INTERNATIONAL UNION OF RAILWAYS

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Leaflet to be classified in Volumes :
VI - TRACTION
VII - WAY AND WORKS

605 OR

2nd Edition, 1-1-81

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PROTECTION FROM CORROSION(1)

MEASURES TO BE TAKEN

ON DIRECT CURRENT CATENARIES

TO REDUCE THE RISKS

ON ADJACENT PIPING AND CABLE SYSTEMS

(1) Obligatory provisions are preceded by an asterisk : *

(Reprint of 1-3-1984)

UPDATING

Leaflet 605, 2nd Edition of 1-1-81			
Amendment		Amendment	
No.	Date	No.	Date

0 - GENERAL

0.1 - Purpose of the leaflet

0.1.1 - The purpose of the present leaflet is to define the measures to be taken on railways electrified with direct current to reduce the risks of corrosion on the adjoining piping and cable systems (1).

0.2 - Introduction

0.2.1 - On direct current electrified lines, the running rails are used for the return of the traction current to sub-stations.

0.2.2 - It cannot be avoided, however, that some part of this current leaves the rails and passes through the earth to rejoin the return circuit at a point nearer the feeder sub-station and so reaches the bus-bar of this sub-station.

0.2.3 - These leakages, called «stray currents» seek the least resistant paths and, in particular, piping and cable systems (1) of any kind placed in the neighbourhood of tracks and badly insulated from earth.

0.2.4 - There is a danger of corrosion at the exit points of the stray currents.

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(1) In this leaflet the term «piping and cable system» includes all metal conduits (cables, pipes, conductors, etc...) liable to be corroded.

0.3 - General principles

***0.3.1** - In order that the running rails of a direct-current electrified line shall disperse only a slight quantity of current through the earth, it is necessary that :

*a) the insulation of the return circuit of traction currents constituted by the rails should be as good as it is possible to make it in practice ;

*b) the resistance of the return circuit constituted by the rails should be as low as it is possible to make it in practice:

***0.3.2** - In this respect, the corresponding measures to be taken on direct-current electrified lines relate to their construction and their maintenance.

1 - INSULATION OF THE RETURN CIRCUIT (RUNNING RAILS) IN RELATION TO EARTH

1.1 - For rails laid on an independent bed, the conditions to be satisfied to ensure a good insulation of the track in relation to earth are generally fulfilled by reason of the method of construction and maintenance, when the line has been installed and is maintained in accordance with normal practice. The conditions to which particular attention should be paid are given below.

***1.2** - The bed must be laid in such a manner as to prevent water stagnation or must be dried by hydraulic drainage.

*1.3 - If the tracks are laid on wooden sleepers, the sleepers must be sound, the ballast must be clean, well aerated, levelled off beneath the flange of the rails and must not cover the sleepers. Any contact between the ballast and the rails, the fishplates and non-insulated cables connected thereto, must be avoided.

In order to prevent any possible upward propagation of moisture from facilitating, in the long run, contact between the ballast and the ends of sleeper screws, it is necessary to use sleepers with blind holes.

*1.4 - If the tracks are laid on reinforced concrete sleepers, it is necessary to insert an insulating pad between the rail and the sleeper and to correctly insulate the devices used to fasten the rails to sleepers ; care must be taken that the ballast has adequate depth and is well-maintained so that it ensures good insulation of the track in relation to earth.

The regulations contained in paragraph 1.3, concerning the ballast, must also be applied to tracks laid on reinforced concrete sleepers.

1.5 - It is preferable not to use metal sleepers on direct-current electrified lines. In cases where the use of these sleepers cannot be avoided, care must be taken to ensure that the ballast has adequate depth and is well-maintained in order that it ensures good insulation of the track in relation to earth.

*1.6 - At the ends of an electrified section connecting with non-electrified tracks, insulating joints the insulating characteristics of which must be checked periodically, must be inserted in order to interrupt the electric continuity between electrified and non-electrified tracks. The position of these joints must be such that the return of the traction current is ensured, irrespective of the position of the tractive unit.

*1.7 - Whatever the method used for laying the tracks and mainly at points such as level crossings, structural works, etc..., it is necessary to avoid any direct contact or any metallic connection between the rails and the conductive parts which are connected to them, on the one hand, and all conductive structures in contact with the earth, including metal parts of bridges, on the other hand.

*1.8 - On metal or reinforced concrete structural works, it is necessary to ensure the insulation of the track in relation to the metal structure of these structural works.

In particular, on metal non-ballasted bridges, rails shall be laid, preferably, on non-conductive materials, such as wooden sleepers or beams, for example, and care will be taken that no securing part (sleeper screw, bolt, strap, stirrup, etc...) either permanently or intermittently touches the bridge at the moment of the passage of a train.

A periodical check shall be made, for example, once a year, to verify that no contact exists between the rails and the structure.

*1.9 - It is necessary to take special measures for the insulation of rod or wire transmission of points or of locking apparatus terminating at a signal box, as the latter may cause heavy current leakage to earth, through the signal-box frame.

In general, all metal transmissions of the different track and signals apparatus, as well as armouring and sheathing of electric cables and water and gas conduits, etc... running alongside or crossing the tracks may cause heavy leakages of current to earth.

In order to eliminate the cause of this leakage of current to earth, it is necessary that :

- in points and crossings - whether or not there exists locking apparatus - to insulate the transmission in relation to the tracks, either by elastic articulation insulating devices, or insulating pads or by any other equivalent system.

- in the case of cables, water pipes, etc... it is necessary to interrupt the electric continuity of armouring, sheaths, pipes, etc... so as to increase considerably the electric resistance of these leakage channels.

***1.10** - The good condition of all the above-mentioned insulations must be periodically checked ; similar checks must be made for the device mentioned in Paragraph 3.4

2 - CONDUCTIVITY OF THE RETURN CIRCUIT

***2.1** - The conductivity of the return circuit must be appropriate for the traction current intensity. In the particular case of the use of track circuits insulated on a single stretch of rail, which leads to reduce the «rail» section of the return circuit of the traction current, a special study must be undertaken to determine the measures to be taken.

2.2 - The limitation of the number of joints and the maintenance at a low value of the electrical resistance of each one of them improve the electric conductivity of the track. It is recommended, in this respect, to weld the rails to one another and to points and crossings.

***2.3** - If the rails are not welded, use must be made, preferably, of welded or brazed rail connections, made in such a manner that the resistance of the joint does not exceed that of 2 meters of rail.

2.4 - The use of non-welded or non-brazed rail connections is not recommended. Those which would be used in exceptional circumstances should be carefully checked in order that their resistance should not exceed that of a length of rail of five meters.

2.5 - On track sections where the intensity of the return current may be maximum (in the neighbourhood of sub-stations, on heavily-loaded lines or on sharp gradients), it is recommended to double and even triple the rail-to-rail connections and the cross-tying of rails.

***2.6** - It is necessary to ensure the good conductivity of the track at particular points (branching-off tracks, points, crossings, swing bridges,...) by the use, if so required, of connections achieved by means of conductors of suitable cross-section which are insulated from earth.

At the time when return connections are made, care must be taken that the return-current conductive wheels of tractive vehicles are always on a track which is in direct contact with the return circuit.

2.7 - It is recommended that, as far as possible, an equal division of current between all stretches of rail of one track or of parallel tracks be effected. For this purpose, except if signalling requirements preclude it, cross connections, suitably spaced and dimensioned, shall be made.

***2.8** - It is necessary to check periodically the good condition of the longitudinal or transversal electric bonding of the tracks.

3 - RETURN FEEDERS AND BUS BARS

***3.1** - The traction current return system must be so arranged that in case of interruption to electric continuity of a return feeder or of its attachment to the rails, the latter remain metallically connected, by other feeders, to the bus bars of the sub-stations in service.

If it is necessary to perform a break between various parts constituting the return feeder of an electrified installation, either in order to facilitate conductivity or insulation checks, or to isolate particular areas (branching-off track sections, sidings...), use must not be made of a circuit-breaker, but exclusively of a disconnecting link, the operation of which is subject to special conditions (operating order or standstill switched-on).

***3.2** - The bus bars of the return circuit, as well as the connections linking them to the rails, must be insulated from earth over their whole length. Their insulation must be checked periodically, in addition to occasional inspections when an accidental alteration of the conditions relative to the return feeders may be feared.

In addition, it is necessary to choose, if possible, for the connection points of return feeders, locations where the ground is dry and distant from extensive cable and piping systems because it is in the neighbourhood of these connection points that the danger of corrosion is the most pronounced.

***3.3** - Attention must be paid to maintaining in good condition the connections between the return feeders and the rails. Special measures may be taken to check the good condition of the return feeders.

3.4 - For safety's sake, one is generally led to create a connection between the metal structures of a sub-station and the return circuit of the traction current. If the structure is suitably insulated from earth, this connection may be made directly.

If this is not the case, it is recommended that a connection be created by means of a device ensuring electric continuity only when required.

APPLICATION

With effect from 1 January 1981 for obligatory provisions.

All Railways in the Union with lines electrified with direct current, the track of which is laid on an independent bed.

RECORD REFERENCES

Headings under which the question has been dealt with :

- Study of questions of general interest in regard to electrolytic corrosion caused by railway lines and participation in the work of the CMI.

(5th Committee -E- : Naples, May, 1953 ; Hamburg, June-July, 1954 ; Amsterdam, June, 1955. - Board of Management : December, 1955).

- Revision of UIC Leaflet 605-1.

(Way and Works Committee : Paris, June 1980).