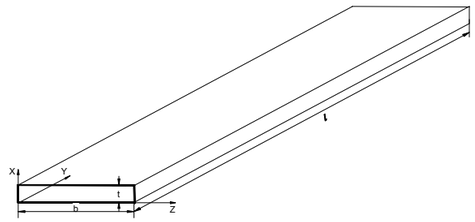
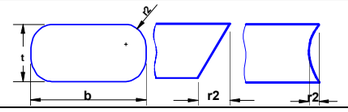
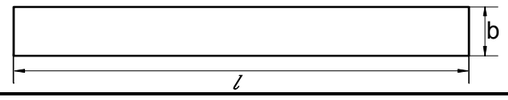
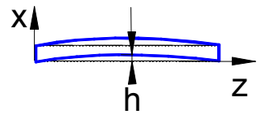
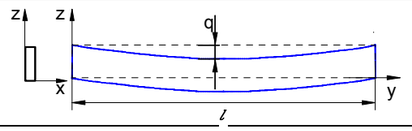
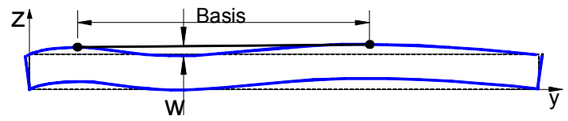
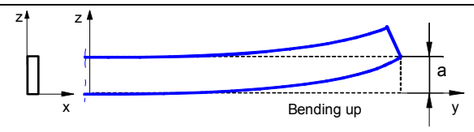
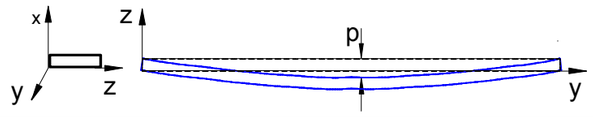
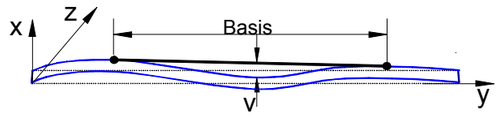
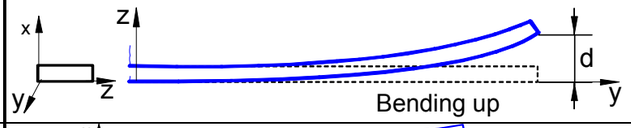
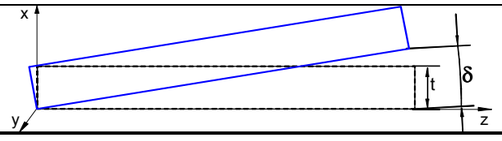
Annex 1.1: Allowed deviations of dimension and form of hot-rolled flat steel

1) Tolerances of dimensions		Class 2 / basis (DIN 1017 / April 1967)	Class 1 / special	Measurement tool to be used
1.1 Width b [mm] (10 mm ≤ b ≤ 150 mm)		10 ≤ b ≤ 35 mm: ± 0,75 mm 38 ≤ b ≤ 75 mm: ± 1,0 mm 80 ≤ b ≤ 100 mm: ± 1,5 mm 110 ≤ b ≤ 120 mm: ± 2,0 mm 130 ≤ b ≤ 150 mm: ± 2,5 mm	10 ≤ b ≤ 120 mm: ± 1,0 mm 130 ≤ b ≤ 150 mm: ± 1,5 mm	Sliding calliper
1.2 Thickness t [mm] (5 ≤ t ≥ 60 mm)		5 ≤ t ≤ 20 mm: ± 0,5 mm	10 ≤ b ≤ 120 mm: + 0,3 mm / - 0,2 mm 130 ≤ b ≤ 150 mm: + 0,6 mm / - 0,2 mm	Sliding calliper
1.8 Max. curve radius at other edges r2 [mm] (sharp-angularity of edges)		not tolerated	10 ≤ b ≤ 120 mm: ± 1,0 mm 130 ≤ b ≤ 150 mm: ± 1,5 mm	Radius gauge
1.10 Length l [mm] (3.000 ≤ l ≤ 12.000 mm)		+ 100 0	+ 100 0	Measuring tape

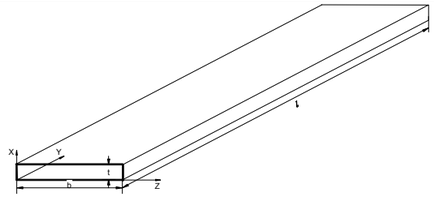
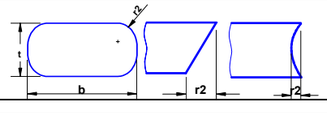
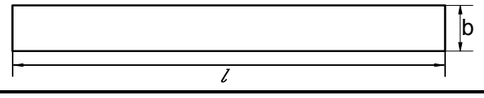
2) Deviation of form of cross section [mm]

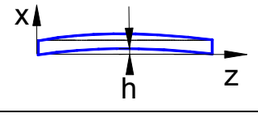
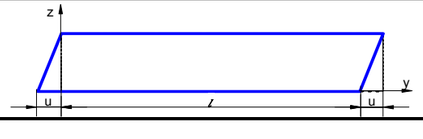
2.1 Bending h of web over width		not tolerated	h ≤ 0,003 * b	Measuring stick

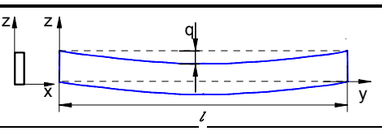
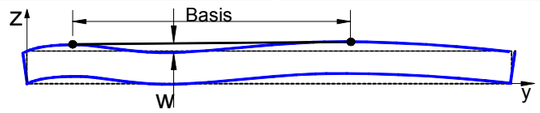
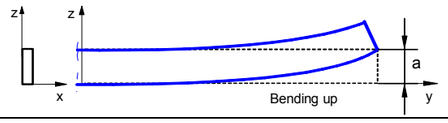
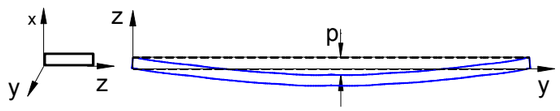
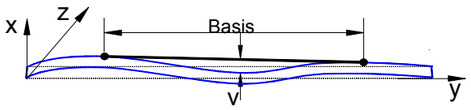
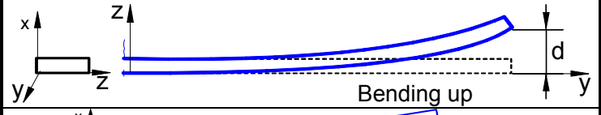
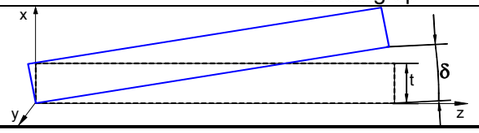
3) Deviation of form from straight line (evenness) [mm]

			4.000 ≤ l < 6.000 mm + 30	
3.1 Bending q in web plane ("sabre shape")		10 ≤ b ≤ 120 mm: q ≤ 0,004 * l_B (Basis 1.000 mm: max. 4,0 mm) 130 ≤ b ≤ 150 mm: q ≤ 0,0025 * l_B (Basis 1.000 mm: max. 2,5 mm)	q ≤ 0,00125 * l_B (basis 1.000 mm: max. 1,25 mm)	Measuring stick
3.2 Waveness w in web plane		not tolerated	q_{max} = ± 0,00125 * l (basis 1.000 mm : max. 1,25 mm basis 2.000 mm : max. 2,5 mm)	Measuring stick
3.3 Bending up a in web plane at ends (1.000 mm)		not tolerated	2,5 mm	Measuring stick
3.4 Bending p perpendicular to web plane ("Deviation aloft")		not tolerated	p ≤ 0,003 * l_B, but max. 8 mm 10 ≤ b ≤ 120 mm: 3 mm 130 ≤ b ≤ 150 mm: 8 mm	Measuring stick
3.5 Longitudinal waves v perpendicular to web plane		not tolerated	basis 1.000 mm : max. 1,25 mm basis 2.000 mm : max. 2,5 mm	Measuring stick
3.6 Bending up d perpendicular to web plane at ends (1.000 mm)		not tolerated	2,5 mm	Measuring stick
3.7 Torsion T / twist δ of web plane		not tolerated	max. 0,35° / m at ends: max. 2 mm Toverall = b * sin 0,35° * l	Goniometer / Measuring stick

Annnex 1.2: Allowed deviations of dimension and form of hot-rolled universal flats

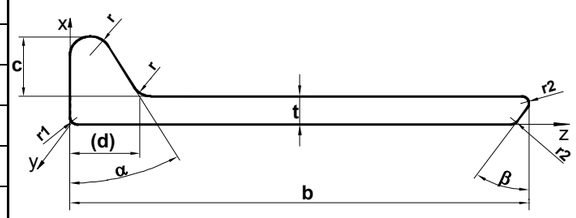
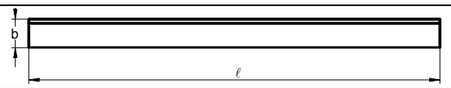
1) Tolerances of dimensions		Class 2 / basis (DIN 59200 / May 2001)		Class 1 / special (b ≤ 180 mm)		Measurement tool to be used
1.1 Width b [mm] (150 mm < b ≤ 1.250 mm)		± 0,02 * b, max. ± 10 mm		± 0,01 * b, max. ± 2,0 mm		Sliding calliper
1.2 a) Thickness t [mm] (t ≥ 4 mm)		4 ≤ t < 10 mm	10 ≤ t < 20 mm	+ 0,6 - 0,2		Sliding calliper
		A: + 0,6 - 0,4	B: + 0,7 - 0,3	A: + 0,8 - 0,4	B: + 0,9 - 0,3	
b) Deviation of thickness Δ t [mm] over width (z)		150 ≤ b ≤ 500 mm Δ t (z) ≤ 0,5 mm		150 ≤ b ≤ 500 mm Δ t (z) ≤ 0,5 mm		
1.8 Max. curve radius at other edges r2 [mm] (sharp-angularity of edges)		4 ≤ t ≤ 13 mm: 2,0 mm ("usual deviation")	13 ≤ t ≤ 18 mm: 3,0 mm ("usual deviation")	4 ≤ t ≤ 13 mm: 0,5 mm ("limited deviation (R)")	13 ≤ t ≤ 18 mm: 0,75 mm ("limited deviation (R)")	Radius gauge
1.10 Length l [mm]		+ 200 0	+ 200 0	+ 100 0	+ 100 0	Measuring tape

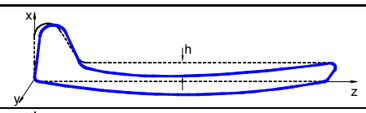
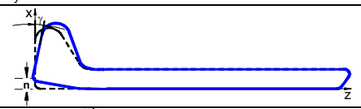
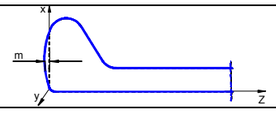
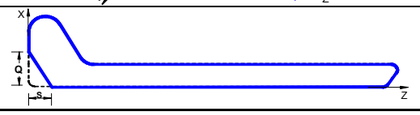
2) Deviation of form of cross section [mm]				
2.1 Bending h of web over width		t ≤ 50 mm: h_{max} ≤ 0,003 *b (b = 150 mm: h_{max} = 0,45 mm)	t ≤ 50 mm: h_{max} ≤ 0,003 *b (b = 150 mm: h_{max} = 0,45 mm)	Measuring stick
2.5 Deviation u of rectangularity (for b ≤ 500 mm)		150 ≤ b ≤ 500 mm: max. 5 mm	150 ≤ b ≤ 500 mm: max. 5 mm	Goniometer / Measuring stick

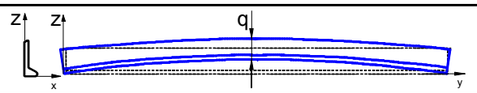
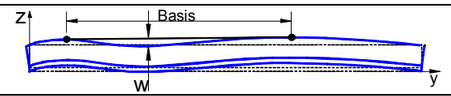
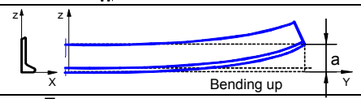
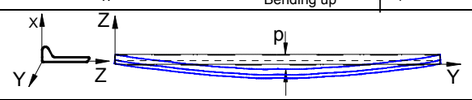
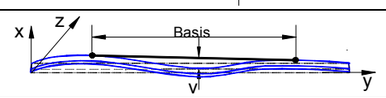
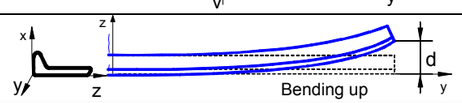
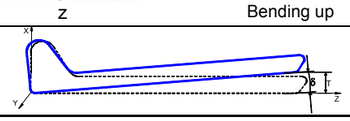
3) Deviation of form from straight line (evenness) [mm]				
3.1 Bending q in web plane ("sabre shape")		t ≤ 50 mm: q_{max} = ± 0,0025 * l_B (l_{max} = 12.000 mm : q_{max} = ± 30 mm) ("usual straight universal flat") (basis 1.000 mm : 2,5 mm basis 2.000 mm : 5,0 mm)	t ≤ 50 mm: q_{max} = ± 0,00125 * l_B (l_{max} = 12.000 mm : q_{max} = ± 15 mm) ("special straight universal flat (L)") (Basis 1.000 mm : 1,25 mm Basis 2.000 mm : 2,5 mm)	Measuring stick
3.2 Waveness w in web plane		q_{max} = ± 0,0025 * l (basis 1.000 mm : max. 2,5 mm basis 2.000 mm : max. 5,0 mm)	q_{max} = ± 0,00125 * l (basis 1.000 mm : max. 1,25 mm basis 2.000 mm : max. 2,5 mm)	Measuring stick
3.3 Bending up a in web plane at ends (1.000 mm)		not tolerated	2,5 mm	Measuring stick
3.4 Bending p perpendicular to web plane ("Deviation aloft")		p_{max} ≤ 0,007 * l , but max. 20 mm (basis 1.000 mm : p_{max} = 7 mm / "usual even")	p_{max} ≤ 0,003 * l ,but max. 8 mm (basis 1.000 mm : p_{max} = 3 mm / "precise even(S)")	Measuring stick
3.5 Longitudinal waves v perpendicular to web plane		basis 1.000 mm : max. 7 mm ("usual even") max. 3 mm ("precise even")	basis 1.000 mm : max. 1,25 mm basis 2.000 mm : max. 2,5 mm	Measuring stick
3.6 Bending up d perpendicular to web plane at ends (1.000 mm)		not tolerated	2,5 mm	Measuring stick
3.7 Torsion T / twist δ in web plane		not tolerated	max. 0,35° / m at ends: max. 2 mm Toverall = b * sin 0,35° * l	Goniometer / Measuring stick

Annex 1.3: Allowed deviations of dimension and form of hot-rolled bulb flats

all dimensions not being named are in [mm]

1) Tolerances of dimensions		Class 3 / basis (EN 10067)			Class 2 / standard		Class 1 / special		Measurement tool to be used
		60 ≤ b ‹ 80	80 ≤ b ≤ 120	140 ≤ b ≤ 180	60 ≤ b ≤ 120	140 ≤ b ≤ 180	60 ≤ b ≤ 120	140 ≤ b ≤ 180	
1.1 Width b [mm]		± 1,5	± 1,5	± 2,0	± 1,25	± 1,75	± 1,0	± 1,5	Outline gauge / Sliding calliper
1.2 Thickness t [mm]		+ 0,7 - 0,3	+ 0,7 - 0,3	+ 1,0 - 0,3	+ 0,5 - 0,3	+ 0,8 - 0,3	+ 0,3 - 0,2	+ 0,6 - 0,2	Outline gauge / Sliding calliper
1.3 Bulb height c [mm]		not tolerated			+ 0,7 - 0,3	+ 1,0 - 0,3	+ 0,4 - 0,3	+ 0,5 - 0,3	Outline gauge / Sliding calliper
1.4 Height overall c + t [mm]		not tolerated			+ 1,0 - 0,5	+ 1,5 - 0,5	+ 0,7 - 0,5	+ 1,0 - 0,5	Outline gauge / Sliding calliper
1.5 Bulb radius r [mm]		not tolerated			± 1,0	± 1,5	± 1,0	± 1,0	Outline gauge / Radius gauge
1.6 Bulb angle α [grd]		not tolerated			± 1,0°	± 1,0°	± 1,0°	± 1,0°	Outline gauge / Goniometer
1.7 Max. curve radius at bulb r1 [mm]		2,0	2,0	2,0	2,0	2,0	2,0	2,0	Outline gauge / Radius gauge
1.8 Max. curve radius at other edges r2 [mm] *)		2,0	2,0	2,0	2,0	2,0	1,0	1,0	Shape gauge / Radius gauge
1.9 Max. bevelling of bar feet β [grd] *)		not tolerated			≤ 4°	≤ 4°	≤ 4°	≤ 4°	Outline gauge / Goniometer
1.10 Length l [mm]		+ 100 0	+ 100 0	+ 100 0	+ 100 0	+ 100 0	+ 100 0	+ 100 0	Measuring tape

2) Deviations of form of cross section [mm]									
2.1 Bending h of web over width		not tolerated			h ≤ 0,004 * b		h ≤ 0,003 * b		Outline gauge / Measuring stick
2.2 Angle of bulb compressing γ / deviation n from evenness of web close to bulb		not tolerated			γ ≤ ± 1,0° n ≤ 2,0 mm		γ ≤ ± 0,5° n ≤ 1,0 mm		Outline gauge / Goniometer / Measuring stick
2.3 Deviation m from evenness of bulb head		not tolerated			± 0,4	± 0,6	± 0,2	± 0,3	Shape gauge / Measuring stick
2.4 Deviation Q resp. s from evenness of bulb head		not tolerated			S_{max} = 2,0 mm	S_{max} = 3,0 mm	S_{max} = 1,0 mm	S_{max} = 1,5 mm	Outline gauge / Measuring stick
					Q_{max} ≤ ¾ t : max. 5,3 mm		Q_{max} ≤ ¾ t : max. 2,3 mm		Outline gauge / Measuring stick

3) Deviation of form from straight line (evenness) [mm]						
3.1 Bending q over length in web plane ("sabre shape")		q_{max} = ± 0,0035* l (EN 10067 / without add. straightening) l_{max} = 12.000 mm : q_{max} = ± 42 mm	q_{max} = ± 0,0025* l (Tolerance of straightening standard) l_{max} = 12.000 mm : q_{max} = ± 30 mm		q_{max} = ± 0,00125* l (Tolerance of straightening special) l_{max} = 12.000 mm : q_{max} = ± 15 mm		Measuring stick
3.2 Waveness w in web plane		not tolerated	q_{max} = ± 0,0025* l basis 1.000 mm : max. 2,5 mm basis 2.000 mm : max. 5,0 mm		q_{max} = ± 0,00125* l basis 1.000 mm : max. 1,25 mm basis 2.000 mm : max. 2,5 mm		Measuring stick
3.3 Bending up a in web plane at ends (1.000 mm)		not tolerated	5,0 mm		2,5 mm		Measuring stick
3.4 Bending p over profile length perpendicular to web plane ("Deviation aloft")		not tolerated	5 mm	10 mm	3 mm	8 mm	Measuring stick
3.5 Longitudinal waves v perpendicular to web plane		not tolerated	basis 1.000 mm : max. 2,5 mm basis 2.000 mm : max. 5,0 mm		basis 1.000 mm : max. 1,25 mm basis 2.000 mm : max. 2,5 mm		Measuring stick
3.6 Bending up d perpendicular to web plane at ends (1.000 mm)		not tolerated	5,0 mm		2,5 mm		Measuring stick
3.7 Torsion T / twist δ of web plane		not tolerated	max. 0,5° / m at ends: max. 3 mm Toverall = b * sin 0,5° * l		max. 0,35° / m at ends: max. 2 mm Toverall = b * sin 0,35° * l		Angle gauge / Goniometer / Measuring stick

*) without additional machining

Tolerances		Thin plates (t ≤ 8 mm)	Small profiles (b ≤ 180 mm)		
			Universal flat	Flat steel	Bulb flats
Dimension deviations	1.1 Width b [mm]	M2	M1	M1	L1 / M1
	1.2 Thickness t [mm]	M1	M1	M1	L1 / M1
	1.3 Bulb height c [mm]	-	-	-	(L1 / M1)
	1.4 Height overall c + t [mm]	-	-	-	L1 / M1
	1.5 Bulb radius r [mm]	-	-	-	L1 / L2
	1.6 Bulb angle α [grd]	-	-	-	L1 / M3
	1.7 Max. curve radius at bulb r1 [mm]	-	-	-	L1 / L2
	1.8 Max. curve radius at other edges r2 [mm]	-	L2	L2	L1 / L2
	1.9 Max. bevelling at bar feet β [grd] *)	-	-	-	L1 / M3
	1.10 Length ℓ [mm]	M2	M2	M2	M2
Form deviations of cross section	2.1 Bending h over width (of web)	-	M4	M4	L1 / M4
	2.2 Angle of bulb compressing γ / deviation n from evenness of web close to bulb	-	-	-	L1 / M3+4
	2.3 Deviation m from evenness of bulb head	-	-	-	L1 / M4
	2.4 Deviation Q resp. s from eveness of bulb head	-	-	-	L1 / M4
	2.5 Deviation u from rectangularity	M3+4	M3+4	-	-
Form deviations from straight line (evenness)	3.1 Bending q over length / in web plane ("sabre shape")	M4	M4	M4	M4
	3.2 Waveness w in web plane	-	M4	M4	M4
	3.3 Bending up a in web plane at ends (1.000 mm)	-	L3 / M4	L3 / M4	L3 / M4
	3.4 Bending p over plate length and width / profile length perpendicular to web plane ("Deviation aloft")	M4	M4	M4	M4
	3.5 Longitudinal waves v perpendicular to web plane	-	M4	M4	M4
	3.6 Bending up d perpendicular to web plane at ends (1.000 mm)		L3 / M4	L3 / M4	L3 / M4
	3.7 Torsion T / twist δ of web plane	-	L4 / M3+4	L4 / M3+4	L4 / M3+4

L1 - Cross section shape gauge
L2 - Radius gauge
L3 - Distance gauge
L4 - Angle gauge

M1 - Sliding calliper
M3 - Goniometer

M2 - Measuring tape
M4 - Measuring stick, possibly combined with additional measuring tools

Anlage 2.1: Recommended measuring devices to check allowed deviations of dimension and form (tolerances)