DIN EN 13814-1:2024-12 (E)

Safety of amusement rides and amusement devices - Part 1: Design and manufacture (includes Amendment A1:2024)

Contents

Page

European foreword 6

Introduction 7

1 Scope 8

2 Normative references 8

3 Terms and definitions 11

4 Requirements for design analysis 16
4.1 Design documents 16
4.1.1 General 16
4.1.2 Design risk assessment 16
4.1.3 Description of design and operation 16
4.1.4 Design and manufacturing drawings 16
4.1.5 Principles of analysis 17
4.2 Selection of materials 18
4.2.1 General 18
4.2.2 Recommended steels 18
4.2.3 Aluminium alloy 19
4.2.4 Timber 19
4.2.5 Plastic composites 19
4.2.6 Concrete 19
4.2.7 Fasteners for structural components 19
4.2.8 Standards relating to ropes, chains, safety devices, connectors and adapters 19
4.3 Design loads 20
4.3.1 General 20
4.3.2 Permanent actions 21
4.3.3 Variable actions 21
4.3.4 Seismic forces 25
4.3.5 Applicable coefficients 26
4.3.6 Load combination 27
4.4 Structural analysis - Principles 28
4.4.1 General 28
4.4.2 Analysis principles for various types of rides 29
4.4.3 Other railways with track-bound vehicles 33
4.5 Verification of stability 34
4.5.1 Safety against overturning, sliding and lifting 34
4.6 Ground anchorage 36
4.6.1 General 36
4.6.2 Design load bearing capacity of weight anchors 37
4.6.3 Design load bearing capacity of rod anchors 37
4.6.4 Testing of anchors (Numbering) 39
4.6.5 Calculation of loads on anchors 39
4.6.6 Further requirements 40
4.6.7 Ground support for packing 41
4.7 Verification of strength 41
4.7.1 General 41
4.7.2 Predominantly static stress 42
4.7.3 Fluctuating stress 42

4.7.4 Bolts ... 45
4.7.5 Ropes, chains, safety devices, connectors and adapters ... 47
4.8 Structural design and construction ... 49
4.8.1 Arrangement, accessibility ... 49
4.8.2 Locking and safety devices for fasteners ... 49
4.8.3 Joints intended for regular dismantling ... 49
4.8.4 Designing of components subject to fluctuating loads ... 50
4.8.5 Supports ... 50
4.8.6 Central masts ... 50
4.8.7 Prevention of corrosion and rot ... 50

5 Requirements for design and manufacture of rides and structures ... 50
5.1 Risk reduction by prevailing design and safety measures ... 50
5.1.1 General ... 50
5.1.2 Risk assessment ... 51
5.1.3 Risk reduction for platforms, ramps, floors, stairs and walkways ... 52
5.1.4 Risk reduction by the use of barriers, fencing and guarding ... 56
5.1.5 Guarding of machinery parts ... 60
5.1.6 Risk reduction in the case of access and egress ... 60
5.1.7 Risk reduction for passengers units ... 62
5.1.8 Requirements by special provisions ... 75
5.2 Supplementary safety requirements for various types of amusement device ... 76
5.2.1 Amusement rides with vertical axis ... 76
5.2.2 Amusement rides with horizontal axis ... 78
5.2.3 Rail-guided channel or track-bound amusement devices ... 80
5.2.4 Dodgem cars/Bumper cars ... 82
5.2.5 Speedways/Go-karts ... 87
5.2.6 Mini-motorbikes for children ... 87
5.2.7 Boat rides ... 88
5.2.8 Flume rides ... 89
5.2.9 Helter skelters, slides, etc ... 90
5.2.10 Side shows, booths, win-a-prize and sales stands, mazes, halls of mirrors, fun houses, labyrinths, hammers, ring the bell and similar ... 91
5.2.11 Shooting stands and trailers, shooting devices ... 93
5.3 Mechanical systems ... 95
5.3.1 Hydraulic and pneumatic devices ... 95
5.3.2 Lifting and elevating units being integral part of a ride ... 97
5.4 Manufacture and supply ... 100
5.4.1 Manufacturer ... 100
5.4.2 Quality assurance -- Quality plan ... 100
5.4.3 Manufacturing process ... 102
5.4.4 Safety precautions to be taken by the manufacturer ... 103
5.4.5 Electrical installations ... 104
5.5 Supply ... 104
5.5.1 Manuals ... 104
5.5.2 Special information ... 105
5.5.3 Drawings and diagrams ... 106
5.6 Design documentation ... 106
5.6.1 General ... 106
5.6.2 Description of installation and technical specification/information ... 107
5.7 Amusement Device Log ... 107
5.7.1 General ... 107
5.8 Official technical dossier ... 109
5.8.1 General ... 109
5.8.2 Content ... 109
5.8.3 Identification marking ... 109

Annex A (normative) Electrical equipment and control systems ... 111

A.1 Electrical equipment ... 111
A.1.1 General ... 111
A.1.2 Protection against electric shocks ... 111

A.1.3 Protection against lightning 112
A.1.4 Lighting 112
A.1.5 Generators 113
A.1.6 Heaters and light fittings 113
A.1.7 Communication !means" 113
A.2 Control Systems 113
A.2.1 General 113
A.2.2 Safety-related control functions 114
A.2.3 Safety-related parameters 115
A.2.4 Passenger restraints 116
A.2.5 Fall Prevention 117
A.2.6 Inhibiting of safety functions 118
A.2.7 Operating modes 119
A.2.8 Collision prevention safety function 121

Annex B (informative) Control systems - Best practices 123

B.1 Security 123
B.2 Example block zone logic 123
B.3 Requirements for the positioning of sensors and stopping devices 123

Annex C (informative) Guidance on design of passenger containment 125

Annex D (informative) Amusement Device Log for an amusement device 130

Annex E (informative) List of main hazards, hazardous situations and events for spectators and passengers during the operation and use of amusement rides 151

Annex F (informative) Guest behaviour 155

F.1 Scope 155
F.2 Terms and definitions 155
F.2.1 General 155
F.2.2 Boarding passengers 155
F.2.3 Riding passengers 155
F.2.4 Exiting passengers 155
F.2.5 Waiting passenger 155
F.2.6 Behaviour 155
F.2.7 Foreseeable behaviour 155
F.2.8 Parent or Supervision Companion 156
F.2.9 Child 156
F.2.10 Information to public 156
F.2.11 Parents or Supervision Companions accompanying children 156
F.3 Classification of age and basic capabilities 156
F.4 Human factors 158
F.5 General Strategy of Risk mitigation in Guest Behaviour 158
F.5.1 General 158
F.5.2 Adults 158
F.5.3 Refusal of access 159
F.5.4 Normal Behaviour 159
F.5.5 Unacceptable behaviour 159

Annex G (informative) Limited accessibility to amusement devices 160

Annex H (informative) Safety envelope for passengers 162

H.1 Design Criteria 162
H.2 Anthropometric Basis 162
H.3 Methods for Defining Safety Envelope Boundaries 162
H.3.1 Documentation 162
H.3.2 Prerequisites 163
H.3.3 Safety envelopes 163

H.3.4 Hazards and related safety envelope class 163

Annex I (informative) Acceleration effects on passengers 165

I.1 Medical tolerance - General 165
I.2 Rides 165
I.2.1 General 165
I.2.2 General Definitions and Limitations 166
I.2.3 Acceleration in X-Direction 166
I.2.4 Acceleration in Y-Direction 168
I.2.5 Acceleration in Z-direction (parallel to Spine) 169
I.2.6 Combinations 170
I.3 Reversals 171
I.3.1 Reversals in X and Y 171
I.3.2 Transitions in Z 172
I.4 Example obtaining admissible accelerations 174

Bibliography 176