No: SV.FIAT
SR. PPS to MM
Railway Board
Rail Bhavan
New Delhi- 110 001

Sub: Committee Report on Corrosion of FIAT Bogie Frame.
Ref: Para 5.18 of minutes of CME’s conference held on 26\textsuperscript{th} & 27\textsuperscript{th} October 2015 at Mumbai.

With reference to above, a Committee at SAG level was formed to study the problem of corrosion of FIAT Bogie Frame and submit a report duly recommending the remedial action for the same.

The Committee has accordingly made a detailed study of the subject taking into account various factors that could contribute to the problem and made a detailed analysis including the analysis at M&C lab at RDSO. The committee has come up with recommendations to alleviate the problem.

The report along with recommendations is enclosed herewith for kind perusal of MM and further directives please.

DA: as above

(Indrajit Singh)
Executive Director/Carriage

N.O.O. for information please
i) CDE/Mechanical, Rail Coach Factory, Hussainpur, Kapurthala- 144 602
ii) CWM/ Northern Railway, Carriage & Wagon Workshop Jagadhari
iii) AED/M&C, M&C Directorate, RDSO, Manak Nagar Lucknow
COMMITTEE REPORT
ON
CORROSION OF FIAT BOGIE FRAME

Committee Members:

- Sh. Mohd. Saquib Director/Carriage/VDG
- Sh. P. V. Kohade, Dy CME/P/Lower Parel/Mumbai
- Sh. Lalit Kishore, Dy CME/Design/RCF
- Sh. Jawahar Lal, Dy. CME/C/Liluah
Report of committee on corrosion of Fiat bogie frames.

During 14th CMG it was decided that a committee will be constituted at JAG/SG officers level to study the issue of Corrosion of FIAT Bogie Frames in order to establish the reasons for corrosion duly taking into account material composition, geographical locations, painting methodology and provision of discharge pipes in CDTS/Bio-toilet system discharges the waste to ground without splashing in bogie frame and other components in Fiat Bogie. Accordingly a committee was nominated. The committee members included:

- Sh. Mohd. Saquib Director/Carriage/VDG
- Sh. P. V. Kohade, Dy CME/P/Lower Parel/Mumbai
- Sh. Lalit Kishore, Dy CME/Design/RCF
- Sh. Jawahar Lal, Dy. CME/C/Liluah

Committee visited RCF, Lower Parel, Liluah, Jagadhari Workshops and BCT, Tikiapara & NDLS Depots in connection with manufacturing, maintenance practices and availability of facilities at depots / workshops. The detailed observations along-with recommendations of the committee are as under:

1. Material composition of Fiat Bogie frame material:

   Chemical properties:

<table>
<thead>
<tr>
<th>Description</th>
<th>Steel</th>
<th>C</th>
<th>Mn</th>
<th>Cr</th>
<th>Ni</th>
<th>Si</th>
<th>S</th>
<th>P</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material of original coaches</td>
<td>ST52-3 DIN 17100-1980</td>
<td>0.24</td>
<td>1.6</td>
<td>---</td>
<td>---</td>
<td>.55</td>
<td>.045</td>
<td>.045</td>
<td>---</td>
</tr>
<tr>
<td>Material used till 2011</td>
<td>S355J2G3+N EN10025 Part-2 ST52</td>
<td>0.23</td>
<td>1.70</td>
<td>---</td>
<td>---</td>
<td>0.60</td>
<td>0.035</td>
<td>0.040</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>(With Old Spec)</td>
<td>max</td>
<td>max</td>
<td>max</td>
<td>max</td>
<td>max</td>
<td>max</td>
<td>max</td>
<td></td>
</tr>
<tr>
<td>Material used after 2011</td>
<td>S355J2W+N EN10025 Part-5 ST52</td>
<td>0.19</td>
<td>0.45</td>
<td>0.35</td>
<td>0.70</td>
<td>0.55</td>
<td>0.035</td>
<td>0.035</td>
<td>0.20-0.60</td>
</tr>
</tbody>
</table>
### Mechanical properties:

<table>
<thead>
<tr>
<th>Description</th>
<th>Steel</th>
<th>Yield Strength</th>
<th>Tensile Strength</th>
<th>% elongation</th>
<th>Impact Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material of original coaches</td>
<td>ST52-3&lt;br&gt;DIN 17100-1980</td>
<td>355 MPa</td>
<td>490-630 MPa</td>
<td>20%</td>
<td>27 J at -20 °C</td>
</tr>
<tr>
<td>Material used till 2011</td>
<td>S355J2G3+N/St52&lt;br&gt;EN10025 Part-2&lt;br&gt;ST52 (With Old Spec)</td>
<td>355 MPa</td>
<td>470-630 MPa</td>
<td>20%</td>
<td>27 J at -20 °C</td>
</tr>
<tr>
<td>Material used after 2011</td>
<td>S355J2W+N&lt;br&gt;EN10025 Part-5&lt;br&gt;Corrosion resistant&lt;br&gt;ST52 (With New Spec)</td>
<td>Min 335MPa</td>
<td>510-680MPa</td>
<td>20%</td>
<td>27 J at -20 °C</td>
</tr>
</tbody>
</table>

The material used for indigenous production of FIAT Bogies till 2011 was as per EN 10025 (Part -2) which is for non-alloy structural steel. This steel was equivalent to the steel used by OEM which was as per DIN17100-1980 (ST52-3).

The material composition of weathering steel conforming to EN10025 (Part-5), being used now for FIAT bogies, has been compared with original material used by FIAT in their bogies. The material composition of weathering steel is superior due to presence of Chromium. However, pitting and scaling has been observed on the new plates available at RCF during inspection, which needs to be addressed with the sheet manufacturer. The spec used now is for Structural Steels with improved atmospheric corrosion resistance which is considered very much suitable for Bogies..

ICF bogies are manufactured from structural steel to IS:2062 (E250 Grade WC). A comparison of Mechanical and Chemical Properties shows that the steel used for FIAT bogies is superior due to presence of chromium as alloying element, carbon being less and Mechanical properties being much superior.

Therefore it can be concluded that the material presently being used is a superior material and can be continued for manufacture of FIAT Bogies; provided the issue of pitting and scaling in new plates received at RCF are addressed by the supplier.
2. **Manufacturing Procedure adopted for newly manufactured FIAT bogies at RCF, KXH:**

2.1. At present, the blank plates are shot blasted then complete bogie frame is shot blasted. The introduction of component level shot blasting has resulted into segregating the flaw sheets at component level.

2.2. This shot blasted frame is painted with high build epoxy primer–high performance anticorrosion epoxy coating (two packs) to the RDSO Specification No: M&C/PCN/123/2006 and high build epoxy paint Epoxy based elastified top coat (two components) shade RAL 7012 in a recently installed painting booth having facilities of oven for baking the paints. The handling and stacking equipments have also been provided with nylon base to prevent damage to paint layer.

2.3. In past, component level shot blasting was not carried out whereas complete bogie frame was shot blasted. The paint procedure in the past was also not of the required standard as it did not have proper paint booth. The current system appears to be adequate.

3. **Maintenance requirement of FIAT Bogies.**

   Maintenance requirements for FIAT Bogies have been laid down both for regular maintenance in Depots and for full overhauling in Workshops:

   **Maintenance requirement in Depots-**

   **Trip** – Visual check for cracks, damages and corrosion.

   **Monthly** – Washing of Bogie Frame with water jet and visual inspection for cracks, damages and corrosion.

   **Half Yearly** –
   - Washing of bogie and visual inspection for cracks, damages and corrosion.
   - Paint touch up with high built epoxy primer and paint as per RCF spec. no. MDTs – 1668094.

   **BCT, NDLS & Tikiapara Depots:** It is found that during maintenance in depots bogies are not being washed religiously as a part of schedule and no paint touch up work is done in Depots.

   **Maintenance Requirement in shops-**

1. **Shop Schedule 1:**
   - Visual check for cracks, damages and corrosion.
   - All welded joins to be checked with the dye-penetrant and rectify.
   - Corrosion attention to be given as per para. 4.6.22.5; if bogie frame is corroded.
2. Shop Schedule 2:
• Visual check for cracks, damages and corrosion.
• Check dimensional and geometrical tolerances as per FIAT drg. no. 1267505.
• Check welded joins with dye-penetrant and rectify.
• Clean the bogie frame by scraping and shot blasting and paint with high built epoxy primer and paint as per RCF spec. MDTS – 166 (Rev. 2) and MDTS – 094 with min. DFT 200 microns.

Corrosion Attention

CAMTECH maintenance manual indicates that FIAT bogie frames are more susceptible to stone hitting as it is at a much lower height because of “Y” shape as compared to ICF bogie frame. Procedure for maintenance & prevention from corrosion of LHB design FIAT Bogie frame is strictly to be adopted as per clause 4.6.22.5 of CAMTECH maintenance manual during Shop Schedule (IOH/POH) to minimize corrosion. Procedure to be adopted for FIAT Bogie frame maintenance by workshop is as under:

✓ Cleaning of bogie frame.
✓ Washing with suitable detergent as per RCF: T S No. 17.617 100 Ver. 02 (copy enclosed).
✓ After cleaning and scrapping, check the depth of dent marks. Small pitting holesup to a maximum depth of 3 mm may be permitted provided these are:
  • Staggered and non-continuous
  • are not concentrated on the bottom bend portion of the side frame
✓ It is recommended to remove rust by de-scaling by adopting suitable method of grit/shot blasting or by using rust converter to IS:13515-92 (STD ISI marked product) for removal of corrosion.
✓ It is recommended to use rust remover during maintenance only where grit/shot blasting is not possible, as Rust remover is not a substitute for grit/shot blasting.
✓ Apply high build epoxy primer–High performance anticorrosion epoxy coating (two packs) to the RDSO Specification No.M&C/PCN/123/2006 as per RCF’s Spec. No. MDTS 166 (copy enclosed).
✓ Apply high build epoxy paint Epoxy based elastified top coat (two components) shade RAL 7012 as per RCF Specification. No MDTS 166.

Coaching workshops Lower Parel, Liluah and Jagadharai:

The committee examined maintenance procedure at three workshops namely Lower Parel, Liluah and Jagadharai. It is observed that that maintenance of FIAT bogie frame is not being carried out as per CAMTECH maintenance manual. The frames are not washed properly during schedules. They are cleaned by wire brush and painted with PU paint by brush (not by elastified paint as mentioned in the maintenance manual except Liluah where paint is as recommended but cleaning and application is not proper). The depots/workshops are also not equipped with infrastructure required for prescribed maintenance procedure.
4. **Availability of maintenance facilities:**

The facilities available at maintenance depots and workshops were examined and with respect to the work done for bogie maintenance the status is as follows:

**BCT, NDLS & Tikiapara Depots:**
The depots are having facilities for jet washing and since only paint touch up work is to be done, the facilities available are considered adequate. The available facilities with respect to coach holding, however may be examined by Depots themselves and if required, additional water jet machines and pitlines created.

**Carriage Workshops Lower Parel, Jagadhari and Liluah:**
Adequate facilities are not available at workshops to comply with the maintenance procedure requirements laid down in the CAMTECH manual such as: cleaning/washing facilities (Lower Parel has washing set up), grit/shot blasting facilities and painting facilities. Also, the prescribed rust remover/convertor to IS:13515-92 and paints to RDSO Specification No: M&C/PCN/123/2006 and RCF specification No MDTS 166 are not being used. This is leading to poor maintenance of Bogies.

5. **Effect of Geographical Location**

The bogies have been examined at three workshops i.e. JUDW, Lower Parel and Liluah Workshops and in all the three shops extensive corrosion has been observed. The coaches maintained in JUDW are not being exposed to costal belts as much as the coaches maintained in the other two shops. Still the extent of corrosion is same or almost same in these coaches when compared with coaches maintained in Lower Parel and Liluah Shops. Therefore, committee is of the view that within the boundaries of IR, there is no perceptible effect of geographical location as far as corrosion of bogie frame is concerned.

6. **Impact of CDTS or Bio-toilet system discharge:**

6.1. CDTS discharge is in line with the bogie frame and feacal matter in sizeable quantity splashes all over Fiat bogie frame causing main source of corrosion. The distance from bottom of CDTS retention tank to rail level is 225 mm. Instructions have been issued to Railways to provide flexible attachment so that outlet point can be further lowered. But Railways experienced that this flexible connector falls within one or two trips and is not long lasting. Hence flexible attachment is not being provided by Railways.

6.2. The bogies of first bio-toilet AC-2T coach No: 13360/WR turned out on 20.12.13 by RCF was inspected at sickline at BCT and observed that there are no signs of corrosion at the bottom of bogie frame even after 18 months. The main reason appears that the outlet of the bio-tank is not in line with bogie frame and also the discharge material is only treated water in very minimal quantity. It is also learnt that approximately 150 coaches have been turned out by RCFK, RCFR and ICF with bio-toilets. Railways may be asked for their feedback regarding corrosion of bogie frame of these coaches.
7. Conclusion:

7.1 The material composition has been found as per specification used in originally imported coaches. In fact it has been further improved of late. However, stacking of raw material sheets at OEM and bogie frame producer level should be done in covered area. The sheets may have protection cover to avoid damage of outer skin. The process of rolling of these sheets should also be improved so that surface defects can be minimized.

7.2 Workshop/depts should do the maintenance as per prescribed procedure given in CAMTECH maintenance manual, which is presently not being followed. It is further recommended that washing of bogie frame in washing line may be done in every trip during Primary maintenance.

7.3 Workshop/depts should augment their infrastructure in-line with the prescribed maintenance procedure such as cleaning/washing facilities, grit/shot blasting facilities and painting facilities.

7.4 Production Units should curtail the time lag between shot blasting and painting. It should not be more than 30 minutes in any case; however, it should be preferable to have the minimum possible exposure to ambient condition after shot blasting and before painting.

7.5 Production Units should carry out component level shot blasting so that flawed material can be segregated at component stage itself.

7.6 Prima facie it appears that coaches fitted with Bio-toilet have minimal corrosion. Therefore, it shall be appropriate that Bio-tank should be fitted on all coaches. Feedback of bio-toilet fitted coaches should be obtained for FIAT bogie corrosion status from Railways on half yearly basis for proper analysis.

7.7 It has been reported by Shops that even in first Shop Schedule itself paint layer is found peeled off in patches and corrosion is observed. This indicates poor adhesion of paint. The paint quality needs to be suitably upgraded to overcome such defects and ensure that it lasts for atleast POH to POH.

7.8 It is recommended that CDTs discharge be redesigned to ensure that it is not in-line with lowest part of the bogie frame (side frame). Once design is finalized retrofitment on existing coaches may be done.

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(Jawaharlal)
Dy CME/C/Lilua