UIC CODE 579-1

3rd edition, March 2003

Translation

OR

Wagons - Periodic overhaul - Methods for establishing its frequency and nature

Wagons - Révision périodique - Méthodologies pour en déterminer la périodicité et la consistance
Güterwagen - Periodische Revision - Methodologien zur Bestimmung ihrer Häufigkeit und ihres Umfangs

UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volume :

V - Rolling Stock

Application :

With effect from 1 January 1998
All members of the International Union of Railways

Record of updates

2nd edition, January 1998

3rd edition, March 2003	Retyped in FrameMaker. Important: the articles (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

Contents

Summary

Wagons must undergo preventive maintenance in the form of periodic overhauls. These overhauls are designed to give the wagons a major new technical potential enabling them to run without heavy maintenance between overhauls. This leaflet looks at two maintenance systems (time-based and performance-based) and describes a method for calculating the overhaul cycle for each wagon.

1 - General

1.1 - Purpose of this leaflet

Wagons must undergo preventive maintenance in the form of periodic overhauls. These overhauls are designed to give the wagons a major new technical potential enabling them to run without heavy maintenance between overhauls.

This leaflet looks at two maintenance systems (time-based and performance-based) and describes a method for calculating the overhaul cycle for each wagon.

1.2 - Nature and features of the methods

The methods are essentially experience-based and rely on observation of wagon behaviour in service.

The approach uses the national and international rules in force (frequency and nature of the overhauls) as its starting point and aims to help railways make progress in stages on the basis of actual observation of the in-service behaviour of the various wagon series. The choice of performing maintenance on a wagon series according to one of the two systems described is discretionary.

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2 - Principles

2.1 - Aim

The frequency and nature of the overhauls must enable the required quality of service to be ensured (safety, minimum wagon standstill as a result of accidents) under optimum economic conditions (minimum overall maintenance cost).

2.2 - Conditions under which the "time-based" and "performance-based" systems are suitable for defining overhaul rules

In both time-based and performance-based systems, a set overhaul rule is only valid for a given wagon series and for technological features, construction materials and working conditions that are sufficiently uniform (annual distance covered, type of traffic, etc.). Application of one of these methods implies that conditions imposed are all met simultaneously.

2.3 - Investigation methods

2.3.1 - Performance-based maintenance

Maintaining a wagon fleet on a performance basis will require access to at least the following information sources in order to determine how a wagon series is affected by wear and tear:

- a feedback system enabling the in-service behaviour of wagons to be monitored (for example: reason for withdrawal, accidental damage, wear, cause of damage, etc.);
- a representative sampling system for the wagon series;
- a data bank that can provide information on wagon utilisation.

2.3.2 - Time-based maintenance

Maintaining a wagon fleet on a time basis will require access to at least the following information sources in order to determine how a wagon series is affected by wear and tear:

- examination of a representative sample of the wagon series after a known period of use;
- access to a data bank for individual components, established in various ways.

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3 - Changes in the condition of a wagon between two overhauls

Figures 1 and 2 - page 11 in Appendix A and figures 3 to 5 - page 12 in Appendix B give a schematic representation of changes in the overall condition of a wagon during its service life. This condition varies according to a "saw-tooth" curve, deteriorating gradually according to various laws (wear, ageing, deformation, fatigue, corrosion, etc.) during service and then recovering after each overhaul. For each component and therefore for the wagon as a whole, this condition must not fall below a certain limit, failing which costly intermediate repairs or risks to operating safety may ensure.

This outcome can be achieved in various ways, whether maintenance is time-based or performance-based. Indeed, the schedule may comprise a pattern of successive overhauls of similar content or sequences of overhauls of different content.

Appendices A - page 11 and B - page 12 give illustrations of these possible overhaul sequences.

This diversity does not represent an obstacle to the application of one of the two methods.

Quite to the contrary, it can provide useful comparisons between the various solutions adopted.

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4 - Description of the methods

4.1 - Performance-based maintenance

4.1.1 - Principle and calculation of the optimum performance limit between two overhauls

In this type of maintenance, each wagon goes in for overhaul on reaching a performance limit expressed in tonne-kilometres[1]. This limit is calculated for each uniform series of wagons as defined in point 2.2 - page 3, such that the condition of each wagon is above the minimum permissible overall condition.

With reference to figure 6 - page 13 in Appendix C, proceed as follows for each component:

- establish the component's wear behaviour through statistical sampling methods;
- monitor to ensure that the minimum permissible condition is not exceeded.

The performance limit and the nature of the overhaul are determined by combining the wear behaviour of all the components (see Appendix D - page 14).

If some components have a performance limit that is too low in relation to the whole range of components, they may undergo intermediate maintenance to restore some of their potential. The decision to undertake this operation must be dictated both by good management and a concern for operating safety.

4.1.2 - Benefits and drawbacks

This type of maintenance is highly cost-effective for the following reasons:

- the potential performance of a wagon can be fully exploited;
- the number and nature of the maintenance operations are optimised;
- for the same traffic level, the wagon-fleet size can be reduced thanks to greater availability.

It has the following drawbacks:

- a computer system is needed to implement it;
- regular sampling operations are necessary.

1. References to tonne-kilometres in this leaflet shall be understood as the total mass of the wagon (tare or tare + load) multiplied by the distance it has covered.

4.2 - Time-based maintenance

4.2.1 - Principle and calculation of the time limit between overhauls

In this type of maintenance, a uniform wagon series as defined in point 2.2 - page 3 undergoes an overhaul at the end of a period expressed in years and in such a way that no wagon falls below the minimum permissible condition (see Appendix E - page 15).

By reference to figure 9 - page 16 in Appendix F, the idea is to start from the existing schedule for the wagon as represented by the line ABCDE and examine the technical possibility and economic viability of adopting a new schedule (illustrated, for example, by the line AFGHI). This examination must be conducted for each individual component.

The desired improvement in respect of the overhaul time limit is illustrated by the horizontal projection of segment BF. This improvement must be reasonable (e.g. 1 year) failing which the study described below would be unrealistic.

Figure 9 in Appendix F shows that with the new schedule, the overhaul will come later but will be more thorough in nature since it will be performed on components in a worse overall state of repair (previous content: BC; new content: FG).

The method therefore involves ascertaining whether:

- the overall condition of the wagon at F in the target schedule will still be acceptable;
- the average cost of the new overhaul makes the change of schedule relevant in overall economic terms.

The examination of these two points must be done shortly before the date the overhaul falls, for example at point K. At this stage, it is possible to ascertain the actual average condition of the wagon series, for example by examining a representative sample of wagons.

Using the information described in point 2.3 - page 3, it is possible to ascertain the content (BC) of the operation for each component and therefore the average cost at point B (current schedule).

It is also possible, provided the targeted extension of the deadline is not excessive, to predict whether each of the components will be able to hold out to point F (new planned deadline), in other words to establish whether there is a risk of dangerous or frequent accident-related damage occurring in the meantime. On this basis, it will be possible to assess the content (FG) of the new overhaul for each individual component.

This method therefore helps provide an answer to the two questions posed above: the first concerning the technical possibility of extending the time limit, the second concerning the overall economic viability of an extension of this kind.

4.2.2 - Benefits and drawbacks

This type of maintenance holds the following advantages:

- scheduling of overhauls is simple;
- scheduling and implementation can be done cost-effectively.

There are, however, the following drawbacks:

- disparities in the performance of wagons cannot be taken into account;
- since the nature of the overhaul is generally dictated by experience, larger safety margins must be allowed;
- low cost-effectiveness, especially when the wagons are used infrequently;
- if the wagons are used to the full, the minimum permissible overall condition may be reached prematurely.

5 - Results

A record should be kept of the results that form the basis for calculating the wagon overhaul deadline (time- or performance-based).

Where appropriate, these results may be complemented by other parameters relevant to the decision-making process, for example:

- remaining service life of the wagon;
- need to plan and balance-out the annual workload of maintenance workshops;
- legal, regulatory or organisational constraints.

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6 - Validity check

The in-service behaviour of the wagons should be monitored using suitable means (damage frequency statistics, for example). This check is necessary in any case, irrespective of the maintenance system used.

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7 - Special case of new wagons

The methods described above result from observation of the in-service behaviour of wagons and are not directly applicable for setting the time-based or performance-based deadline for the first overhaul for newly-built wagons and the corresponding marking of these wagons.

Two solutions apply under these circumstances:

7.1 - Standard wagons (or wagons equivalent to existing series in terms of their use and technology)

Proceed by analogy at the time of delivery. Subsequently, application of one or the other of the methods described above will help to confirm or modify the overhaul deadline.

7.2 - Special wagons or wagons involving new technology

Overhaul deadlines should be determined with caution. Some components, particularly in the wagon infrastructure, are often comparable with components in known series. Subsequently, application of one or the other of the methods described above will help to determine the overhaul deadline.

Appendix A - Changes in the condition of a wagon as a function of performance

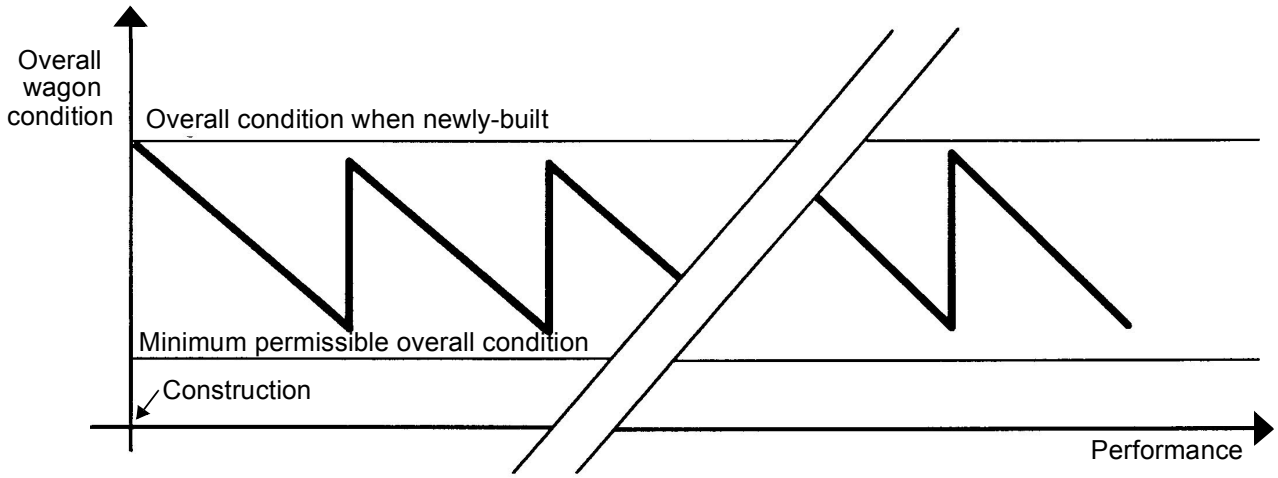

Fig. 1 - Example of a sequence of overhauls of similar content

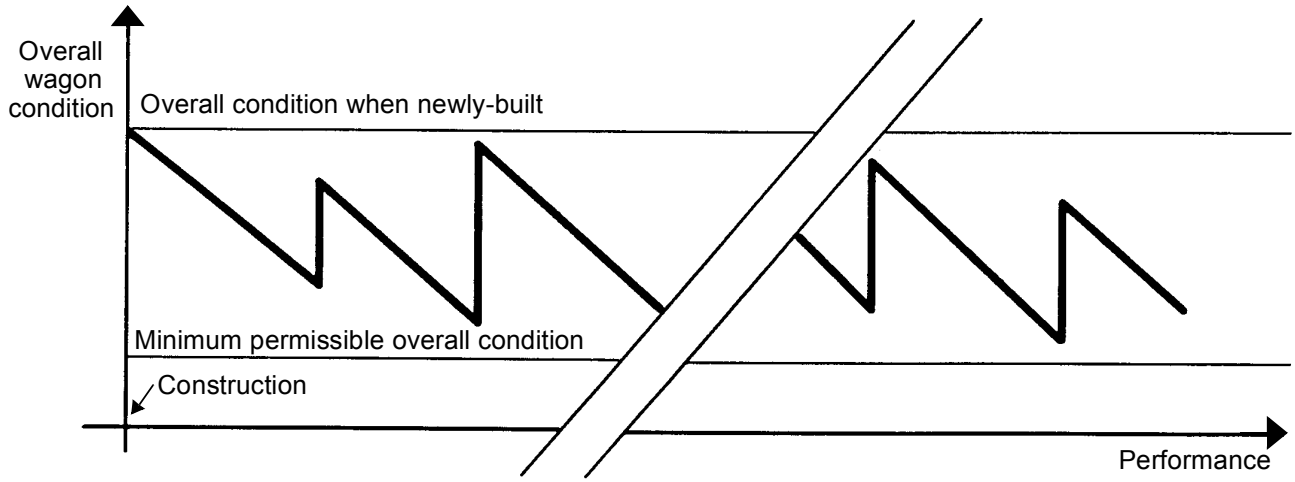

Fig. 2 - Example of a sequence of overhauls of different content

Appendix B - Changes in the condition of a wagon as a function of time

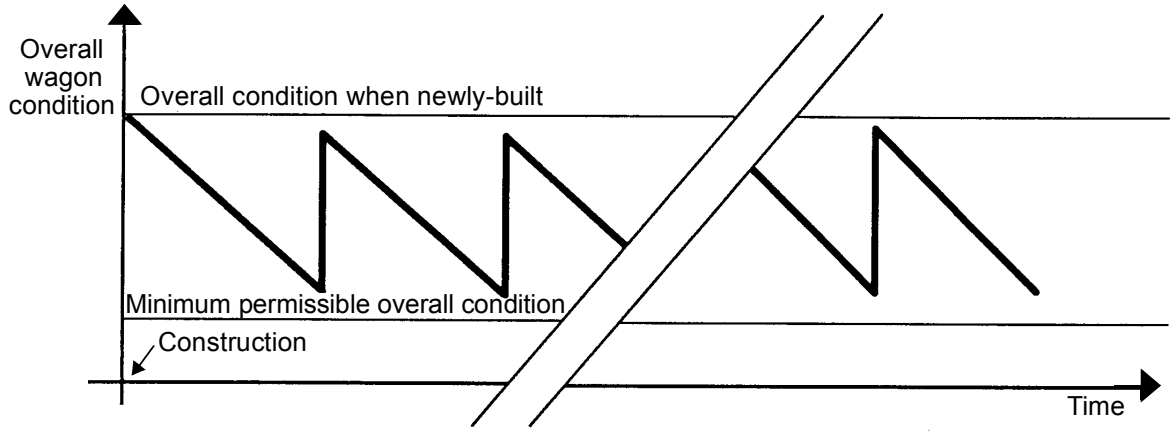

Fig. 3 - Example of a sequence of overhauls of similar content

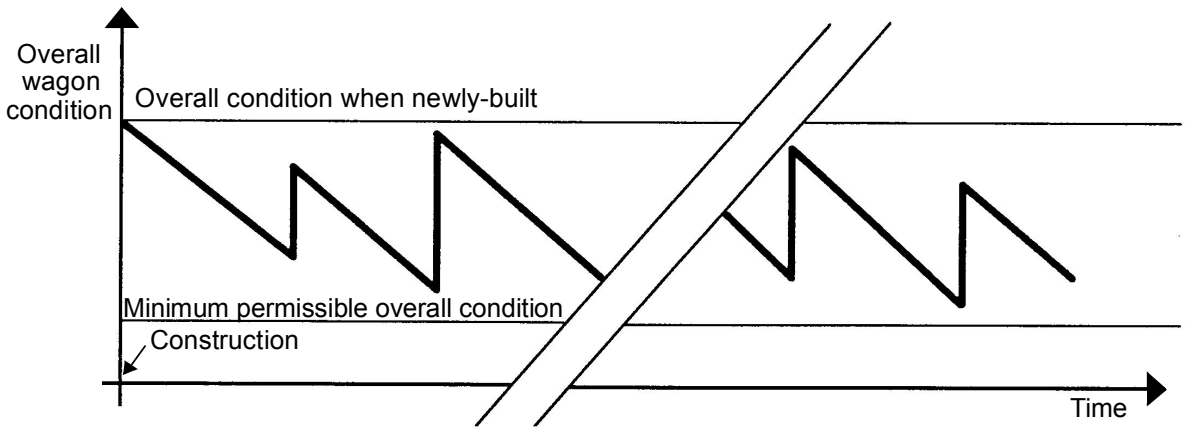

Fig. 4 - 1st example of a sequence of overhauls of different content

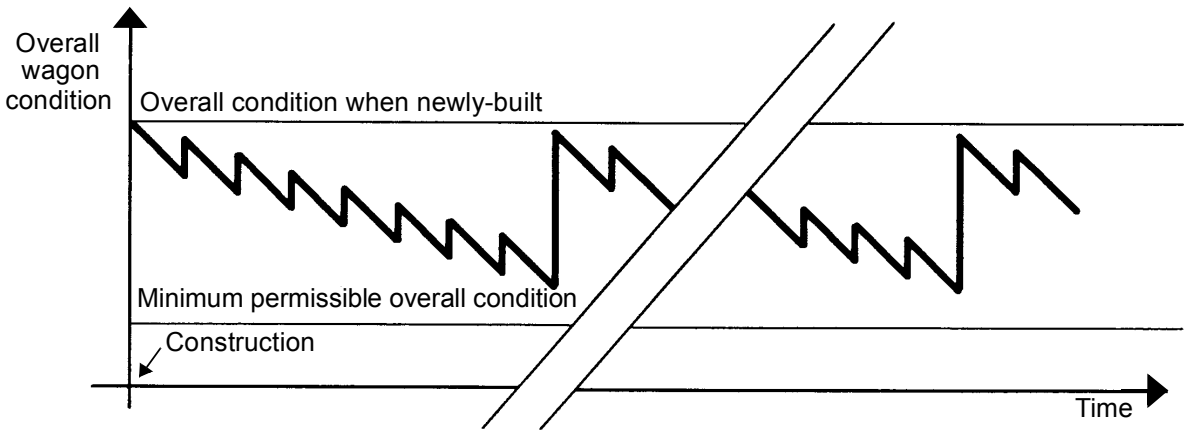

Fig. 5 - 2nd example of a sequence of overhauls of different content

Appendix C - Example of determination of the wear behaviour pattern of a component

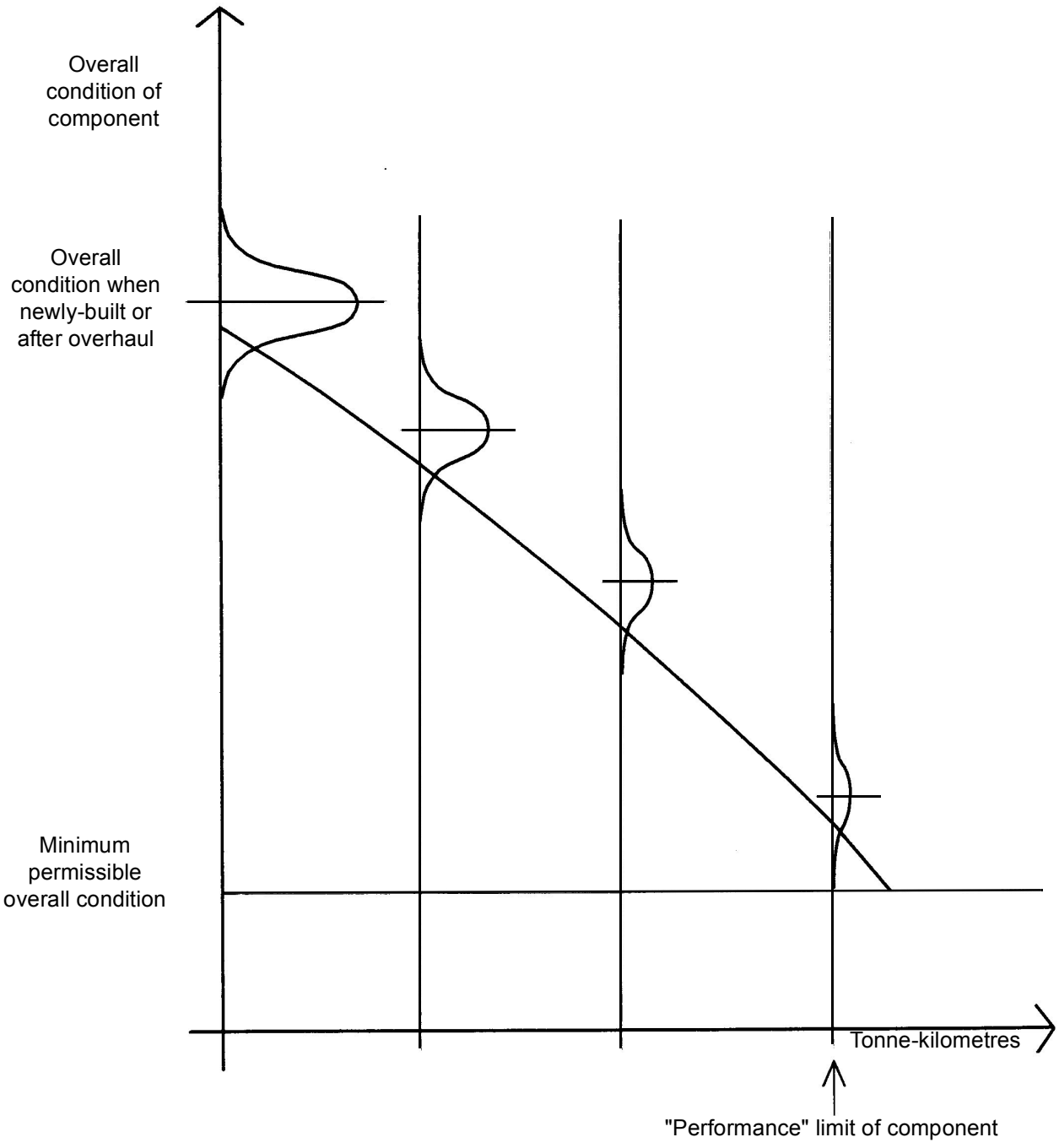

Fig. 6 - Example of determination of the wear behaviour pattern of a component

Appendix D - Scheduling of performance-based overhauls

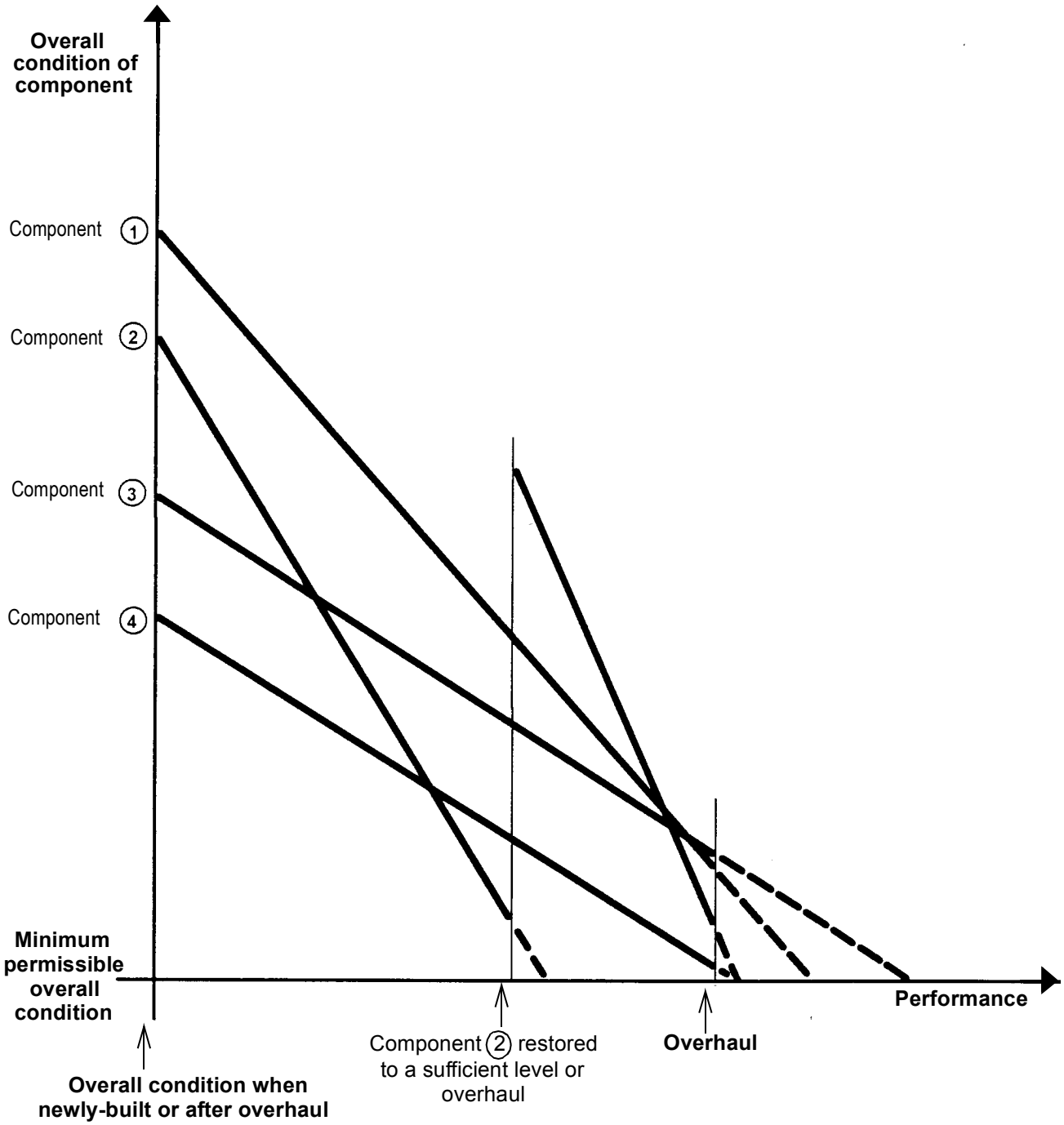

Fig. 7 - Example of combination of the wear behaviour patterns of several components

Appendix E - Scheduling of time-based overhauls

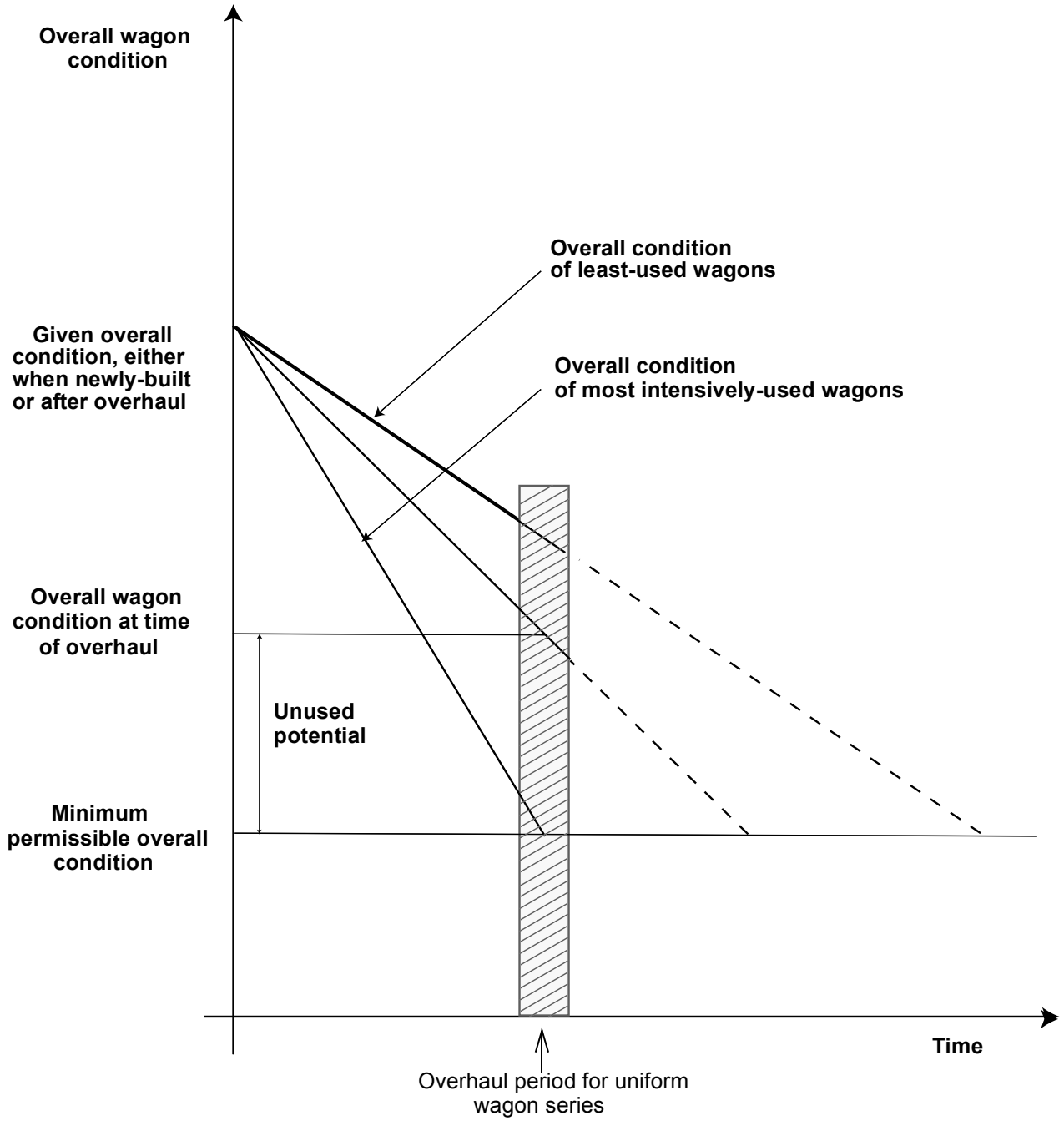

Fig. 8 - Scheduling of time-based overhauls

Appendix F - Principle and calculation of the time interval between two overhauls

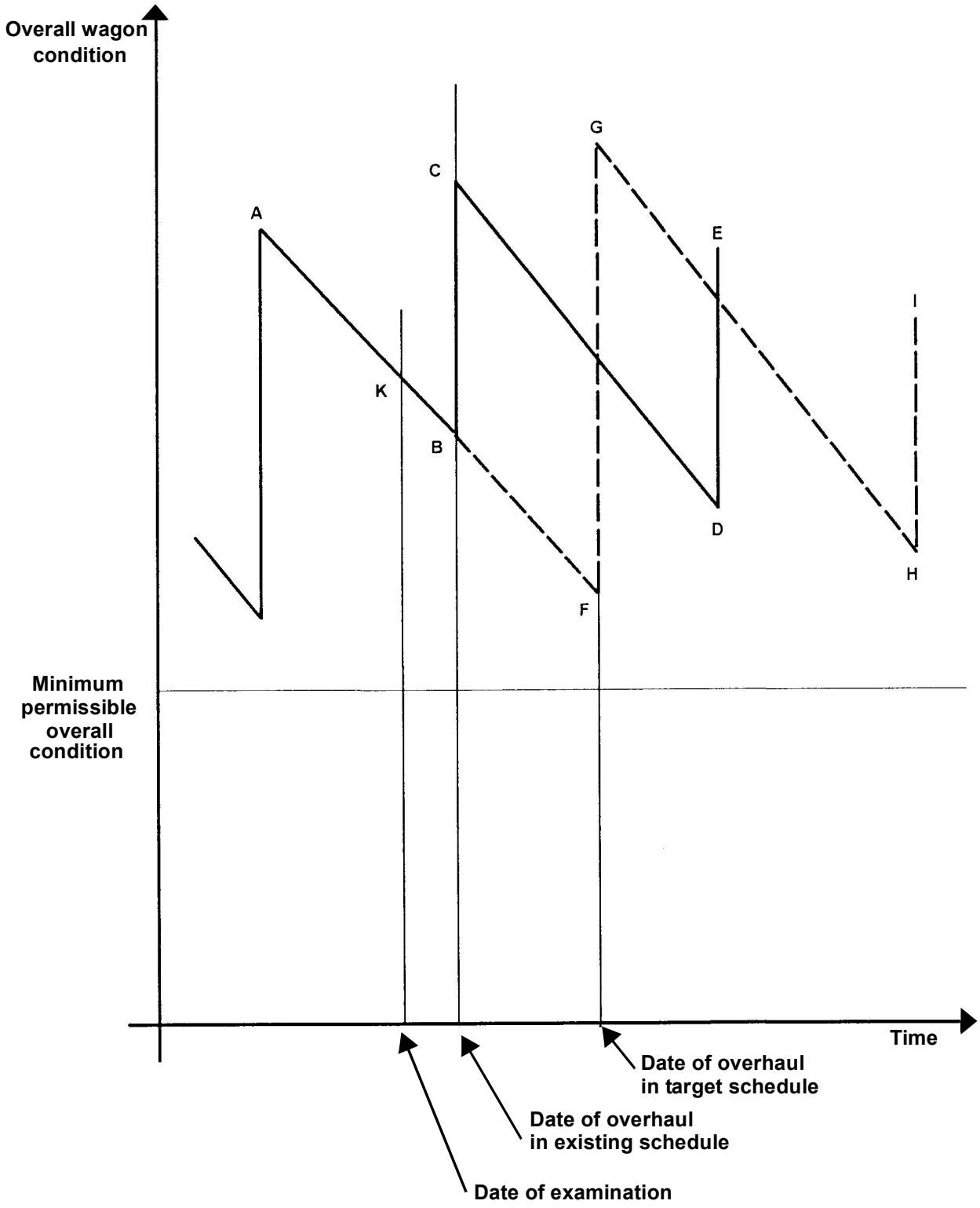

Fig. 9 - Principle and calculation of the time interval between two overhauls

Bibliography

1. UIC leaflets

International Union of Railways
Leaflet 579-2: Conditions for the technical transfer inspection of wagons, 2nd edition of 1.1.97

2. Minutes of meetings

International Union of Railways
Rolling Stock Committee (Question 5RIV 5 - New wagon maintenance system. Point 6.2 - Approval of Leaflet 579-1 "Wagons - Periodic overhaul - Methods for establishing its frequency and nature"), April 1997

Warning

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