

2nd edition, May 2004

*Translation*

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## **Application of digital track geometry analysis to the planning of tamping and lining/levelling work**

*Application de l'évaluation digitale de l'état géométrique de la voie dans le cadre de la planification des travaux de bourrage et de dressage*

*Anwendung der digitalen Bewertung des geometrischen Gleiszustandes zur Planung von Stopf- und Richtarbeiten*



UNION INTERNATIONALE DES CHEMINS DE FER  
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NB: The contents of the edition of January 1986 have not been changed.

Important: the points in this leaflet have been renumbered in the new edition. The first digit of each point has been increased by one (i.e. 0 becomes 1, 1 becomes 2, and so on). Please take account of this when using cross-references from other leaflets.

*The person responsible for this leaflet is named in the UIC Code*

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## Summary

*UIC Leaflet 715-1* sets out the general principles relating to the continuous measurement of the geometrical quality of the track and of switch and crossing work: the frequency of measurement, limiting values, analysis and preparation of programmes of work. The measurements involve the use of digital procedures and, in conjunction with other observations, is based on determining the requirement in terms of tamping and lining/levelling work. The standard of geometrical quality to be achieved is defined as a function of the running speed, the desired level of comfort and the limiting intervention thresholds.

With a view to optimising maintenance costs the work needs to be scheduled in the light of the actual condition of the track and not just systematically: the leaflet provides recommendations concerning the length of the sections to be dealt with according to the defects observed.

## 1 - Preliminary notes

The cost of maintaining track, switches and crossings is a major factor in the management of all member railways.

This leaflet is exclusively concerned with track tamping and lining/levelling work of lines with speeds up to and including 200 km/h. For lines operated at higher speeds other criteria may apply.

In terms of meeting users' requirements covering the quality and quantity of railway installations needed for operating railway traffic, all organisational and technical resources should be deployed to minimise maintenance costs without reducing track life.

In this context, special importance shall be attached to the technical and economic optimisation of selecting the time and extent of maintenance work. Depending on the equipment involved, the aim should be to apply maintenance based on the actual condition of the track.

The technical details of the geometrical measurements and the digital input and analysis of the measurements by the different member railways are presented in detail in the final report relating to question 7G20 (published in *UIC Leaflet IF 1/85* (see [Bibliography - page 8](#))), which serves as background to the present leaflet.

## **2 - Parameters for determining the relevance and extent of track tamping and lining/levelling work**

### **2.1 - Principle**

The decision to carry out track tamping and lining/levelling work should be based exclusively on the actual condition of the track and on observation of track geometry changes over time and not on specific maintenance intervals or loading stages. The need for such work is determined from measurements and assessment of local conditions.

The results should be documented so that they can be retrieved.

### **2.2 - When to carry out measurements**

The frequency of measuring the track geometry (graduated depending on track category) should be sufficient to ensure that no unacceptable situation can arise between two measurements. Each railway should set the frequency of measurement for its lines depending on:

- track loading,
- line speeds,
- the type of traffic,
- local conditions.

As far as major lines are concerned at least two annual field surveys (autumn/spring) are recommended. The results of the autumn recordings should be used for planning the work programme for the following year and those of the spring survey for updating this programme.

### **2.3 - Assessment of track geometry**

For technical and economy reasons, tamping and lining/levelling work should only be carried out when the following conditions, as specified by each railway, apply:

- the track geometry limits have been exceeded,
- the ride comfort limits can no longer be ensured,
- the economical intervention threshold has been reached.

The track geometry assessment should make allowance for vehicle responses. The relationship between track faults and vehicle responses (accelerations, forces generated) are at present not sufficiently well researched to enable precise limiting values for the effect of track geometry on ride comfort to be specified. For this reason vehicle responses can be used only for detecting intolerable individual faults. Limiting values for ride comfort to be observed should be laid down jointly by the Rolling Stock, Track and Commercial departments.

## 2.4 - Analysis of measurements

When determining the tamping and lining/levelling work to be undertaken, reference must be made to the analog and digital recordings. Skilled personnel are required for the analysis of track geometry and the action to be taken.

Storage of the digital measurements is advisable in order to be able to monitor the development trend of track geometry and compare track lining/levelling variations over a longer period of time. Storage of the data captured is essential so as to be able to compare the results of two successive measurements.

Digital analysis:

- permits quantification of the measurements taken,
- can provide information on the location and magnitude of a track fault (individual fault),
- permits an objective assessment of track geometry,
- enables a uniform analysis to be made, free from any subjective influence, of 200 m to 300 m assessment lengths for line sections or the whole track network.

The analog recordings of the measurements are essential for assessing:

- the type of track faults,
- special problems connected with curve geometry,
- the action to be taken to correct track faults,
- the specific limits to be set for the tamping and lining/levelling sections,
- the standard of work required (acceptance).

Apart from the track geometry measurements and digital analysis made, the following criteria are the most important factors to be considered when determining the tamping and lining/levelling work required:

- the results of vehicle ride measurements,
- the results of control measurements of theoretical track conditions,
- information obtained from line patrols, locomotive and rear vehicle observation runs,
- track category (track loading, running speeds),
- track superstructure,
- age and condition of track materials,

- ballast quality,
- rail running surface faults (corrugation, wave formation),
- subgrade conditions.

## **2.5 - Scheduling and approval of work**

Scheduling of the tamping and lining/levelling work required is carried out by the responsible local maintenance section. These schedules must generally be checked and approved by the competent higher authority for plausibility and to ensure uniform track quality.

The interval between approval of the work and its implementation should generally be about 6 months (at least 3 months) in order to ensure that, in operating terms, track possessions can be as long as possible so as to obtain maximum utilisation of tampers and liners and thus reduce costs.

In order to achieve a high quality of work, track possessions should exceed 3 hours in length. Coordination with other technical services (e.g. overhead lines, bridges) should be ensured so that simultaneous use can be made of track possessions.



## **3 - Setting limits for maintenance work**

### **3.1 - Correction of individual faults**

Individual faults are isolated irregularities in the track geometry, the length of which does not exceed 10 m. Depending on the type and magnitude of the irregularities, they must be corrected immediately or within a few days, either manually (manual packing) or mechanically (with small tampers).

When individual faults are corrected, the adjoining lengths must also be considered. When work is needed near "forced points" (e.g. bridges, level crossings, station platforms), the theoretical track geometry must be restored at the same time. When the irregularity lies on open track, adaptation to the adjoining track level is required.

The further development and use of small tampers should be encouraged in order to permit individual faults to be corrected cost-effectively.

### **3.2 - Correction of individual faults during continuous track overhauls**

If the digital analysis of several track sections shows that the total number of irregularities to be corrected extends over approximately half of the total zone under assessment, a continuous track overhaul is recommended.

The application of a continuous track overhaul is intended:

- to ensure a uniform standard of track geometry at the speeds operated,
- to extend track life by reducing loading of the track components.

### **3.3 - Continuous track overhaul initiated by track geometry assessment**

Quality standards and associated costs must be defined for each line depending on its importance.

The quality standards to be applied to each line must be determined by agreement with the commercial department.

The principle of maintenance is not to allow the degree of quality of the track to fall below the agreed comfort level. If this were to happen, maintenance costs would increase and track life would be reduced.

A line section must undergo continuous overhaul, when its prescribed standard of quality is no longer ensured, or when quality has already fallen below it.

For reasons of economy, sections under assessment, whose quality has not yet fallen below the prescribed standard but may be expected to decline to that level or fall below it before the next overhaul, should be processed at the same time.

## 4 - Conclusions

This leaflet sets out the principles for planning and performing track tamping and lining/levelling work.

Whether tamping and lining/levelling work is required should be determined solely in relation to the actual condition of the track. For this purpose consideration should be given to the results obtained from:

- digital analysis,
- analog measurements,
- measurements of vehicle responses,
- local field observations.

In order to assess the measurements obtained, track-related quality standards and the corresponding maintenance costs should in future be determined for each line so that the quality standards to be observed can be specified jointly with the commercial departments.

When determining the need for carrying out tamping and lining/levelling work, digital analysis represents an objective parameter, thus contributing towards reducing track maintenance costs.

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