

Content

0	General	9
0.1	Scope	9
0.2	Technical basics	10
0.3	Required Assessments	10
0.4	Stresses and component types	10
0.5	Calculation procedure	14
1	Static strength assessment with nominal stresses	16
1.0	General	16
1.1	Characteristic values of stress	17
1.2	Material properties	19
1.3	Design parameters	25
1.4	Component strength	28
1.5	Safety factors	29
1.6	Assessment	30
2	Fatigue strength assessment with nominal stresses	33
2.0	General	33
2.1	Characteristic values of stress	33
2.2	Material properties	35
2.3	Design parameters	37
2.4	Component strength	46
2.5	Safety factors	57
2.6	Assessment	58
3	Static strength assessment with local stresses	61
3.0	General	61
3.1	Characteristic values of stress	62
3.2	Material properties	65
3.3	Design parameters	71
3.4	Component strength	75
3.5	Safety factors	76
3.6	Assessment	77
4	Fatigue strength assessment with local stresses	80
4.0	General	80
4.1	Characteristic values of stress	80
4.2	Material properties	83
4.3	Design parameters	85
4.4	Component strength	94
4.5	Safety factors	105
4.6	Assessment	106
5	Annexes	110
5.1	Material tables	110
5.2	Stress concentration factors	152
5.3	Fatigue notch factors	160
5.4	Fatigue classes for welded components made of steel and aluminium alloys	167
5.5	Estimation of fatigue limit of surface treated components	182
5.6	Experimental determination of component strength values	188
5.7	Load assumptions	191
6	Examples	193
6.1	Shaft shoulder	193
6.2	Cast component	201
6.3	Compressor flange made of GJL	205
6.4	Welded perforated rod	208
6.5	Welded aluminium T-profile	216
6.6	Welded aluminium component	219

7	Symbols	225
7.1	Abbreviations	225
7.2	Indexes	225
7.3	Lowercase letters	225
7.4	Uppercase letters	226
7.5	Greek letters	227
7.6	Basic equations	228
8	Changes	229

0 General

0.1 Scope

This guideline is valid for mechanical engineering and related fields. Its application shall be agreed between the contracting parties.

For mechanically stressed components, the guideline allows an analytical assessment of the static strength and of the fatigue strength, the latter in the form of an assessment of the fatigue limit, the fatigue strength for finite life or the variable amplitude fatigue strength, depending on the service stress conditions. Other analytical assessments, for example of stability, of safety against brittle fracture (for deep temperatures or shock loads) or of deformation under load as well as experimental strength assessments are not subject of this guideline.

The guideline is valid for components of iron or aluminium materials, including cases of elevated temperatures, produced by milling, forging, casting, with or without machining, or by welding. In detail, it applies to:

- components with geometrical notches,
- components with welded joints, produced by arc welding, beam welding (laser or electron beam welding, laser beam GMAW hybrid welding), resistance spot welding or resistance seam welding
- static loading,
- fatigue loading from about 10⁴ constant or variable amplitude cycles onwards,
- milled and forging steel, including stainless steel, cast iron materials as well as wrought or cast aluminium alloys,
- component temperatures from –40°C to 500°C for steel,
- from –25°C to 500°C for cast iron materials and
- from –25°C to 200°C for aluminium materials,
- non-corrosive environment.

The calculation algorithm for the analytical strength assessment is described in this guideline for the material groups as listed in Table 0.1.1.

In accordance with the material standards taken into consideration, the maximum material tensile strength is $R_m = 1\,400$ MPa for steel and cast iron (ADI casting EN-GJS-1400-1), and 610 MPa for aluminium (EN AW-7049A). The field of application of the algorithms in this guideline may be extended with caution to tensile strengths of $R_m = 1\,600$ MPa for steel. It is not yet possible to state a higher limit for aluminium. The guideline can also be applied for further materials in the described material groups, if the necessary strength values are available.

If an application of the guideline is outside the mentioned fields of application, additional specifications shall be agreed upon.

Table 0.1.1: Material groups in the FKM-Guideline

	material group		material standard
steel ¹⁾	structural steel	milled steel	DIN EN 10 025-2
	fine grain structural steel		DIN EN 10 025-3 DIN EN 10 025-4
	heat treatable steel		DIN EN ISO 683-1 DIN EN ISO 683-2
	case hardening steel		DIN EN ISO 683-3
	nitriding steel		DIN EN 10 085
	stainless steel		DIN EN 10 088-2
	forged steel		SEW 550
cast iron	cast steel, heat treatable cast steel	GS	DIN EN 10 293
	nodular cast iron	GJS	DIN EN 1563
	ausferritic spheroidal graphite cast iron	ADI	DIN EN 1564
	malleable cast iron	GJM	DIN EN 1562
	cast iron with lamellar graphite	GJL	DIN EN 1561
aluminium	wrought aluminium	AW	DIN EN 485-2 DIN EN 754-2 DIN EN 755-2 DIN EN 586-2
	casted aluminium	AC	DIN EN 1706

¹⁾ The designation “steel” contains components of milled and forged steel.

The guideline is not applicable if a strength assessment in accordance with other standards, rules or guidelines is required or if specific calculation documents are available, for example for screw connections.

It is presupposed that the components have been professionally produced regarding design, material, and workmanship, and that they are technically without fault. Particularly, it is presupposed that for welded components the limit values regarding weld thickness, weld length and weld imperfections required by the relevant standards are complied with.