CORROSION REPAIR

CAUSES OF CORROSION:

- Galvanic cell
- Differential stress cell
- Differential temperature cell
- Differential concentration cell
- Differential aeration cell

Metals are readily attacked by most of the suitable chemicals; non-metals are attackedrarely of varying conditions.

Classification of corrosion: Corrosion can be classified on

Temperature basis

- High temperature corrosion
- Low temperature corrosion

Condition basis

- Wet corrosion or electrochemical
- Dry corrosion or oxidation corrosion

Nomenclature of corrosion

A)	Rust	Oxidation product of iron and steel
B)	Oxides	Oxidation product of no-ferrous metals
C)	Ageing	Oxidation product of non-metal
D)	Decay	Oxidation loss of weld deposition metals due to absorbed hydrogen or Atmospheric oxygen.

Type of corrosion	Characteristic	Prevention
Uniform corrosion or General corrosion	More or less uniform attacksover the entire exposed surfacewith minimum variation in thedepth of change	Protective coating and catholicprotection wherenatural resistance is marginal.
Bimetal corrosion or Galvanic corrosion.	When two or more dissimilarmetals are electrically coupled and placed in electrolyte andresults from the existence of apotential difference between the metals which cause a flow ofcurrent between them.	It can be minimized by keepingthe anode large or avoided byelectrically insulating themembers of the couple withdielectric spacers provided this insulation is complete.
Crevice	A type of corrosive	

corrosion	attackassociated with the confinedspaces or crevices formed by certain mechanical configuration such as tappedjoint, gasket interfaces andtubular sleeves. Both approximating surfaces neednot be metal. It is alsoassociated with the shieldedareas caused by setting out ofparticular solids on a surface or under marine growth. It occursin surface coated componentsdue to oxygen deficiency. Excess of hydrogen ion stimulates corrosion.	1. Eliminate crevice 2. Design change 3. Using non-permeable gasketor seals 4. Materials with poor wetability 5. Periodic removal of sediments and debris fromtank bottoms 6. Insuring adequate adhesionof coating
Pitting corrosion	A form of localised corrosion inwhich the	Correct selection of materialwith adequate

	attack is confined to numerous small cavities on themetal surface a true pit has alength/depth ratio equal or greater than one.	pitting resistance.
Cavitation corrosion	It superficially resembles pitting, but the surface appearsconsiderably rougher and hasmany closely spaced pits which are neat and orderly arrayed. Itis due to plastic deformation and honey combing.	1. Design change 2. Cathodic protection 3. Rubber and elastomericmaterial 4. Proper choice of materialssuch as stainless steel in place of brass.
Selective leaching or selective dissolution	When one element is preferentially dissolved from asolid solution, i.e. when a phase is selectively attacked in analloy. Example dezincificationof brass	It is intentional corrosion forproperty modification.

	alloys.	
Erosion corrosion	It exemplified by an increase inthe corrosion rate caused byrelative motion between the surface and the environment.Surface exhibits severe weight loss and many scooped out,rounded areas appear likesculptured impression.	1. Design modification 2. More resistance materials
Fretting corrosion	Two metals in contact underload and having smallrelationship between themexhibit intense attack at the area of contact and is usually revealed by reddening of lubeoil between them.	Proper colour matching
Inter-granular corrosion	Due to in homogeneous condition at the grain	Careful control of heat treatingmeasures.

	boundaries. This may be due tosegregation mechanism or intergranular precipitation.	
Exfoliation corrosion or lamellar corrosion	Is a special form of intergranularattack, which primarily affects aluminium and magnesium alloys? It is directional and is characterizedby attack of the elongated grainon a plane parallel to the rolledor extruded surface. This result in characteristic delimitation or stratification of the surfacestructure.	1. Extended ageing cycles for all alloys 2. Organic and sprayed metalcoating 3. Promoting equi-axed grainstructure on the surface.

Causes of corrosion in Indian Railway coaches:

- Water seepage through the flooring to the top of trough floor
- Leakage of water through lavatory flooring.
- Missing of commode chute and drain pipe.
- Defective water pipe fittings.
- Absence of surface preparation during replacement of commode and drain pipe.
- Habits of flushing the flooring with the water jet for cleaning.
- The conditions of air trapped in between trough floor and flooring due to climate change.
- Striking of flying ballast when the train is running.
- Design of window seal leaves the gap between the side panel to allow the rain water andwater during washing of the coaches flow through the panel and to drain out at thebottom.

- Blockage of drain water by accumulated dust on top of trough floor and other areas ofunder-frame and panels.

- Improper welding of PVC flooring.

- Improper welding of sole bar box.

- Spreading of water from side filling.

Areas prone to high rate of corrosion in passenger coaches are:

- Trough floor: areas adjacent to lavatory, doorway, and luggage compartment in SLRand kitchen area of pantry car.

- Head stock: areas inner and outer head stock, stiffener, protection tube area, supporttube area etc.
- Side wall bottom: area below lavatory and between body side pillars.

- Body pillars: bottom portion of pillar near doorway and lavatory area.

- Cross bearers: joint between sole bar and cross bearers.

- Body side door: bottom of door due to accumulation of dust.

- Battery boxes: corrosion due to acid action.

- Roof: ventilator and area around it.

Vulnerable members and locations:

- Tubular frame below lavatories and trough floor in bays adjoining lavatories in alltypes of coaches and under the luggage compartments of SLRs and parcel vans andkitchen area of pantry cars.

- Sole-bar, body pillars, turn-under in the bays under and adjoining lavatories in alltypes of coaches and in addition kitchen area of pantry cars.

- Sole bars, turn under and pillars above lifting pads.

- Sole bars and pillars behind the sliding door pockets of SLR‟s & parcel vans.

- Sole bars, pillars and turn-under at door corners.

- Side panels below window in non ac coaches and lower portion of body pillars.

Corrosion repairs

Material & treatment of components

It is essential to use low alloy high tensile corten type steel sheets and plates to IRS-M41-1974for repairs of integral coaches. The thickness of steel sheets/plates to be used shall be asunder:

S. No.	Description of components	Thickness of steel sheets & Plates IRSM 41-Gr. I
1	Inner head stock- centre plate	10 mm
	Inner head stock- beam web plate	8 mm
2	Outer head stock	8 mm
3	Sole bar	5 mm
4	End wall stanchions cross bears above & belowtrough floor	4 mm
5	Turn under With elongated holes	4 mm
	Turn under Without elongated holes	2 mm
6	Floor side moulding	2 mm
7	Through floor body side pillars body side and endwall panels waist rail and light rail	2 mm
8	Roof sheet	1.6 mm

- All body shell replacement components less than 5 mm thickness used for corrosionrepairs should be hot phosphate and applied with protective paints. Cold phosphateshould be done body wall side panel areas where welding has been carried out on hot Phosphate components.

- Zinc rich primer should be used where spot welding is done. Components of 5 mm ormore thickness should be grit blasted and immediately followed by application of redoxide zinc chromate primer.

- Welding electrodes and paints should be of the prescribed quality conforming to therelevant IS/ IRS specification. Where the corrosion noticed is of a very minor nature andhas just started, there is no need to renew parts. The paint and rust should be thoroughlycleaned to reach the bare metal and the surface treated with two coats of primer. Inaddition under frame members should be given four coats of bituminous solution.

- Design improvements / modifications: Several design improvements/ modifications foreliminating/minimising corrosion have been issued by the RDSO/ICF from time to time. Brief details of these together with the action to be taken by the railways are given below:

- FRP tissue sandwiched between layers of bitumensince 1982 FRP tissue sandwiched between bituminous coats has been laid on trough floor,sidewall and body pillars up to waist rail height and the entire under frame.On these post 1982 coaches, whenever corrosion repair is carried out on portion laid withFRP tissue, patch repair of the FRP tissue should also be done to the extent to which theoriginal lining is removed for repairs to the corresponding parts.

- Trough floor: 13 mm dia. holes provided in the valleys of through floor for drainage ofcondensation were increased to 19 mm so as to allow quicker drainage. This modificationmay be incorporated in all coaches, if not already done, whenever trough floor is laidwith FRP tissue, these holes should be pierced through.

- Stainless steel trough floor: use of austenitic stainless steel in place of corten type steel toIRSM-41 has been made in parcel vans, SLRs and pantry cars, where corrosion maybecome

prominent due to carriage of perishables and where there is possibility of seepageof water to a large extant. Earlier ICF had turned out some SCN coaches also withaustenitic stainless steel trough floor. Coaches provided with austenitic stainless steel trough floor should be repaired with equivalent material using special type of low heatinput type electrodes. Now a decision has been taken to provide SS trough floor in alltypes of coaches through RSP.

• Sealing of window sills: To prevent seepage of water through the gap between the sidewall and window sill, a modified arrangement as per RDSO sketch - 76014 has beenintroduced on all coaches which are being turned out by ICF from 1975 onwards. Thismodification has not eliminated the seepage of water and problem still persists. Furtherdesign modification is required to mitigate the problem.

• Lavatory pan with longer neck: The neck of the lavatory pan have been increased by 100mm. to avoid drain water from spilling over troughfloor and connected members. It is essential

that at the time of corrosion repairs in thelavatory area or renewal of magnesium oxy-chloride flooring composition in thelavatories, pans having shorter neck may be used only after welding an additional piece tothe neck to bring it in conformity with RDSO (Drg.No.C/LF-1880 AIL-3drawing not available,)

• Stainless steel inlay in lavatory instead of decolite flooring: In order to eliminate anyleakage of water or chloride through the floor leading to corrosion of the underframe, ICFhas started providing a stainless steel inlay in the lavatory with conventional lavatory panduly supported as per RDSO (Drg.No. ICF/SK-1-0-666 Alt. d., Drawing not available). The stainless inlay is made from1.6 mm steel sheet and has a skirting up to waist rail. The inlay is provided with a 20 mmslope for smooth flow of water towards lavatory pan. 2 mm thick PVC overlay is postedover the inlay. Some railways have tried the floor of polyurethane layer in the lavatoriesto prevent the leakage of water.

• PVC flooring over plywood: Till 1988, the standard flooring in lower class coaches hasbeen timber floor boards with magnesium

oxy-chloride and in first class coaches,corridor, doorways, gangways and lavatories were provided with timber floor boards withmagnesium oxy-chloride flooring and compartment portion was provided with PVCpasted over plywood with timber flooring. In case of AC coaches, doorways, gangwaysand lavatories were provided with timber floor boards with magnesium oxy-chloride

flooring and compartment portion was provided with PVC pasted over plywood andtimber flooring board till 1982. In order to prevent seepage of water through decoliteflooring to eliminate release of chloride ion leading to corrosion, flooring consisting of

PVC over plywood has been introduced in all areas except lavatory since 1983 in ACcoaches and since 1989 in second class coaches. Now the plywood has been replaced with compreg board. Aluminium chequered sheets are laid over the PVC near door bays

and lavatory bays to prevent the seepage of water.

- Battery box frames: To prevent corrosion battery box frames are now being hotgalvanised before riveting aluminium sheets. This should be ensured during POH. Inaddition, to prevent acid from batteries coming in contact with battery boxes, the

batteryboxes should be fitted with FRP trays to ICF drg.No.GS-7-1-018 during POH. If andwhen battery boxes need renewal, the new battery box should be to RDSO (Drg.No.GS-7-1-015., drawing not available)

Note- the Drawings mentioned in the text, may be obtained from RDSO website