

# DIN EN 16228-1:2014-10 (E)

## Drilling and foundation equipment - Safety - Part 1: Common requirements

---

<b>Contents</b>		<b>Page</b>
Foreword .....		6
Introduction .....		7
<b>1</b>	<b>Scope .....</b>	<b>8</b>
<b>2</b>	<b>Normative references .....</b>	<b>8</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>11</b>
<b>4</b>	<b>List of significant hazards .....</b>	<b>15</b>
<b>5</b>	<b>Safety requirements and/or protective measures .....</b>	<b>19</b>
5.1	General .....	19
5.2	Requirements for strength and stability .....	20
5.2.1	Loads .....	20
5.2.2	Structural calculations .....	21
5.2.3	Rigid body stability .....	22
5.2.4	Floating ship, barge or pontoon .....	31
5.3	Electrotechnical systems .....	31
5.3.1	General .....	31
5.3.2	Battery installation .....	31
5.4	Hydraulic and pneumatic systems .....	32
5.4.1	Hydraulic systems .....	32
5.4.2	Pneumatic systems .....	32
5.4.3	Hoses, pipes and fittings under pressure .....	32
5.5	Failure of the power supply .....	33
5.6	Uncontrolled motion .....	33
5.7	Brakes of the carrier machine .....	33
5.7.1	Brakes for travelling .....	33
5.7.2	Brakes for slewing .....	33
5.8	Winches, draw-works and ropes .....	33
5.8.1	General .....	33
5.8.2	Winches and pulleys .....	34
5.8.3	Pulley and drum diameters .....	35
5.8.4	Ropes and rope end terminations .....	35
5.8.5	Roller and leaf chains .....	35
5.9	Masts, derricks and feed beams .....	36
5.10	Indicating/limiting devices for inclination .....	36
5.10.1	Inclination of leader, mast or boom .....	36
5.10.2	Inclination of the carrier .....	36
5.10.3	Stroke limiting devices .....	36
5.11	Ergonomics for control stations and servicing points .....	36
5.12	Access to operating positions, intervention and servicing points .....	37
5.13	Platforms on masts and leaders .....	37
5.13.1	General .....	37
5.13.2	Working platform for lifting personnel .....	37
5.13.3	Movable platform .....	39
5.14	Operating position(s) .....	39
5.14.1	General .....	39
5.14.2	Visibility .....	41
5.15	Control systems .....	41

5.15.1	General .....	41
5.15.2	Required performance levels for safety related parts of control systems .....	41
5.15.3	Starting .....	43
5.15.4	Stopping .....	43
5.16	Control devices .....	43
5.16.1	General .....	43
5.16.2	Inadvertent actuation of controls .....	44
5.16.3	Controls for extending the crawlers (tracks) of the carrier machine .....	44
5.17	Remotely controlled and automated drilling and foundation equipment .....	44
5.17.1	General .....	44
5.17.2	Operating position .....	45
5.17.3	Emergency stop .....	45
5.17.4	Control system .....	45
5.18	Unmanned, automatically operated drilling and foundation equipment .....	45
5.19	Retrieval, transportation, lifting and towing of the drilling and foundation equipment and its parts .....	45
5.19.1	Common use .....	45
5.19.2	Retrieval/Towing .....	46
5.19.3	Tie-down .....	46
5.19.4	Lifting points .....	46
5.19.5	Transportation .....	46
5.20	Handling of drilling tools .....	46
5.21	Isolation of energy sources .....	46
5.22	Hot and cold surfaces and sharp edges .....	46
5.23	Protection against moving parts .....	47
5.23.1	General .....	47
5.23.2	Moving parts involved in the process .....	47
5.23.3	Transmission parts .....	50
5.23.4	Drilling and foundation equipment using threaded drill string connections .....	50
5.23.5	Clamps and rod breaking clamps used in the drilling process .....	51
5.23.6	Tools handling system .....	51
5.24	Falling or ejected objects .....	51
5.25	Lighting .....	52
5.25.1	Working light .....	52
5.25.2	Illumination when tramming or slewing .....	52
5.25.3	Lighting inside the cab .....	52
5.26	Fire prevention .....	52
5.26.1	General .....	52
5.26.2	Fire extinguishers .....	53
5.26.3	Installation of fire extinguishers .....	53
5.26.4	Fire prevention for fuel and hydraulic circuits .....	53
5.27	Noise and vibration .....	53
5.27.1	General .....	53
5.27.2	Noise .....	53
5.27.3	Vibration .....	54
5.28	Exhaust gases and dust .....	54
5.28.1	Engine exhausts .....	54
5.28.2	Dust .....	54
5.29	Maintenance .....	55
5.30	Warning devices .....	55
6	Verification of the safety requirements and/or protective measures .....	55
6.1	General .....	55
6.2	Testing .....	61
6.2.1	General .....	61
6.2.2	Tests .....	61
7	Information for use .....	62
7.1	Marking .....	62
7.1.1	Data plate for drilling and foundation equipment .....	62
7.1.2	Data plate for working platforms for lifting personnel and movable platforms .....	63
7.2	Indicators .....	63

7.2.1	Information indicators .....	63
7.2.2	Warning signs for residual hazards .....	63
7.2.3	Warning devices .....	63
7.3	Instruction books for drilling and foundation equipment .....	63
7.3.1	General .....	63
7.3.2	Operator's manual .....	64
7.3.3	Maintenance instructions .....	69
7.3.4	Spare parts list .....	70
<b>Annex A (informative) List of drilling and foundation equipment .....</b>		<b>71</b>
A.1	General .....	71
A.2	Illustrations .....	72
<b>Annex B (normative) Noise test code .....</b>		<b>124</b>
B.1	General .....	124
B.2	Operation of the drilling and foundation equipment during noise tests .....	124
B.2.1	General .....	124
B.2.2	Multiple power units .....	124
B.2.3	Fan speed .....	125
B.2.4	Different types of drilling and foundation equipment .....	125
B.3	Determination of the sound power level .....	125
B.3.1	Basic noise emission standards .....	125
B.3.2	Determination according to EN ISO 3744 .....	127
B.4	Measurement of emission sound pressure level at the operator's position .....	127
B.4.1	General .....	127
B.4.2	Performance of test at a fixed operator's position .....	127
B.4.3	Performance of test for operator's and assistant(s) position for remote-controlled machines .....	128
B.4.4	Acceptance criteria of measurements .....	128
B.5	Uncertainty of measurements .....	128
B.6	Information to be recorded and reported .....	128
B.7	Noise declaration .....	129
<b>Annex C (normative) Whole-body and hand-arm vibration test .....</b>		<b>130</b>
C.1	General .....	130
C.2	Measurement .....	130
<b>Annex D (informative) Symbols and signs .....</b>		<b>131</b>
D.1	Introduction .....	131
D.2	General safety and warning signs .....	131
D.3	General control symbols .....	133
D.4	Symbols for information .....	134
D.5	Symbols to be used for the control of the engine, fuel, brake transmission systems and hydraulic system .....	135
D.6	Symbols to be used for the control of the drilling operation .....	135
D.6.1	General symbols .....	135
D.6.2	Symbols for general machine functions .....	136
D.6.3	Rod handling system .....	137
D.6.4	Mast erection and positioning .....	138
D.6.5	Winch and slip rope drum .....	141
D.6.6	Tramming .....	141
D.7	Miscellaneous symbols .....	142
<b>Annex E (normative) Instruction selecting and fitting of wire rope grips for free fall application .....</b>		<b>143</b>
E.1	General .....	143
E.2	Installation .....	143
E.3	Number of grips .....	143

E.4	Tightening torque .....	143
E.5	Detachable connections .....	144
<b>Annex F (normative) Ground pressure calculation for crawler mounted drilling and foundation equipment .....</b>		<b>145</b>
F.1	General .....	145
F.2	Calculation of ground pressures .....	145
<b>Annex G (normative) Test conditions of the stopping performances of the rotation of the drilling head .....</b>		<b>148</b>
G.1	General .....	148
G.2	Conditions of measure .....	148
G.3	Measures implementation .....	148
G.3.1	General .....	148
G.3.2	Measurements .....	149
G.3.3	Data to be recorded .....	149
G.3.4	Evaluation of results .....	149
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC .....</b>		<b>150</b>
<b>Bibliography .....</b>		<b>151</b>