Quality Documentation is essential for taking remedial measures. Quality control methods are available and are widely followed in the Industry. The test results are to be statistically analyzed to ‘Zero in’ on the point of araisal of the defect.

This tracing back process is the essence of quality systems and is mandated by ISO systems, which depends on the feedback loop.

Advance systems like Six Sigma have laid down elaborate Documentation and Control Systems. These are normally done by certified Agencies and the Unit in charges should enlist the support of these Agencies, wherever required.

The customer is the final Arbitrator of the quality. The system should provide regular feedback from users and the user should get a feedback on follow up action.

914 Inspection by 3rd Party

This becomes essential when

a. The shops supply to a non railway customer
b. In-house facilities are inadequate

Dispensing with an inspection system requires the organization to have a high level of self-esteem with regard to Quality - which should be the ultimate aim. A Zero defect Quality system with periodic Audit will take an organization towards this. Until this is achieved, it is necessary to have at least a Quality Audit and Periodic Inspection through 3rd Parties for shop manufactured products.

915 Certification of Laboratories

ISO-9000 does not cover reliability of a Testing Laboratory. Reputed Laboratories go in for Accredition with Agencies like NABL. All testing facilities & laboratories of CMT in PUs/workshops/major LCDs should immediately get this accreditation.

An accreditation would bring out the inadequacies of the Laboratory and make its Test results acceptable to even outside Agencies. This enhances the Quality and Reliability of the Laboratory results, which is key to ensure even internal Quality.

916 Quality enforcement of outsourced work

Work can be outsourced for execution outside the factory as well as inside the factory - but with contractor's Labor and Material. Quality gets impacted on the under mentioned counts:

a. Raw materials used not conforming to Quality
b. Consumables like electrodes, lubricants, chemicals, paints and protective coatings not conforming to Quality
c. Small components used in execution of the work not conforming to Quality
d. Work process deviations resulting in bad quality
e. Lack of QAP
f. Usage of workers not fully Qualified in the Trade
g. Lack of Proper Supervision

All contracts for outsourcing - besides involving a process of vendor pre-qualification should clearly mention in the contract all the above aspects to ensure adherence of the work to set Quality norms.

917 Product Inspection

Inspection should not be at the stage of finished product - as any rejection at this stage is wasteful and adds to costs.

As laid down at para 911 stage/in process inspection is cost effective as a defective component / work does not proceed to the next stage.
All components / works over a threshold value should be subjected to in process inspection and only inexpensive items / work should be confined to only final product inspection.

Inspection can be by the Railway Organization’s Inspectors or by accredited and reputed 3rd Parties. (See para 914)

918 Inspection Vs Process Control

Process control (see Annexure 9.3) is the ultimate solution in Quality enforcement. Once the entire process starting from ordering inputs to work process through to final assembly is controlled through scientific methods, product inspection will become redundant and will be substituted by periodic system Quality and conformance Audit by in-house agencies as well as 3rd Parties.

This will bring up Quality Conformance to the highest level like Six-Sigma or even Zero Defects.

919 Quality enforcement through warranty obligation

In all commercial transactions involving equipment purchase/repair, warranty is specified by the supplier. This is to validate performance reliability of the Task executed during new manufacture or repairs.

920 Accountability for Defects

A system of accountability on the part of production unit/Workshop for the rolling stock produced/ overhauled/ repaired for a specific period after turning out the rolling stock should be in place. Defects noted by Zonal Railways within such warranty periods should be reported to the Workshop / PU - who turned out the stock giving details of:

a. Rolling stock identification number
b. Date of out-turn from shops, which has to be stenciled on the stock
c. In the case of a major component (non-consumable)- Batch Number, Date of Manufacture, name of manufacture.
d. Type of Defects

To facilitate the above, drawings of all major components will demand specifying:

a. Name of Manufacturer
b. Lot / Batch number
c. Date of Manufacture

These data should be incorporated in the inspection certificates. The drawings should also specify tests mandated for critical items - including in process inspection schedule

Production Units/Workshops will take necessary corrective and preventive actions based on the complaints received from the open line.

In case of material failure of items supplied by vendors, the stores department should be advised, in order to raise the warranty claim on the firm through the MMIS.

Failure of rolling stock within a specified period of manufacture, rebuild and POH shall be closely monitored by Railways & Production Units and shall form part of discussions in all co-ordination/ maintenance group meetings.
Quality assurance in shops and maintenance depots

**Factor**

**Expected Results**

**Action Needed**

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<th>Expected Results</th>
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<td>Design</td>
<td>Performance, features, Reliability, Durability, Serviceability, Aesthetics.</td>
<td>DFMA, QFD, Concurrent Engg</td>
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<td>Input Material</td>
<td>Conformance to Requirement, On time Delivery, Zero Rejections</td>
<td>Vendor Selection Process/ evaluation, Weightage for Quality, QAP of Vendor, Vendor</td>
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<tr>
<td>Worker reliability</td>
<td>Desired Quality, Worker Skill &amp; Commitment to Quality, Worker Skill up gradation</td>
<td>Supply Process validation/ Grading Training, skill appraisal, competence certified worker, Motivation.</td>
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<td>Inspection</td>
<td>Reliability of Inspection, Effectiveness of Inspection, Inspection as a deterrent to slack working</td>
<td>Scientific sampling plans, Detailed in process inspection, Stoppage of work when defect found, Zero defect tolerance</td>
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<td>Supervisor Effectiveness</td>
<td>Attainment of supervisor roles, Quality commitment of supervisors.</td>
<td>Duty definition of supervisors, Supervisor motivation, Training of supervisor</td>
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<tr>
<td>Process reliability</td>
<td>Ensure consistency in output quality, Maintain Targeted tolerance Levels, Optimize resource utilization</td>
<td>Statistical quality control methods for variables &amp; Attribute, feedback loop, TPM. Zero process deviation, Strict enforcement of Work instructions</td>
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<td>Zero tolerance to defects by management. Management focus on Quality</td>
<td>Quality commitment Top Down, Ensure adherence to level stated in quality policy, Attain excellence in Quality.</td>
<td>Motivate Management commitment to quality Shift focus from Quantity to Quality</td>
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