

1st edition:
Version:

May 2021
Original

Infrastructure for tilting trains



© International Union of Railways, 2021. All rights reserved.
This document may not be reproduced – even in part – without the written authorisation of UIC.

IRS to be classified in volumes of UIC:

7 - Railway Infrastructure

Complete reference in case of citation:

IRS-70705:2021,Ed1: Infrastructure for tilting trains

Approbation date:

March 2021

With effect from:

March 2021

Application recommended to:

All Members of the International Union of Railways

Keywords:

Infrastructure, track, tilting trains, line alignment, minimum curve radius, transition curves, cant

Warning

No part of this publication may be copied, reproduced or distributed by any means whatsoever, including electronic, except for private and individual use, without the express permission of the International Union of Railways (UIC). The same applies for translation, adaptation or transformation, arrangement or reproduction by any method or procedure whatsoever. The sole exceptions - noting the author's name and the source - are "analyses and brief quotations justified by the critical, argumentative, educational, scientific or informative nature of the publication into which they are incorporated".
(Articles L 122-4 and L122-5 of the French Intellectual Property Code).

© International Union of Railways (UIC) - Paris, 2021

Published by the International Union of Railways (UIC)

16 rue Jean Rey, 75015 Paris - France, May 2021

Dépôt Légal May 2021

ISBN 978-2-7461-3078-4



Record of updates:

1st edition, May 2021

First edition.
UIC Leaflet 705 is being replaced by IRS 70705.

CONTENTS

Foreword	1
Executive summary	3
Field of application	4
Reference documents	5
Abbreviations and Symbols	6

General Application

1 – General	8
2 – Basic parameters used	9
2.1 – Revenue speeds of tilting trains	9
2.2 – Maximum axleloads.....	9
3 – Line alignment	11
3.1 – Minimum curve radius (R)	11
3.2 – Transition curves	11
3.2.1 – Length of transition sections	11
3.2.2 – Proportionality between curve and cant.....	11
3.2.3 – Distance between successive transition sections	12
3.3 – Cant (D).....	12
3.3.1 – Minimum cant (D).....	12
3.3.2 – Minimum change in cant between successive curves	12
3.3.3 – Maximum cant (D).....	12
4 – Kinematics	13
4.1 – Cant deficiency at the level of the track (I)	13
4.1.1 – Maximum deficiency (I)	13
4.1.2 – Limitation of deficiency (I) as a function of the curve radius (R)	14
4.1.3 – Restrictions on deficiency (I) for special features in the track	14
4.2 – Rate of change of cant dD/dt	14
4.3 – Rate of change of cant deficiency dI/dt	15
5 – Track	16
5.1 – Track equipment.....	16
5.2 – Quality of track geometry	16
6 – Speed increase tests	17
7 – Other areas	18

7.1 – Monitoring of speed. Protection against excess speed	18
7.2 – Sign boards	18
7.3 – Interaction between pantograph and overhead line	18
7.4 – Equivalent conicity	18
7.5 – Clearance gauge	18
7.6 – Pressure impacts in tunnels and in the open	18
7.7 – Protection of people on station platforms	18
7.8 – Power supply	18
8 – Information for the purpose of extending UIC Leaflet 518 to cover tilting trains (UIC Leaflet 518-1) 19	
Appendix A: Summary table	20
Regulatory listing	24
Bibliography	25

Foreword

An International Railway Solution (IRS) is a document drawn up by consensus and applied on a voluntary basis which aims to facilitate and harmonise railway operation.

IRSs are gradually replacing UIC leaflets.

Members of the International Union of Railways (UIC) participate in the creation of IRSs, of which they benefit in full. Furthermore, marketing to railway stakeholders contributes to the sharing and harmonisation of good practices, in accordance with UIC's primary goal.

While IRSs do not have the force of law, they are created and published in a professional manner and with technical approval on the basis of UIC procedures, and have full technical legitimacy in the railway sector.

The "General application" section constitutes the heart of the IRS and contains the working group's expertise applicable in the broadest manner. The addition of a "Specific application" aims to cover factors specific to a region, a type of service, etc.

Some provisions shall be implemented in all cases to ensure correct application and maintain the system's cohesiveness. Certain operational circumstances require that specific provisions be systematically applied by all users of the document.

For the purposes of understanding, the user acknowledges that the expression of:

- obligation indicates requirements to be respected in order to comply with the expertise expressed in the document (usually "shall");
- recommendation indicates options that are favourable but not essential (usually "should");
- permission indicates options that are recognised but without consequence (usually "may");
- capacity indicates possibilities from a technical standpoint and not permissions or probabilities (usually "can").

Obligation, recommendation and capacity can be expressed in the negative to indicate prohibiting, non-recommendation and incapacity.

If applicable, notably for the purposes of compliance with a UIC approval, passages that are recommended or mandatory for the cohesiveness of the system will be accompanied by the letters "R" and "MCS" respectively.

This IRS reflects the following UIC working group expertise:

TEG (Track Experts Group)

It integrates in full or in part the following UIC leaflets:

UIC Leaflet 705, Infrastructure for tilting trains, 1st edition, August 2003

Executive summary

Work was launched in early 1999 as part of a UIC study on reducing journey times on conventional lines. Following initial discussions, it was decided that the rules governing infrastructure for tilting trains would be harmonised on a documentary basis.

The project partners involved comprised not only railways already with tilting trains in operation but also ones which had plans to introduce tilting trains in the future.

Two significant results were produced: a list of essential parameters to be taken on board and the establishment of limit values. A list of parameters not affected by tilt was also drawn up.

For the sake of clarity, the IRS also contains some explanations on basic technical subjects such as the impact of tilting trains on wheel/rail interaction. A table has been appended to the IRS summarising all the rules adopted by the railway companies that were members of the working party. The table is therefore the starting point for the work carried out.

The most important considerations are the range of definitions (basic parameters such as maximum and minimum speeds, axle loads, track layout, cant deficiency to be applied, etc.), kinematics, track equipment and track geometrical quality, interface parameters track/train, etc.

Maintenance-related topics were not covered by the work. Some railways have advocated carrying out studies with a view to determining speed increases that could be achieved by running tilting vehicles on high-speed lines.

The IRS 70705 Infrastructure for tilting trains, formerly *UIC Leaflet 705*, includes an updated Appendix A: Summary table with new information provided by the UIC TEG (Track Experts Group) in 2020.

Field of application

This IRS relates to the track design parameters for operation of tilting trains. The impact of this type of traffic on track maintenance is not addressed. Railways operating tilting trains may adapt the design parameters in the light of any acceptable additional maintenance

Reference documents

The following documents are cited in this IRS or strongly support its requirements and recommendations:

1. UIC Leaflets

International Union of Railways (UIC)

- [1] *UIC Leaflet 518: Testing and approval of railway vehicles from the point of view of their dynamic behaviour - Safety - Track fatigue - Running behaviour*, 4th edition, October 2009
- [2] *UIC Leaflet 518-1: Supplement to UIC Leaflet 518: application to vehicles equipped with a cant deficiency compensation system and/or to vehicles intended to operate with a higher cant deficiency than stated for categories I to III*, Cancellation