DIN EN 15595:2021-07 (E)

Railway applications - Braking - Wheel slide protection (includes Corrigendum :2021)

Contents

Page

European foreword 6

Introduction 7

1 Scope 8

2 Normative references 8

3 Terms and definitions 9

4 Symbols and abbreviations 12

5 Requirements 12
5.1 Functional requirements 12
5.1.1 Objectives of wheel slide protection 12
5.1.2 General functional requirements 13
5.1.3 Control of the brake force 13
5.1.4 Wheel slide protection watchdog (safety timer) 14
5.1.5 Air supply 14
5.1.6 Wheel diameter differences 14
5.1.7 Wheel rotation monitoring (WRM) 14
5.1.8 Diagnostics 15
5.2 Design requirements 16
5.2.1 Environmental specification 16
5.2.2 Fire behaviour 16
5.2.3 RAMS 17
5.2.4 Mechanical construction 17
5.2.5 Power management 17
5.2.6 Software 18
5.2.7 Electronic control unit Input/Output (I/O) 18
5.2.8 Sensor - axle speed acquisition 18
5.2.9 Actuator - modification of brake force 18
5.3 Installation recommendations 19
5.3.1 General installation requirements 19
5.3.2 Air system 19
5.3.3 Power supply and electrical system 19
5.4 Performance requirements for WSP 20
5.4.1 Performance 20
5.4.2 Stopping distance and adhesion improvement 21
5.4.3 Wheelset slide limits 21
5.4.4 Track damage 22
5.4.5 Maximum deceleration 22
5.4.6 Air consumption 23
5.4.7 Output based on speed information provided by WSP 23

6 Range of tests 24
6.1 General 24
6.1.1 Test classifications 24
6.1.2 Assessor 24
6.2 Type Test 24
6.2.1 General 24

6.2.2 Test requirements 24
6.2.3 Individual component Type Test 24
6.3 Vehicle Implementation Test 25
6.3.1 General 25
6.3.2 Test requirements 26
6.3.3 Conformity of previous vehicle tests 26
6.4 List of tests 26
6.4.1 Standard tests 26
6.4.2 Drag tests 26
6.4.3 Test methods for speeds from 160 up to 200 km/h 27
6.4.4 Test methods for speeds > 200 km/h 27
6.4.5 Supplementary higher deceleration tests 27
6.4.6 Supplementary approval tests for WSP acting in vehicles with brakes that are independent of adhesion 27
6.4.7 Supplementary approval tests involving tractive units and trainsets having dynamic brakes 27
6.4.8 Testing of wheel rotation monitoring (WRM) 28
6.5 Re-testing 34
6.5.1 General 34
6.5.2 Hardware 34
6.5.3 Software 35

7 Test methods 35
7.1 General 35
7.2 Measurement 36
7.3 Tests on vehicle 37
7.3.1 General 37
7.3.2 Generation of degraded adhesion 38
7.3.3 Environmental conditions 38
7.4 Test in simulation environment 39
7.4.1 General 39
7.4.2 Tests on simulation rig 39
7.4.3 Additional specific simulator tests 40
7.4.4 Optional tests 40

8 Evaluation of test 40
8.1 Correcting the stopping distances 40
8.2 Number and validity of dry tests 40
8.3 Evaluation of slide test 40
8.3.1 General 40
8.3.2 Evaluation of stopping performance 41
8.3.3 Evaluation of test validity 42
8.3.4 Evaluation of relative air consumption 51

9 Documentation of tests 52
9.1 Test Specification 52
9.2 Test report 53

10 Routine test and inspection 54

11 Designation, identification and marking 54

Annex A (normative) Tables linking the WSP / WRM Requirements to Tests and Test Criteria 55

Annex B (normative) Minimum requirements for a WSP simulator 75

B.1 General 75
B.1.1 General 75
B.1.2 Use of the simulator model 75
B.2 Adhesion model 81
B.2.1 General 81
B.2.2 Constant adhesion condition 81

B.2.3 Variable adhesion condition 81
B.2.4 Adhesion conditioning factors 82
B.3 Test and performance model 82
B.3.1 General 82
B.3.2 Simulator performance 82
B.3.3 Test requirements 82
B.3.4 Stopping performance 82
B.3.5 Wheel damage 83
B.3.6 Air system 83
B.3.7 Pass/fail limits 83
B.3.8 Fault conditions 83
B.3.9 WSP outputs 84
B.4 Vehicle performance model 84
B.4.1 General 84
B.4.2 Friction material 84
B.4.3 Pneumatic actuator/brake demand 84
B.4.4 Body/Bogie/wheel dynamics 84
B.5 Vehicle functional model 85
B.5.1 General 85
B.5.2 Functional inputs 85
B.6 Simulator validation 85
B.6.1 General 85
B.6.2 Validation of test benches 85
B.6.3 Management 88

Annex C (informative) Example of customer specific simulator tests 89

C.1 Naturally occurring variable adhesion tests 89
C.1.1 General 89
C.1.2 Sequence 89
C.1.3 Measurement and pass/fail criteria 91
C.2 Sustained low adhesion track condition (SLAC) Tests 92
C.2.1 Sequence 92
C.2.2 Measurement/pass fail criteria 93
C.2.3 WSP speed reference (vref) 93
C.3 Operating speeds above 160 km/h 93
C.3.1 Criteria 93
C.3.2 Sequence 94
C.3.3 Measurement and pass/fail criteria 94

Annex D (informative) Optional tests 95

D.1 Sander system tests -- Criteria 95
D.2 Dynamic braking system tests -- Criteria 96
D.3 Peripheral output tests -- Criteria 96

Annex E (informative) Typical diagram of a real WSP test 98

Annex F (informative) In-service monitoring 100

Annex G (informative) Braking configurations 101

G.1 Per bogie control 101
G.2 Per wagon control 101

Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC aimed to be covered 103

Bibliography 105