Maintenance of Passenger Coaches

- Safety, Hygiene and Passenger Amenities

By

Saurabh Prasad
Dy.Chief Mech. Engr., Indian Railways

Railway Staff College, Vadodara
15.2.2008
My Background

- Passenger rail coach maintenance and operations
- Alumnus of
  - Massachusetts Institute of Technology, USA
  - Indian Railways Institute of Mech.& Elect. Engineering, Jamalpur
- Interests: Supply Chain Management, Quality Systems
- I spend time by Reading and Playing with my two Labradors
- Travel: USA, Spain, Thailand, Singapore, New Zealand, France, Germany, Switzerland, Nepal, India
Agenda

- Coach Maintenance Basics
- Safety Issues
- On-board Services
- Quality Systems
- Supply Chain Management
- Assimilation and Up-gradation of Technology
IR offers a wide range of Passenger Services

- Luxury Trains
- Rajdhani / Shatabdi
- Mail-Express
- Garib Rath
- Suburban Trains
- Hill Railways
Coach Maintenance Basics
Coach Maintenance Basics

- The Principle of Ownership
- When to maintain?
- Other end attention
- Schedules
- Out of course Repair
- Facilities for maintenance
- What to monitor as a Maintenance Manager
Coach Maintenance Basics

The Principle of Ownership

- Monitor Health
- Accountability
- Regular Inputs

- BRAKE SYSTEM
- ROLLING GEAR
- BOGIE
- INTERIORS

- INTENSIVE CLEANING
- BRAKE SYSTEM CHECKS
- SUSPENSION SYSTEM
- AMENITY FITTINGS
- PEST CONTROL

- SAFETY
  - MEET TRAFFIC DEMAND
  - TIMELY SCHEDULES
  - SEND TO WORKSHOP
  - CONDEMN & PROCURE
Coach Maintenance Basics

- When to Maintain?
  - **FIXED INTERVAL BASIS**
  - **CONDITION BASIS**

  Fixed interval for primary maintenance – Distance Basis
  Fixed interval for periodical maintenance schedules – Time Basis
## Coach Maintenance Basics

### When to Maintain?

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Primary End</th>
<th>Other End at platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical Maintenance schedule</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Under-gear Examination &amp; Brake system maintenance</td>
<td>Yes</td>
<td>Not required if round trip distance &lt; 3500 kms.</td>
</tr>
<tr>
<td>External Cleaning</td>
<td>Yes</td>
<td>Not required if round trip distance &lt; 3500 kms.</td>
</tr>
<tr>
<td>Internal Cleaning &amp; Passenger Amenities</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Watering</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Brake Power Check prior to start</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Other end attention

- Terminating Examination
- Positive security arrangements
- High Pressure Cleaning of Toilets
- Washable Aprons
- Waste Management
- Watering Hydrants
- Brake Power Check prior to start
- Material Storage & Movement

Shatabdi Express being provided ‘other-end’ attention on the platform before commencing its return journey
## Coach Maintenance Basics

### Schedules for Passenger Carrying Coaches

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Periodicity</th>
<th>Where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 month</td>
<td>On-rake in primary maintenance depot</td>
</tr>
<tr>
<td>B</td>
<td>2 months</td>
<td>On-rake in primary maintenance depot</td>
</tr>
<tr>
<td>C or IOH</td>
<td>6 months</td>
<td>Intermediate Overhaul at associated IOH Shed</td>
</tr>
<tr>
<td>POH</td>
<td>12 months</td>
<td>Periodic Overhaul at nominated Workshop</td>
</tr>
<tr>
<td>MLR</td>
<td>12-15 years</td>
<td>Once in lifetime at CRWS, Bhopal and others</td>
</tr>
</tbody>
</table>
Coach Maintenance Basics

- Out of Course Repair
  - 2.2 per 100 coaches p.m.

- Non-Schedule Detachments

Source: 2006-07 Data - Mumbai Division, Central Railway
Coach Maintenance Basics

- Out of Course Repair

20.8 per 100 coaches p.m.

- On-Rake Attention during Maintenance

Source: 2006-07 Data - Mumbai Division, Central Railway
Coach Maintenance Basics

- Facilities for Maintenance

- 24 Coach length maintenance sidings
- Ergonomically designed pits
- 3m wide catwalks to move materials
- CFL Illumination for siding and pits
- High Pressure mechanized cleaning
- Watering & Drainage arrangements
- Adjacent Staff Rooms and Store
- Communication facilities
- Adjoining Shed for attending coaches

Photos: Wadibunder, Mumbai
 Coach Maintenance Basics

- Facilities for Maintenance
  - Coach Lifting facilities to run out bogies
  - Ergonomically designed pits
  - 25 T EOT Cranes, Forklifts
  - Welding Facilities
  - Inspection & Testing of sub-assemblies
  - Unit exchange of sub-assemblies
  - Wheel Changing, Turning and Profiling

Photo: Wadibunder, Mumbai
Coach Maintenance Basics

- **What to monitor as a Maintenance Manager**

**Operations**
- Punctuality
- Ineffective Percentage
- Other-end detachment
- Traffic Demand Pattern
- Availability of Spare coaches

**Reliability**
- Out of course repair
- En-route / Non schedule detachments
- Failures within X days of Manufacture / POH
Coach Maintenance Basics

What to monitor as a Maintenance Manager

**Amenities**
- Customer Satisfaction Indices
- Zero-defect coaches

**Stock**
- Timely conduct of schedules/ Over-dues
- Time taken for maintenance and schedules

**Resources**
- Availability of manpower, Training needs
- Discipline, Absenteeism, Work-culture
- Availability of materials, Inventory turns
- Tools and equipment, Machine Downtime
Safety Issues
Safety Issues

- Originating, En-route & Terminating examination
- Brake System
- Wheel-sets
- Fire Hazards
- Accidents - Minimizing Injuries to passengers
- Occupational Health and Safety
- Inspections, Super-checks and Audits
Safety Issues

- Originating, En-route and Terminating examination

  Visual examination to detect hanging / broken parts when train rolls in /out at stations

  Axle Box temperature recording at en-route and terminating stations

  Releasing of Brakes (Distributor Valve)
Safety Issues

- **Brake System**
  - Check Application and release
  - Continuity Check - loco attach/detach
  - Brake power check
  - Angle cock clamp to prevent miscreants
  - Moisture affects reliability
  - Unit Exchange of Distributor Valves, Brake Cylinders
Safety Issues

- **Wheel-sets**

  - **Wheel Profile due to wear in-service**
  - **Wheel Diameter measurement**

  **Thermal Stresses**
  - **Heat Checks, Thermal Cracks**
  - **Shattered Rim, Shelled Tread**

  **Roller Bearing Failures**
  - **Examine for Tell-tale signs, Temperature**
Safety Issues

- **Fire Hazards**
  - Maintenance of LPG based kitchen system during POH and Monthly schedules
  - Ventilation Arrangement
  - Joint inspections by Commercial and Mechanical departments with pantry contractor
  - Adherence to Safety Regulations included in contract conditions of pantry-car services

- **On Coaches**
  - Safety Precautions listed for information of travellers
  - Provision of Fire Extinguishers on trains
# Safety Issues

- **Fire Hazards**

## Up-grading coaches to UIC norms

<table>
<thead>
<tr>
<th>Furnishing</th>
<th>Upgraded Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paneling for Side walls and partitions</td>
<td>Resin bonded Thermosetting Laminates</td>
</tr>
<tr>
<td>Cushioning Material for berths and seats</td>
<td>Densified Thermal bonded polyester blocks instead of PU foam</td>
</tr>
<tr>
<td>Upholstery Fabric</td>
<td>Vinyl coated Fire-retardant grade upholstery Fabric</td>
</tr>
<tr>
<td>Curtains</td>
<td>Fire Retardant fabric</td>
</tr>
</tbody>
</table>
| Flooring Material                   | • Compreg board for flooring  
|                                    | • PVC flooring to latest specs                               |
| Roof Ceiling Material               | NFTC Roof Ceiling / Non-asbestos Limpet Sheets               |
Safety Issues

- **Accidents - Minimizing Injuries to Passengers**

  **Coach Design**

  - Integral Design and Anti-telescopic design of shell
  - Destruction tubes under Lavatories at ends
  - Design studies by RITES, RDSO and IR to improve crashworthiness of coaches

  **Some Modifications done by Workshops**

  - Ladder with PU foam
  - Sunk-in Soap Dish
Safety Issues

- Occupational Health and Safety
- Helmets
- Footwear
- Welding Gear
- Hand Gloves
- Aprons
- Masks
Safety Issues

- Inspections, Super-checks and Audits

**Division**

<table>
<thead>
<tr>
<th>Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rake Maintenance</td>
</tr>
<tr>
<td>Night Inspections</td>
</tr>
<tr>
<td>Operations</td>
</tr>
<tr>
<td>Quality of Work</td>
</tr>
</tbody>
</table>

**Multi-disciplinary Teams**

<table>
<thead>
<tr>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety and Amenities</td>
</tr>
<tr>
<td>Co-ordination Issues</td>
</tr>
<tr>
<td>Stores Verification</td>
</tr>
</tbody>
</table>

**RDSO & RITES**

<table>
<thead>
<tr>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Audits</td>
</tr>
<tr>
<td>Technical Issues</td>
</tr>
<tr>
<td>Material Inspection</td>
</tr>
</tbody>
</table>

**GM and HQ**

<table>
<thead>
<tr>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
</tr>
<tr>
<td>Strategic Inputs</td>
</tr>
<tr>
<td>Long-term Impact</td>
</tr>
<tr>
<td>Co-ordination Issues</td>
</tr>
</tbody>
</table>
On-Board Services
On-Board Services

- Hygiene – Toilet and coach cleanliness
- Amenities
- Pest Control
- Linen Management
- On-board deficiencies and diagnostics
- Importance of Customer Feedback
Hygiene – Toilet and coach cleanliness

- On-board cleaning crew on trains
- Outsourced to professional agencies

- High pressure Jet Cleaning of Toilets at Igatpuri
  - En-route Stations, every 250-350 kms
  - From 06.00 to 22.00 hrs

- Travelling Safaiwallas (Cleaners) on Pushpak Express
  - On-board cleaning crew on trains
  - Outsourced to professional agencies
On-Board Services

- Hygiene – Toilet and coach cleanliness
  - 25 ‘Clean Train’ Stations in India
  - Outsourced to professional agencies
  - From 06.00 to 22.00 hrs
  - High quality cleaning in 20 min. halt

Disinfecting Toilet fixtures at Itarsi

Cleaning Windows at Ratlam
On-Board Services

- Hygiene – Toilet and coach cleanliness

Intensive Cleaning at Primary end

Before

After

Before

After
On-Board Services

- Amenities
  - Mobile and Laptop charging
  - GPS based Real-time info displays
  - Retro-reflective Multi-lingual boards
  - Quality cleaning for heavy toilet usage
  - Odour Control System
  - Dirt Trap Mats
  - Linen in air-conditioned coaches
  - Pantry Meals on-board
  - Theme based decor
On-Board Services

- **Pest Control**
  - Periodic Dis-infestation by spraying chemicals
  - Special attention to Pantry cars & AC coaches
  - Use of baits and rat-traps
  - Treatment of live burrows at depots/stations
  - Anti-mosquito fogging at primary depots
  - Sprays at ‘Clean Train’ stations
On-Board Services

- On-Board deficiencies and diagnostics

- On-Board Staff
  - Report at Terminus, Next Attention Point

- Inspecting Officials
  - Inspection Notes, Letters

- Dignitaries
  - Letters

- Passengers
  - On-Board Complaint
  - Email, Letter
  - Control Office
  - Nodal Office

Coach Maintenance Staff at the Primary end or ‘Other End’ or En-route Station based on Nature of complaint.
On-Board Services

- Importance of Customer Feedback
  - What is important to customer?
  - What pinches the most?
  - Corrective and Preventive Action
  - Continual Improvement
  - Class-wise Assessment
  - Train-wise Assessment
  - Direction-wise Assessment

Customer Feedback Form
Quality Systems
Quality Systems

- Quality in context of coach maintenance
- P-D-C-A
- ISO Quality Management Systems
- Customer Satisfaction Indices
- Moving up the Maturity ladder
- Kaizen – The incremental approach
- The Quality Trilogy
Quality in context of coach maintenance

- Safety
- Security
- Reliability
- Hygiene
- Comfort
- Amenities
Quality Systems

P-D-C-A

Deccan Queen - 2005

Final Implementation
- Retain old seating system
- New décor & toilets
- Modified odour control

Improve Deccan Queen
- Passenger Amenities
- Quality Management System
- ‘Gift to Passengers: 75th year’

Reaction of Passengers
- Agitated over seats: ‘Gherao’
- Unhappy with Fragrance
- Happy with Décor, Toilets

Changes
- General Coach seats like AC
- Odour Control Systems
- New décor and toilets
Quality Systems

ISO 9001 Quality Management Systems

Salient Features

- Customer Focus
- Lay down Goals, Work methods
- Process Approach
- Conformity Assessment
- Corrective and Preventive Action
- Continual Improvement

Steps to ISO 9001:2000

Establish QMS → Implementation → Assessment

- Quality Policy
- Quality Manual
- Documentation
- Training
- Mgt. Review
- Audits
Quality Systems

- Customer Satisfaction Indices (CSI)

CSI links Customer Expectations, Perceived Quality and Perceived Value to Customer Satisfaction

- Assign Weights
  - Perceived Value
  - Hygiene
  - Safety
  - Amenities

- Conduct Survey
  - All Classes
  - Up & Down Trains
  - Perceived Quality
  - Expectations

- Compute CSI
  - Scale
  - Overall Score
  - Analyze SWOT
  - Act on Analysis
Quality Systems

- **Customer Satisfaction Indices (CSI)**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supermarkets</td>
<td>75</td>
</tr>
<tr>
<td>Gasoline Stations</td>
<td>71</td>
</tr>
<tr>
<td>Banks</td>
<td>77</td>
</tr>
<tr>
<td>Airlines</td>
<td>63</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breweries</td>
<td>83</td>
</tr>
<tr>
<td>Newspapers</td>
<td>66</td>
</tr>
<tr>
<td>Apparel</td>
<td>82</td>
</tr>
<tr>
<td>Personal Computers</td>
<td>75</td>
</tr>
</tbody>
</table>

- Mumbai Division, Central Railway CSI scores (2007) - AC coaches: **68.79** and Non-AC coaches: **67.80**

**National ASCI Score for USA**: 75.2 in Q3 of 2007

*Source: www.theacsi.org*
Quality Systems

Moving up the Maturity Ladder

The Process Maturity Continuum

Level 1
Unknown

Level 2
Defined

Level 3
Repeatable

Level 4
Capable

Level 5
Efficient

Level 6
Adaptive

- Customer Requirements
- Work Methods & Response
- Performance & Accountability
- Results and Learning Cycles

Source: ISO website
Quality Systems

Kaizen – The incremental approach

- Continuous Improvement
- Small changes add up to big Impact

- Collective efforts of organization
- People & Process orientation

Time

Improvement

Kaizen

Innovation

- Technology Orientation
- Big Step with Dramatic results

Kaizen & Innovation - Improving the Brake Rigging of Coaches

- Magna-flux test of Brake hangers
- Upgrade Material Specifications
- Non-asbestos Brake Blocks
- Brake Beam Suspension
- Centralized Slack Adjuster Repair
- Modification to Brake Shoes
- Bogie Mounted Brake System
- Composite Brake Blocks


Improvement

Time
Quality Systems

The Quality Trilogy

- Identify Customer
- Determine Customer needs
- Translate needs into our language
- Develop product to respond to these needs
- Optimize product features to match our needs and customer needs
- Develop a process to produce the product
- Optimize the process
- Prove process under operating conditions
- Transfer the process to Operations

Source: The Juran Institute
Supply Chain Management
Supply Chain Management

- Sourcing
- Production Planning and Scheduling
- Inventory Management Systems
- Working with lower inventory levels
- Transportation
- Multi-Echelon Supply Chains
Supply Chain Management

- Sourcing

Dependence for

- Knowledge and Capacity
- Capacity

<table>
<thead>
<tr>
<th>Item</th>
<th>Modular</th>
<th>Linen Washing</th>
<th>Safety Exam</th>
<th>Integral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Outsourcing Trap</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Outsourcing Opportunity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worse Outsourcing Situation Bargaining Power?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can live with Outsourcing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To Outsource or not?

Source: Adapted from Clockspeed – Charles H Fine (1998)
## Supply Chain Management

### Production Planning and Scheduling

<table>
<thead>
<tr>
<th>System</th>
<th>Where Relevant</th>
<th>Primary Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequencing Rules</td>
<td>Low Volume</td>
<td>Flexibility to meet different orders, increase throughput</td>
</tr>
<tr>
<td>Optimized Production Technology</td>
<td>Batch; Low volume</td>
<td>Bottleneck Management</td>
</tr>
<tr>
<td>Material Resource Planning</td>
<td>Medium Volume</td>
<td><strong>Effective coordination of material and labor</strong></td>
</tr>
<tr>
<td>Just-in-Time</td>
<td>High Volume, Repetitive</td>
<td>Minimize Set-up times and inventory</td>
</tr>
<tr>
<td>Periodic Review / Cyclic Scheduling</td>
<td>Continuous process</td>
<td>High Capacity Utilization</td>
</tr>
</tbody>
</table>

*Source: Inventory & Production Planning and Scheduling* - Silver, Pyke, Peterson - 3rd edition.*
Supply Chain Management

- Inventory Management Systems
  - Key Questions:
    - How often inventory status should be determined?
    - When to place Replenishment order?
    - How large should the replenishment order be?

<table>
<thead>
<tr>
<th>Aspect</th>
<th>What Coaching Depots do</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning Horizon</td>
<td>Annual Review (AAC)</td>
</tr>
<tr>
<td>ABC Analysis</td>
<td>Also Monitor Safety Items</td>
</tr>
<tr>
<td>Service Levels</td>
<td>Stock-outs, Local purchase</td>
</tr>
<tr>
<td>Inventory Turnover</td>
<td>Monitor Slow-moving items</td>
</tr>
</tbody>
</table>
Supply Chain Management

- Working with lower inventory levels
  - Forecast demand as per Bill of Materials
  - Reduce Lead Times
  - Reduce Variability in supplies
  - ‘Must Change’ Items - Deterministic Situation
  - Anticipate Technology Changes – Order Size
  - E-procurement speeds up ordering system
  - Supplier Relationship Management
  - Improved Quality of materials reduces rejections
Supply Chain Management

- Transportation

Wheels by Rail
Wheels by Road

or

Key Considerations to decide how to Transport

- Landed Cost
- Lead Time
- Access
- FOB/ex Works

- Consolidation
- Loading/Unloading Facilities
- Weigh Out or Cube Out?
- In-house or Out-source
Supply Chain Management

- Multi-Echelon Supply Chains

Manufacturer → Wholesaler → Retailer

Main Zone Store
Division Store
Depot Store
Train Maintenance

Reducing Echelons
- Reduces Inventory, Transport
- Better Service Levels
- IT inputs for information flow

Wadibunder, Mumbai Division: 300 items

Replenishments
Demand Information
Assimilation and Up-gradation of Technology
Assimilation and Up-gradation of Technology

- New Features, Better Materials
- Adopting Changes
- Training
- External Sources of Knowledge
- Information Technology as an enabler
# Assimilation and Up-gradation of Technology

## New Features, Better Materials

<table>
<thead>
<tr>
<th>Feature</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminate Corrosion</td>
<td>Stainless Steel Lavatory Inlays, Fittings</td>
</tr>
<tr>
<td>Prevent Thefts</td>
<td>Composite Brake Blocks, FRP Window Shutters</td>
</tr>
<tr>
<td>Reduce Weight</td>
<td>FRP Boards, Bins, Use of Composites &amp; Plastics</td>
</tr>
<tr>
<td>Longer Life</td>
<td>Hytrel® Washers in Primary Suspension</td>
</tr>
<tr>
<td>Fire Retardancy</td>
<td>Upholstery, Curtains, Cushioning</td>
</tr>
<tr>
<td>Superior Characteristics</td>
<td>Micro-processor Based Odour Control</td>
</tr>
<tr>
<td>Reduce Failures</td>
<td>Stainless Steel Water tanks, Kitec™ Plumbing</td>
</tr>
</tbody>
</table>
Assimilation and Up-gradation of Technology

- Adopting Changes

- Railway Board, Ministry of Railways
- Policy Circulars
- Provision of Funds
- Zonal Railways And Production Units
- Specifications
- Carriage Alteration Instructions
- Technical Standing Orders
- Research, Design & Standards Organization
- Trials
Assimilation and Up-gradation of Technology

Training

TRAINING THE TRAINER
- LATEST DEVELOPMENTS
- REAL WORLD PROBLEMS
- BURNING ISSUES
- TEACHING SKILLS

TRAINING FACILITIES
- EQUIPPED CLASSROOMS
- PRACTICAL TRAINING

TRAINING PROGRAMME
- COURSE DESIGN
- EFFICACY OF PROGRAMME
- MOTIVATION
- ATTENDANCE

Photos: Basic Training Centre, Wadibunder, Mumbai
Assimilation and Up-gradation of Technology

- External Sources of Knowledge
  - Interaction with Academia – Professor Chairs
  - Post-graduate programmes at institutes like IITs
  - Interaction with industry
  - Use of external Consulting Services
  - Conferences, Trade Fairs / Expo
  - What’s going on abroad?
Assimilation and Up-gradation of Technology

- Information Technology as an enabler
  - Management Information Systems
  - Scheduling
  - Coach History
  - Material Management
  - Enterprise Resource Planning Systems
  - e-learning
Thank You

email: saurabhprasad@hotmail.com