

# DIN EN 280:2016-04 (E)

## Mobile elevating work platforms - Design calculations - Stability criteria - Construction - Safety - Examinations and tests (includes Amendment A1:2015)

---

<b>Contents</b>	<b>Page</b>
Foreword.....	5
Introduction .....	6
1 Scope .....	7
2 Normative references .....	8
3 Terms and definitions .....	9
4 List of hazards.....	14
5 Safety requirements and/or measures .....	18
5.1 General.....	18
5.2 Structural and stability calculations .....	18
5.2.1 General.....	18
5.2.2 Loads and forces .....	18
5.2.3 Determination of loads and forces.....	18
5.2.4 Stability calculations .....	21
5.2.5 Structural calculations .....	35
5.3 Chassis and stabilisers .....	36
5.3.1 Chassis .....	36
5.3.2 Stabilisers.....	40
5.4 Extending structure.....	42
5.4.1 Methods to avoid overturning and exceeding permissible stresses: .....	42
5.5 Extending structure drive systems.....	45
5.5.1 General.....	45
5.5.2 Wire rope drive systems .....	46
5.5.3 Chain drive systems.....	48
5.5.4 Lead-screw drive systems .....	49
5.5.5 Rack and pinion drive systems .....	50
5.6 Work platform.....	50
5.7 Controls .....	53
5.8 Electrical equipment.....	55
5.9 Hydraulic systems .....	56
5.10 Hydraulic cylinders.....	58
5.11 Safety devices .....	62
6 Verification of the safety requirements and/or measures .....	64
6.1 Examinations and tests.....	64
6.1.1 General.....	64
6.1.2 Design check.....	64
6.1.3 Manufacturing check.....	64
6.1.4 Tests.....	65
6.2 Type tests of MEWPs .....	70
6.3 Tests before placing on the market .....	70
7 Information for use .....	70
7.1 Instruction handbook .....	70
7.1.1 General.....	70
7.2 Marking .....	74

<b>Annex A</b> (informative) <b>Use of MEWPs in wind speeds greater than 12,5 m/s (Beaufort-Scale)</b> .....	77
<b>Annex B</b> (informative) <b>Dynamic factors in stability and structural calculations</b> .....	78
<b>B.1</b> <b>Stability calculations</b> .....	78
<b>B.2</b> <b>Structural calculations</b> .....	78
<b>Annex C</b> (normative) <b>Calculation of wire rope drive systems</b> .....	80
<b>C.1</b> <b>General</b> .....	80
<b>C.2</b> <b>Calculation of wire rope drive systems</b> .....	80
<b>C.3</b> <b>Calculation of rope diameters (coefficient c)</b> .....	81
<b>C.4</b> <b>Calculation of the diameters of rope drums, rope pulleys and compensating pulleys</b> <b>[coefficient (<math>h_1 \cdot h_2</math>)]</b> .....	81
<b>C.5</b> <b>Efficiency of wire rope drive systems</b> .....	84
<b>Annex D</b> (informative) <b>Calculation example - Wire rope drive systems</b> .....	86
<b>D.1</b> <b>Method used to determine the coefficients and ratios used for 5.5.2 (wire rope drive</b> <b>systems) using the load cycle figures in 5.2.5.3 and operating speeds in 5.4.5</b> .....	86
<b>D.1.1</b> <b>General</b> .....	86
<b>D.1.2</b> <b>Notes</b> .....	86
<b>D.1.3</b> <b>Annex C (normative) method summarised</b> .....	86
<b>D.1.4</b> <b>Calculation example</b> .....	87
<b>D.1.4.1</b> <b>General</b> .....	87
<b>D.1.4.2</b> <b>Mode of operation (drive group) (see C.2 and Table C.1)</b> .....	87
<b>D.1.4.3</b> <b>Calculation of minimum rope diameter (see C.3)</b> .....	89
<b>D.1.4.4</b> <b>Working coefficients</b> .....	89
<b>D.2</b> <b>Calculation of the diameters of rope drums, pulleys and static pulleys</b> .....	89
<b>Annex E</b> (informative) <b>Calculation examples - factor "z", kerb test</b> .....	92
<b>Annex F</b> (normative) <b>Additional requirements for wireless controls and control systems</b> .....	94
<b>F.1</b> <b>General</b> .....	94
<b>F.2</b> <b>Control limitation</b> .....	94
<b>F.3</b> <b>Stop</b> .....	94
<b>F.4</b> <b>Serial data communication</b> .....	94
<b>F.5</b> <b>Use of more than one operator control station</b> .....	95
<b>F.6</b> <b>Battery-powered operator control stations</b> .....	95
<b>F.7</b> <b>Receiver</b> .....	95
<b>F.8</b> <b>Warnings</b> .....	95
<b>F.9</b> <b>Information for use</b> .....	95
<b>Annex G</b> (normative) <b>Dimensions of steps and ladders</b> .....	96
<b>A<sub>1</sub></b> <b>Annex H</b> <b>A<sub>1</sub></b> (informative) <b>Stress history parameters</b> .....	98
<b>H.1</b> <b>Introduction</b> .....	98
<b>H.2</b> <b>Guidance for selection of S class</b> .....	98
<b>H.3</b> <b>Stress history parameters</b> .....	99
<b>H.3.1</b> <b>General procedure</b> .....	99
<b>H.3.2</b> <b>Direct calculation of stress history class</b> .....	100
<b>H.3.3</b> <b>Simplified method to determine stress history class</b> .....	101
<b>A<sub>1</sub></b> <b>Annex I</b> <b>A<sub>1</sub></b> (informative) <b>Fatigue assessment: Relationship between S classes in EN 13001-3-1</b> <b>and B groups in DIN 15018</b> .....	103

<b>Annex J <sup>A1</sup> (normative) Requirements for Performance Level d safety functions .....</b>	<b>104</b>
<b>J.1 General .....</b>	<b>104</b>
<b>J.1.1 Introduction.....</b>	<b>104</b>
<b>J.1.2 Performance Level d safety functions utilising category 2 architecture.....</b>	<b>104</b>
<b>J.1.3 Performance Level d safety functions implemented by SIL 2 functions with a hardware fault tolerance of zero .....</b>	<b>104</b>
<b>J.2 Requirements for unmonitored non-electrical parts of category 3 architectures .....</b>	<b>105</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC .....</b>	<b>106</b>
<b>Bibliography .....</b>	<b>107</b>