DIN EN 17206:2022-02 (E)

Entertainment technology - Machinery for stages and other production areas - Safety requirements and inspections (includes Corrigend um :2021)

Contents

Page

European foreword 7

Introduction 8

1 Scope 10

2 Normative references 10

3 Terms and definitions 12
3.1 General terms 12
3.2 Loads, forces and pressures 16
3.3 Electrical equipment and control systems 18
3.4 Tolerances relating to movement 21

4 Hazards 21
4.1 General 21
4.2 List of Significant Hazards 22

5 Design requirements 26
5.1 General 26
5.2 Examples of machine installations showing the groups 27
5.3 Load assumptions for stage elevators 29
5.4 Load bearing equipment 30
5.4.1 General 30
5.4.2 Load bearing lines 30
5.4.3 Load bearing lines terminations 30
5.5 Winding devices and diverter pulleys 33
5.5.1 Winding devices for wire ropes 33
5.5.2 Diverter pulleys for round wire ropes 33
5.5.3 Drive and idler sprockets for steel chains 33
5.6 Drive systems 34
5.6.1 General 34
5.6.2 Screw jack systems (spindle drives) 35
5.6.3 Hydraulic systems 35
5.6.4 Auxiliary drive systems 36
5.6.5 Manual systems 36
5.7 Load carrying devices 36

6 Safeguarding hazardous areas 37
6.1 Protective spaces for inspection and maintenance 37
6.2 Accessibility of maintenance areas 37
6.3 Safeguarding at crushing, shearing and trapping points, and fall protection 38
6.4 Elevator shaft walls, openings and landing doors 38
6.4.1 General 38
6.4.2 Interlocking of doors 38
6.5 Counterweights 38

7 Electrical equipment and control systems 39
7.1 General requirements 39
7.1.1 General 39
7.1.2 Selection of equipment 40

7.1.3 Physical environment and operation conditions 40
7.2 Incoming supply conductor terminations and devices for disconnecting and switching off 41
7.2.1 Electric motors and associated equipment 41
7.2.2 Protection against electric shock 41
7.2.3 Protection of equipment 41
7.2.4 Control circuits and control functions 42
7.2.5 Travel of groups of machines 43
7.3 Safety functions and control functions in the event of failure 43
7.3.1 General 43
7.3.2 Providing redundancy 44
7.3.3 Hazardous operating conditions 44
7.3.4 Safety devices and safety functions 45
7.3.5 Means for testing safety devices and safety functions 48
7.4 Emergency stop functions 49
7.4.1 Emergency stop 49
7.4.2 Actuators for and design of emergency stop functions 49
7.5 Complementary Protective Measures 49
7.5.1 General 49
7.5.2 Limitation of number of simultaneous moving machines 50
7.5.3 Protection against unplanned load deviations (load profile monitoring) 50
7.6 Electronic and programmable electronic systems (E/PES) 50
7.6.1 General 50
7.6.2 Programmable controllers 50
7.6.3 Use of programmable electronic systems (E/E/PES) to implement safety functions 50
7.7 Use of electronic and programmable electronic systems (E/PES) without safety functions 50
7.8 Operator interfaces, control devices and contactors 50
7.8.1 General 50
7.8.2 Requirements for contactors 50
7.9 Marking, warning signs and reference designations 51
7.10 Testing and validation of electrical systems 51
7.10.1 General 51
7.10.2 Scope of routine testing 51
7.11 Validation and verification of functional safety systems 51

8 Documentation 52
8.1 General 52
8.2 Technical data to be included 52
8.2.1 General 52
8.2.2 User information for safety functions 52
8.3 Marking 53
8.3.1 General 53
8.3.2 Entertainment load limit 53
8.3.3 Supplementary loading information 54
8.3.4 Machinery 54
8.3.5 Remote operation 55
8.4 Documentation and information 55
8.4.1 General 55
8.4.2 Operating manual 55
8.4.3 Installation Instructions 57
8.4.4 Repair and maintenance instructions 57
8.4.5 Inspection and examination 58
8.4.6 Dismantling instructions 58
8.4.7 Appendix to instructions (for additional necessary documents) 58

9 Testing prior to first use and after substantial changes 59
9.1 General 59
9.2 Test log 59
9.3 Testing prior to first use 59
9.3.1 Type, extent and performance of tests 59
9.3.2 Acceptance test 60

9.4 Test after changes and modifications 62
9.4.1 Substantial Changes 62
9.4.2 Any other changes 62

Annex A (normative) Examples of hazards and risk origin 63

Annex B (normative) Use case definitions 72

B.1 General 72
B.2 Upper machinery 72
B.3 Lower stage machinery - lifting 73
B.4 Lower stage machinery - horizontal movement 74

Annex C (informative) Recommended safety functions and measures 75

C.1 General 75
C.2 Upper machinery 75
C.3 Lower machinery - lifting 76
C.4 Lower machinery - horizontal movement 77

Annex D (normative) End user information table to be supplied by the manufacturer 78

Annex E (informative) Designing safeguards on the basis of risk assessment 81

E.1 General 81
E.2 Risk assessment as in EN 62061 81
E.2.1 General 81
E.2.2 Guidance for selecting parameters Se, Fr and Pr for the risk estimation 82
E.2.2.1 Severity of injury (Se) 82
E.2.2.2 Probability of occurrence of harm 83
E.2.2.3 Frequency and duration of exposure (Fr) 83
E.2.2.4 Probability of occurrence of a hazardous event 83
E.2.2.5 Probability of avoiding or limiting harm (Av) 85
E.2.2.6 SIL assignment 85
E.3 Risk assessment as in EN ISO 13849-1 88
E.3.1 General 88
E.3.2 Guidance for selecting parameters S, F and P for the risk estimation 88
E.3.2.1 Severity of injury S1 and S2 88
E.3.2.2 Frequency and/or exposure times to hazard, F1 and F2 88
E.3.2.3 Possibility of avoiding the hazard P1 and P2 88

Annex F (informative) Examples of using the risk graphs 91

F.1 Guidance for risk evaluation values for control system functions 91
F.2 Severity 91
F.3 Possibility of avoiding the hazardous event 92
F.4 Possibility frequency and duration of exposure 92
F.5 Probability of occurrence of a hazardous event 93

Annex G (informative) Application examples 94

G.1 General 94
G.2 Chain hoist for a speaker cluster - Stop on "deadman release" 94
G.2.2 Use Case identification - Annex B 95
G.2.3 Hazard definition - Annex A 95
G.2.4 Safety function allocation - Annex C 95
G.2.5 Initial risk estimation - Annex F 96
G.2.6 Safety function estimation - Annex E 96
G.3 Broadcast studio lighting hoist - Protection against overload 96
G.3.2 Use Case identification - Annex B 97
G.3.3 Hazard definition - Annex A 97
G.3.4 Safety function allocation - Annex C 97

G.3.5 Initial risk estimation - Annex F 98
G.3.6 Safety function estimation - Annex E 98
G.4 Group of winches lifting a common load - protection against loss of group synchronisation 98
G.4.2 Use Case identification - Annex B 99
G.4.3 Hazard definition - Annex A 99
G.4.4 Safety function allocation - Annex C 99
G.4.5 Initial risk estimation - Annex F 99
G.4.6 Safety function estimation - Annex E 100
G.5 Chain hoist to fly a performer - protection against over-speed 100
G.5.2 Use Case identification - Annex B 101
G.5.3 Hazard definition - Annex A 101
G.5.4 Safety function allocation - Annex C 101
G.5.5 Initial risk estimation - Annex F 101
G.5.6 Safety function estimation - Annex E 102
G.6 Two winches to fly a performer - Protection against position deviation 102
G.6.2 Use Case identification - Annex B 102
G.6.3 Hazard definition - Annex A 103
G.6.4 Safety function allocation - Annex C 103
G.6.5 Initial risk estimation - Annex F 103
G.6.6 Safety function estimation - Annex E 103
G.7 Orchestra pit elevator - Protection against crushing/shearing 104
G.7.2 Use Case identification - Annex B 104
G.7.3 Hazard definition - Annex A 104
G.7.4 Safety function allocation - Annex C 104
G.7.5 Initial risk estimation - Annex F 105
G.7.6 Safety function estimation - Annex E 105
G.8 Stage elevator platform - Protection against overload 105
G.8.2 Use Case identification - Annex B 106
G.8.3 Hazard definition - Annex A 106
G.8.4 Safety function allocation - Annex C 106
G.8.5 Initial risk estimation - Annex F 106
G.8.6 Safety function estimation - Annex E 107

Bibliography 108