

# Contents

<b>List of Figures</b> .....	<b>1</b>
<b>1. Introduction - Durability of track geometry maintenance</b> .....	<b>3</b>
1.1 Background .....	3
1.2 Methodology .....	3
1.3 Definition of Track Geometry Durability .....	4
<b>2. Influence of external factors</b> .....	<b>5</b>
2.1 Principal external parameters .....	5
2.2 Principal external parameters – specifics to optimise track geometry durability .....	6
<b>3. Rail grinding</b> .....	<b>8</b>
3.1. The impact of rail head imperfections upon track geometry durability .....	8
3.2. Rail corrugation .....	8
3.3. Rail grinding.....	9
<b>4. Track geometry recording and tamping intervention levels</b> .....	<b>10</b>
4.1 Track geometry recording and standards for intervention levels .....	10
4.2 Attainment of track quality over successive tamping cycles.....	12
4.3 Attainment of track quality – influence of ballast and formation conditions ....	14
4.4 The relationship between ride quality, speed and track quality .....	15
4.5 Optimum tamping threshold level .....	17
<b>5. Track geometry design</b> .....	<b>19</b>
5.1 General .....	19
5.2 Influence of topography .....	19
5.3 Track geometry transitions.....	19
5.4 Circular curves, vertical curves, reverse curves, cant and cant deficiency .....	20
<b>6. Tamping site preparation and planning</b> .....	<b>21</b>
6.1 General – Timescales .....	21
6.2 Weather.....	21
6.3 Site extent.....	22
6.4 Site planning and investigation.....	22
6.5 Track geometry surveys/designs .....	24
<b>7. Lateral geometry restraint by use of ballast gluing and safety caps</b> .....	<b>25</b>
7.1 Ballast Gluing .....	25
7.2 Safety caps.....	26

<b>8. Tamping processes for optimum geometry durability .....</b>	<b>28</b>
8.1 Components .....	28
8.2 Tamping parameters.....	29
8.3 S&C Tamping.....	31
<b>9. Relative and Absolute tamping methods .....</b>	<b>35</b>
9.1. Definitions of Relative and Absolute tamping .....	35
9.2. Relative Tamping .....	35
9.3. Absolute Tamping .....	37
9.4. GNSS Tamping.....	40
<b>10. The stoneblower .....</b>	<b>42</b>
10.1. Description .....	42
10.2. Choice of sites.....	42
10.3. Site preparation.....	43
10.4. Stoneblower durability.....	44
<b>11. Current use of ballast consolidators and Dynamic Track Stabilisers with maintenance tamping .....</b>	<b>45</b>
11.1 Introduction.....	45
11.2 Tampers fitted with sleeper-end consolidators .....	45
11.3 Purpose-built ballast crib and shoulder consolidators .....	46
11.4 Dynamic track stabiliser (DTS).....	48
11.5 Summary of current European practice with DTS and ballast consolidators .....	50
11.6 Best Practice: Dynamic Track Stabilisers and ballast consolidators – background to the 2006/7 UIC tamping trials .....	51
<b>12. Results for tamping durability and from recent UIC trials.....</b>	<b>52</b>
12.1 Historical data .....	52
12.2 Results of the UIC maintenance tamping trials using DTS and ballast crib & shoulder compactor machines.....	54
<b>13. Summary – Best Practice Guide for optimum track geometry durability .....</b>	<b>61</b>
13.1 Introduction .....	61
13.2 Influence of external factors .....	61
13.3 The influence of rail grinding .....	61
13.4 The use of track geometry recording and tamping intervention levels.....	61
13.5 The influence of good track geometry design .....	62
13.6 Tamping site preparation and planning .....	62
13.7 Lateral geometry restraint by use of ballast gluing and safety caps .....	62
13.8 Tamping processes for optimum track geometry durability .....	62
13.9 Relative and Absolute tamping methods.....	63
13.10 The stoneblower.....	63
13.11 Current use of ballast consolidators and DTS with maintenance tamping ..	63
13.12 Results for tamping – maintenance and data from UIC Trials.....	63

<b>Appendix A - Summary of current European track geometry maintenance activities.....</b>	<b>65</b>
<b>Appendix B - Summary of UIC Maintenance of Track Geometry Questionnaires of Influence of Rail Grinding .....</b>	<b>77</b>
<b>Appendix C - Summary of current European practice for ballast profiles and safety caps (lateral restraints).....</b>	<b>83</b>
<b>Appendix D - Comparative results for tamping durability &amp; Data from UIC trials DTS/tamping/consolidation 2007 (see chapter 12).....</b>	<b>93</b>
<b>Glossary .....</b>	<b>109</b>
<b>List of reference.....</b>	<b>113</b>