DIN EN 16228-1:2022-07 (E)

Drilling and foundation equipment - Safety - Part 1: Common requirements (includes Amendment A1:2021)

Contents

Page

European foreword 7

Introduction 9

1 Scope 10

2 Normative references 11

3 Terms and definitions 14

4 List of significant hazards 19

5 Safety requirements and/or protective measures 24
5.1 General 24
5.2 Requirements for strength and stability 24
5.2.1 Loads 24
5.2.2 Structural calculations 25
5.2.3 Rigid body stability 26
5.2.4 Floating ship, barge or pontoon 36
5.3 Electrotechnical systems 36
5.3.1 General 36
5.3.2 Battery installation 37
5.3.3 !Electromagnetic compatibility (EMC)" 37
5.4 Hydraulic and pneumatic systems 37
5.4.1 Hydraulic systems 37
5.4.2 Pneumatic systems 38
5.4.3 Hoses, pipes and fittings under pressure 38
5.5 Failure of the power supply 39
5.6 Uncontrolled motion 39
5.7 Brakes of the carrier machine 39
5.7.1 Brakes for travelling 39
5.7.2 Brakes for slewing 39
5.8 Winches, draw-works and ropes 39
5.8.1 General 39
5.8.2 Winches and pulleys 40
5.8.3 Pulley and drum diameters 41
5.8.4 Ropes and rope end terminations 41
5.8.5 Roller and leaf chains 41
5.9 Masts, derricks and feed beams 42
5.10 Indicating/limiting devices for inclination 42
5.10.1 Inclination of leader, mast or boom 42
5.10.2 Inclination of the carrier 42
5.10.3 Stroke limiting devices 42
5.11 Ergonomics !deleted text" 42
5.11.1 !General 42
5.11.2 Control stations and servicing points" 43
5.12 Access to operating positions, intervention and servicing points 43
5.13 Platforms on masts and leaders 43
5.13.1 General 43
5.13.2 Working platform for lifting personnel 43
5.13.3 Movable platform 45

5.14 Operating position(s) ... 45
5.14.1 General ... 45
5.14.2 Visibility ... 48
5.15 Control systems ... 49
5.15.1 General ... 49
5.15.2 Required performance levels for safety related parts of control systems ... 49
5.15.3 Starting ... 51
5.15.4 Stopping ... 51
5.16 Control devices ... 52
5.16.1 General ... 52
5.16.2 Inadvertent actuation of controls ... 52
5.16.3 Controls for extending the crawlers (tracks) of the carrier machine ... 53
5.17 Remotely controlled and automated drilling and foundation equipment ... 53
5.17.1 General ... 53
5.17.2 Operating position ... 53
5.17.3 Emergency stop ... 53
5.17.4 Control system ... 53
5.18 Unmanned, automatically operated drilling and foundation equipment ... 54
5.19 Retrieval, transportation, lifting and towing of the drilling and foundation equipment and its parts ... 54
5.19.1 Common use ... 54
5.19.2 Retrieval/Towing ... 54
5.19.3 Tie-down ... 54
5.19.4 Lifting points ... 54
5.19.5 Transportation ... 54
5.19.6 !Locking of articulation" ... 55
5.20 Handling of drilling tools ... 55
5.21 Isolation of energy sources ... 55
5.22 Hot and cold surfaces and sharp edges ... 55
5.23 Protection against moving parts ... 55
5.23.1 General ... 55
5.23.2 Moving parts involved in the process ... 55
5.23.3 Transmission parts ... 60
5.23.4 Drilling and foundation equipment using threaded drill string connections ... 60
5.23.5 Clamps and rod breaking clamps used in the drilling process ... 60
5.23.6 Tools handling system ... 61
5.24 Falling or ejected objects ... 61
5.25 Lighting ... 62
5.25.1 Working light ... 62
5.25.2 Illumination when tramming or slewing ... 62
5.25.3 Lighting inside the cab ... 62
5.26 Fire prevention ... 62
5.26.1 General ... 62
5.26.2 Fire extinguishers ... 62
5.26.3 Installation of fire extinguishers ... 62
5.26.4 Fire prevention for fuel and hydraulic circuits ... 63
5.27 Noise and vibration ... 63
5.27.1 General ... 63
5.27.2 Noise ... 63
5.27.3 Vibration ... 64
5.28 Exhaust gases and dust ... 64
5.28.1 Engine exhausts ... 64
5.28.2 Dust ... 64
5.29 Maintenance ... 64
5.30 Warning devices ... 65

6 Verification of the safety requirements and/or protective measures ... 65
6.1 General ... 65
6.2 Testing ... 71
6.2.1 General ... 71
6.2.2 Tests ... 71

7 Information for use 73
7.1 Marking 73
7.1.1 Data plate for drilling and foundation equipment 73
7.1.2 Data plate for working platforms for lifting personnel and movable platforms 73
7.2 Indicators 73
7.2.1 Information indicators 73
7.2.2 Warning signs for residual hazards 73
7.2.3 Warning devices 74
7.3 Instruction books for drilling and foundation equipment 74
7.3.1 General 74
7.3.2 Operator's manual 75
7.3.3 Maintenance instructions 81
7.3.4 Spare parts list 82

Annex A (informative) List of drilling and foundation equipment 83

A.1 General 83
A.2 Illustrations 84

Annex B (normative) Noise test code 142

B.1 General 142
B.2 Operation of the drilling and foundation equipment during noise tests 142
B.2.1 General 142
B.2.2 Multiple power units 142
B.2.3 Fan speed 143
B.2.4 Different types of drilling and foundation equipment 143
B.3 Determination of the sound power level 144
B.3.1 Basic noise emission standards 144
B.3.2 Determination according to EN ISO 3744 145
B.4 Measurement of emission sound pressure level at the operator's position 145
B.4.1 General 145
B.4.2 Performance of test at a fixed operator's position 146
B.4.3 Performance of test for operator's and assistant(s) position for remote-controlled machines 146
B.4.4 Acceptance criteria of measurements 146
B.5 Uncertainty of measurements 146
B.6 Information to be recorded and reported 146
B.7 Noise declaration 147

Annex C (normative) Whole-body and hand-arm vibration test 148

C.1 General 148
C.2 Measurement 148

Annex D (informative) Symbols and signs 149

D.1 Introduction 149
D.2 General safety and warning signs 149
D.3 General control symbols 151
D.4 Symbols for information 152
D.5 Symbols to be used for the control of the engine, fuel, brake transmission systems and hydraulic system 153
D.6 Symbols to be used for the control of the drilling operation 153
D.6.1 General symbols 153
D.6.2 Symbols for general machine functions 154
D.6.3 Rod handling system 155
D.6.4 Mast erection and positioning 156
D.6.5 Winch and slip rope drum 159
D.6.6 Tramming 160
D.7 Miscellaneous symbols 160

Annex E (normative) Instruction selecting and fitting of wire rope grips for free fall application 162

E.1 General 162
E.2 Installation 162
E.3 Number of grips 162
E.4 Tightening torque 162
E.5 Detachable connections 163

Annex F (normative) Ground pressure calculation for crawler mounted drilling and foundation equipment 165

F.1 General 165
F.2 Calculation of ground pressures 165

Annex G (normative) Test conditions of the stopping performances of the rotation of the drilling head 168

G.1 General 168
G.2 Conditions of measure 168
G.3 Measures implementation 168
G.3.1 General 168
G.3.2 Measurements 169
G.3.3 Data to be recorded 169
G.3.4 Evaluation of results 169

Annex ZA (informative) !Relationship between this European Standard and the essential requirements of Directive2006/42/EC aimed to be covered" 170

Bibliography 175