

ZINC-MAGNESIUM



Relevant steelmaking regulation
EUROPEAN STANDARD: UNI EN 10346 : 2015

Areas of use

- Heating
- Irradiation
- Household appliance
- Agriculture
- Road applications
- Construction industry

Hot-dip galvanized zinc-magnesium coated steels

Zinc-magnesium coated steel strips are distinguished by high corrosion resistance and excellent processing characteristics.

Application of a zinc-magnesium coating is achieved by dipping the prepared tape into a molten bath of zinc-aluminum-magnesium.

The bath composition contains 1.5 to 8 percent aluminum and magnesium and at least 0.2 percent magnesium and zinc for the remainder. Information on chemical composition and density can be obtained from the manufacturer.

These products are used in light, deep and very deep profiling and molding.

SURFACE PROTECTION

C	Chemical passivation
O	Oiling
CO	Oiling and chemical passivation
P	Phosphating
PO	Phosphating and oiling
S	Organic passivation

Technical supply conditions

They can be supplied with special requirements for coating finish, surface appearance and surface protection.

Surface protection can be of different types and must be appropriately indicated when placing the order

The surface appearance can be type A, B or C

SURFACE FINISH TYPES

A Coated surface	Minor imperfections - such as small honeycombs, variations in grain size, dark spots, light scratches, and passivation spots - are possible
B Improved surface	It is obtained through skinpass. Small imperfections - such as scratches due to skinpass, streaks, irregularities (not cavities) - are possible with this kind of surface
C Better quality surface	It is obtained through skinpass. The best surface does not harm the apparent uniformity of a high color finish class; the other surface must be at least type B

Coating name	Surface appearance		
	A	B	C
ZM060	X	X	X
ZM070	X	X	X
ZM080	X	X	X
ZM090	X	X	X
ZM100	X	X	X
ZM120	X	X	X
ZM130	X	X	X
ZM140	X	X	X
ZM150	X	X	X
(ZM160)	(X)	(X)	(X)
(ZM175)	(X)	(X)	(X)
(ZM200)	(X)	(X)	(X)
(ZM250)	(X)	(X)	(X)
(ZM300)	(X)	(X)	(X)
(ZM310)	(X)	(X)	(X)
(ZM350)	(X)	(X)	(X)
(ZM430)	(X)	(X)	(X)
° The surface appearance shown in parentheses is available by agreement			

Name of the coating	Minimum weight g/m ²		Typical values of coating thickness per side in the single spot test µm		Density g/cm ³
	Triple spot test	Single spot test	Typical value	Range	
Zinc-magnesium (ZA) coating weight					
ZM060	60	50	4.5	4 to 8	6.2 to 6.6
ZM070	70	60	5.5	4 to 8	
ZM080	80	70	6	4 to 10	
ZM090	90	75	7	5 to 10	
ZM100	100	85	8	5 to 11	
ZM120	120	100	9	6 to 14	
ZM130	130	110	10	7 to 15	
ZM140	140	120	11	8 to 16	
ZM150	150	130	11.5	8 to 17	
ZM160	160	130	12	8 to 17	
ZM175	175	145	13	9 to 18	
ZM190	190	160	15	10 to 20	
ZM200	200	170	15	10 to 20	
ZM250	250	215	19	13 to 25	
ZM300	300	255	23	17 to 30	
ZM310	310	265	24	18 to 31	
ZM350	350	300	27	19 to 33	
ZM430	430	365	35	26 to 46	
a g/m ² include both surfaces					

		 MECHANICAL CHARACTERISTICS				
Name		Yield stress	Breaking	Elongation	Plastic deformation ratio	Hardening
Quality	Type of coating:	R ^e MPa ⁹	R _m MPa ⁹	A ₈₀ % min	r ₉₀ min	n ₉₀ min
DX51D	+Z, +ZF, +ZA, +ZM, +AZ, +AS	-	270 to 500	22	-	-
DX52D	+Z, +ZF, +ZA, +ZM, +AZ, +AS	140 to 300	270 to 420	26	-	-
DX53D	+Z, +ZF, +ZA, +ZM, +AZ, +AS	140 to 260	270 to 380	30	-	-
DX54D	+Z, +ZA	120 to 220	260 to 350	36	1.6	0.18
DX54D	+ZF, +ZM	120 to 220	260 to 350	34	1.4	0.18
DX54D	+AZ	120 to 220	260 to 350	36	-	-
DX54D	+AS	120 to 220	260 to 350	34	1.4	0.18
DX55D	+AS	140 to 240	270 to 370	30	-	-
DX56D	+Z, +ZA	120 to 180	260 to 350	39	1.9	0.21
DX56D	+ZF, +ZM	120 to 180	260 to 350	37	1.7	0.20
DX56D	+AZ, +AS	120 to 180	260 to 350	39	1.7	0.20
DX57D	+Z, +ZA	120 to 170	260 to 350	41	2.1	0.22
DX57D	+ZF, +ZM	120 to 170	260 to 350	39	1.9	0.21
DX57D	+AS	120 to 170	260 to 350	41	1.9	0.21
° 1MPa = 1N/mm ²						

e = laminate thickness in mm

Tensile tests performed on transverse specimens

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CHEMICAL COMPOSITION



Name		Chemical composition max %					
Quality	Type of coating:	C	Si	Mn	P	S	Ti
DX51D	+Z, +ZF, +ZA, +ZM, +AZ, +AS	0.18	0.50	1.20	0.12	0.045	0.030
DX52D	+Z, +ZF, +ZA, +ZM, +AZ, +AS	0.12		0.60	0.10		
DX53D	+Z, +ZF, +ZA, +ZM, +AZ, +AS						
DX54D	+Z, +ZF, +ZA, +ZM, +AZ, +AS						
DX55D	+AS						
DX56D	+Z, +ZF, +ZA, +ZM, +AZ, +AS						
DX57D	+Z, +ZF, +ZA, +ZM, +AS						

MECHANICAL CHARACTERISTICS



Name		Yield stress $R_{p0.2}$ MPa ^d	Breaking R_m MPa ^d	Elongation A_{80} % min
Quality	Type of coating:			
S220GD	+Z, +ZF, +ZA, +ZM, +AZ	220	300	20
S250GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS	250	330	19
S280GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS	280	360	18
S320GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS	320	390	17
S350GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS	350	420	16
S390GD	+Z, +ZF, +ZA, +ZM, +AZ	390	460	16
S420GD	+Z, +ZF, +ZA, +ZM, +AZ	420	480	15
S450GD	+Z, +ZF, +ZA, +ZM, +AZ	450	510	14
S550GD	+Z, +ZF, +ZA, +ZM, +AZ	550	560	-

^d 1MPa = 1N/mm²

Construction steels

CHEMICAL COMPOSITION



Name		Chemical composition max %				
Quality	Type of coating:	C	Si	Mn	P	S
S220GD	+Z, +ZF, +ZA, +ZM, +AZ	0.20	0.60	1.70	0.10	0.045
S250GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS					
S280GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS					
S320GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS					
S350GD	+Z, +ZF, +ZA, +ZM, +AZ, +AS					
S390GD	+Z, +ZF, +ZA, +ZM, +AZ					
S420GD	+Z, +ZF, +ZA, +ZM, +AZ					
S450GD	+Z, +ZF, +ZA, +ZM, +AZ					
S550GD	+Z, +ZF, +ZA, +ZM, +AZ					

MECHANICAL
CHARACTERISTICS

High-resistive steels

Name		Yield stress $R_{p0.2}$ MPa ^f	Hardening index BH_2 MPa ^f min	Breaking R_m MPa ^f	Elongation A_{80} % min	Plastic deformation ratio r_{90} min	Hardening n^{90} min
Quality	Type of coating:						
HX160YD	+Z, +ZF, +ZA +ZM, +AZ, +AS	160 to 220	-	300 to 360	37	1.9	0.20
HX180YD		180 to 240	-	330 to 390	34	1.7	0.18
HX180BD		180 to 240	30	290 to 360	34	1.5	0.16
HX220YD		220 to 280	-	340 to 420	32	1.5	0.17
HX220BD		220 to 280	30	320 to 400	32	1.2	0.15
HX260YD		260 to 320	-	380 to 440	30	1.4	0.16
HX260BD		260 to 320	30	360 to 440	28	-	-
HX260LAD		260 to 330	-	350 to 430	26	-	-
HX300YD		300 to 360	-	390 to 470	27	1.3	0.15
HX300BD		300 to 360	30	400 to 480	26	-	-
HX300LAD		300 to 380	-	380 to 480	23	-	-
HX340BD		340 to 400	30	440 to 520	24	-	-
HX340LAD		340 to 420	-	410 to 510	21	-	-
HX380LAD		380 to 480	-	440 to 560	19	-	-
HX420LAD		420 to 520	-	470 to 590	17	-	-
HX460LAD		460 to 560	-	500 to 640	15	-	-
HX500LAD		500 to 620	-	530 to 690	13	-	-

^f 1 MPa = 1 N/mm²

e = laminate thickness in mm

Tensile tests performed on transverse specimens

CHEMICAL
COMPOSITION

Name		C MAX	Si max	Mn max	P max	S max	Al _{total}	Nb max	Ti max
Quality	Type of coating:								
HX160YD	+Z, +ZF, +ZA +ZM, +AZ, +AS	0.01	0.30	0.60	0.060	0.025	≥0.010	0.09	0.12
HX180YD		0.01	0.30	0.70	0.060	0.025	≥0.010	0.09	0.12
HX180BD		0.06	0.50	0.70	0.060	0.025	≥0.015	0.09	0.12
HX220YD		0.01	0.30	0.90	0.080	0.025	≥0.010	0.09	0.12
HX220BD		0.08	0.50	0.70	0.085	0.025	≥0.015	0.09	0.12
HX260YD		0.01	0.30	1.60	0.10	0.025	≥0.010	0.09	0.12
HX260BD		0.10	0.50	1.00	0.10	0.030	≥0.010	0.09	0.12
HX260LAD		0.11	0.50	1.00	0.030	0.025	≥0.015	0.09	0.15
HX300YD		0.015	0.30	1.60	0.10	0.025	≥0.010	0.09	0.12
HX300BD		0.11	0.50	0.80	0.12	0.025	≥0.010	0.09	0.12
HX300LAD		0.12	0.50	1.40	0.030	0.025	≥0.015	0.09	0.15
HX340BD		0.11	0.50	0.80	0.12	0.025	≥0.010	0.09	0.12
HX340LAD		0.12	0.50	1.4	0.030	0.025	≥0.015	0.10	0.15
HX380LAD		0.12	0.50	1.5	0.030	0.025	≥0.015	0.10	0.15
HX420LAD		0.12	0.50	1.6	0.030	0.025	≥0.015	0.10	0.15
HX460LAD		0.15	0.50	1.7	0.030	0.025	≥0.015	0.10	0.15
HX500LAD		0.15	0.50	1.7	0.030	0.025	≥0.015	0.10	0.15

Tolerances by size and shape



Relevant steelmaking regulation
EUROPEAN STANDARD: UNI EN 10143 : 2006

ATTENTION:

They come in the form of thin metal sheets, wide strips, sheared wide strips, or cut-to-length strips (bands) made from sheared wide strips or thin sheets. **The standards involved are UNI EN 10292, UNI EN 10326, UNI EN 10327, and hot dip-coated products are according to prEN 10336.**

The standard applies to flat products with a coating applied by continuous hot dipping of zinc (Z), zinc-iron alloy (ZF), zinc-aluminum alloy (ZA), aluminum-zinc alloy (AZ), and aluminum-silicon alloy (AS), of cold-forming high-strength low-carbon steels, and of structural steels with a minimum thickness of 0.20 mm and a maximum thickness of 6.50 mm

Thickness tolerances for steels with minimum specified yield strength R_e or $R_{p0.2} < 260$ MPa



Nominal thickness t	Normal tolerance for nominal width w			Special tolerance (S) for nominal width w		
	≤ 1200	$1200 < w \leq 1500$	> 1500	≤ 1200	$1200 < w \leq 1500$	> 1500
$0.20 < t \leq 0.40$	± 0.04	± 0.05	± 0.06	± 0.030	± 0.035	± 0.040
$0.40 < t \leq 0.60$	± 0.04	± 0.05	± 0.06	± 0.035	± 0.040	± 0.045
$0.60 < t \leq 0.80$	± 0.05	± 0.06	± 0.07	± 0.040	± 0.045	± 0.050
$0.80 < t \leq 1.00$	± 0.06	± 0.07	± 0.08	± 0.045	± 0.050	± 0.060
$1.00 < t \leq 1.20$	± 0.07	± 0.08	± 0.09	± 0.050	± 0.060	± 0.070
$1.20 < t \leq 1.60$	± 0.10	± 0.11	± 0.12	± 0.060	± 0.070	± 0.080
$1.60 < t \leq 2.00$	± 0.12	± 0.13	± 0.14	± 0.070	± 0.080	± 0.090
$2.00 < t \leq 2.50$	± 0.14	± 0.15	± 0.16	± 0.090	± 0.100	± 0.110
$2.50 < t \leq 3.00$	± 0.17	± 0.17	± 0.18	± 0.110	± 0.120	± 0.130
$3.00 < t \leq 5.00$	± 0.20	± 0.20	± 0.21	± 0.15	± 0.16	± 0.17
$5.00 < t \leq 6.50$	± 0.22	± 0.22	± 0.23	± 0.17	± 0.18	± 0.19

Thickness tolerances for steels with minimum specified yield strength $260 \text{ MPa} \leq R_{p0.2} \leq 360$ MPa and for DX51D and S550GD qualities



Nominal thickness t	Normal tolerance for nominal width w			Special tolerance (s) for nominal width w		
	≤ 1200	$1200 < w \leq 1500$	> 1500	≤ 1200	$1200 < w \leq 1500$	> 1500
$0.20 < t \leq 0.40$	± 0.05	± 0.06	± 0.07	± 0.035	± 0.040	± 0.045
$0.40 < t \leq 0.60$	± 0.05	± 0.06	± 0.07	± 0.040	± 0.045	± 0.050
$0.60 < t \leq 0.80$	± 0.06	± 0.07	± 0.08	± 0.045	± 0.050	± 0.060
$0.80 < t \leq 1.00$	± 0.07	± 0.08	± 0.09	± 0.050	± 0.060	± 0.070
$1.00 < t \leq 1.20$	± 0.08	± 0.09	± 0.11	± 0.060	± 0.070	± 0.080
$1.20 < t \leq 1.60$	± 0.11	± 0.13	± 0.14	± 0.070	± 0.080	± 0.090
$1.60 < t \leq 2.00$	± 0.14	± 0.15	± 0.16	± 0.080	± 0.090	± 0.110
$2.00 < t \leq 2.50$	± 0.16	± 0.17	± 0.18	± 0.110	± 0.120	± 0.130
$2.50 < t \leq 3.00$	± 0.19	± 0.20	± 0.20	± 0.130	± 0.140	± 0.150
$3.00 < t \leq 5.00$	± 0.22	± 0.24	± 0.25	± 0.17	± 0.18	± 0.19
$5.00 < t \leq 6.50$	± 0.24	± 0.25	± 0.26	± 0.19	± 0.20	± 0.21

Tolerances by size and shape



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Thickness tolerances for steels with minimum specified **yield strength $360 \text{ MPa} \leq R_{p0.2} \leq 420 \text{ MPa}$**

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Nominal thickness t	Normal tolerance for nominal width w			Special tolerance (s) for nominal width w		
	≤ 1200	$1200 < w \leq 1500$	> 1500	≤ 1200	$1200 < w \leq 1500$	> 1500
$0.35 < t \leq 0.40$	± 0.05	± 0.06	± 0.07	± 0.040	± 0.045	± 0.050
$0.40 < t \leq 0.60$	± 0.06	± 0.07	± 0.08	± 0.045	± 0.050	± 0.060
$0.60 < t \leq 0.80$	± 0.07	± 0.08	± 0.09	± 0.050	± 0.060	± 0.070
$0.80 < t \leq 1.00$	± 0.08	± 0.09	± 0.11	± 0.060	± 0.070	± 0.080
$1.00 < t \leq 1.20$	± 0.10	± 0.11	± 0.12	± 0.070	± 0.080	± 0.090
$1.20 < t \leq 1.60$	± 0.13	± 0.14	± 0.16	± 0.080	± 0.090	± 0.110
$1.60 < t \leq 2.00$	± 0.16	± 0.17	± 0.19	± 0.090	± 0.110	± 0.120
$2.00 < t \leq 2.50$	± 0.18	± 0.20	± 0.21	± 0.120	± 0.130	± 0.140
$2.50 < t \leq 3.00$	± 0.22	± 0.22	± 0.23	± 0.140	± 0.150	± 0.160
$3.00 < t \leq 5.00$	± 0.22	± 0.24	± 0.25	± 0.17	± 0.18	± 0.19
$5.00 < t \leq 6.50$	± 0.24	± 0.25	± 0.26	± 0.19	± 0.20	± 0.21

Thickness tolerances for steels with minimum specified **yield strength $420 \text{ MPa} \leq R_{p0.2} \leq 900 \text{ MPa}$**

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Nominal thickness t	Normal tolerance for nominal width w			Special tolerance (s) for nominal width w		
	≤ 1200	$1200 < w \leq 1500$	> 1500	≤ 1200	$1200 < w \leq 1500$	> 1500
$0.35 < t \leq 0.40$	± 0.06	± 0.07	± 0.08	± 0.045	± 0.050	± 0.060
$0.40 < t \leq 0.60$	± 0.06	± 0.08	± 0.09	± 0.050	± 0.060	± 0.070
$0.60 < t \leq 0.80$	± 0.07	± 0.09	± 0.11	± 0.060	± 0.070	± 0.080
$0.80 < t \leq 1.00$	± 0.09	± 0.11	± 0.12	± 0.070	± 0.080	± 0.090
$1.00 < t \leq 1.20$	± 0.11	± 0.13	± 0.14	± 0.080	± 0.090	± 0.110
$1.20 < t \leq 1.60$	± 0.15	± 0.16	± 0.18	± 0.090	± 0.110	± 0.120
$1.60 < t \leq 2.00$	± 0.18	± 0.19	± 0.21	± 0.110	± 0.120	± 0.140
$2.00 < t \leq 2.50$	± 0.21	± 0.22	± 0.24	± 0.140	± 0.150	± 0.170
$2.50 < t \leq 3.00$	± 0.24	± 0.25	± 0.26	± 0.170	± 0.180	± 0.190
$3.00 < t \leq 5.00$	± 0.26	± 0.27	± 0.28	± 0.23	± 0.24	± 0.26
$5.00 < t \leq 6.50$	± 0.28	± 0.29	± 0.30	± 0.25	± 0.26	± 0.28

Tolerances by size and shape



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Tolerance on sheet and strip width ≥ 600 mm

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Nominal width w	Normal tolerance	Special tolerance (s)
$600 \leq w \leq 1200$	+5 0	+2 0
$1200 < w \leq 1500$	+6 0	+2 0
$1500 < w \leq 1800$	+7 0	+3 0
$w > 1800$	+8 0	+3 0

Tolerance on belt width **less than 600 mm**

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Tolerance class	Nominal thickness t	Nominal width			
		$w < 125$	$125 \leq w < 250$	$250 \leq w < 400$	$400 \leq w < 600$
Normal	$t < 0.6$	+0.4 0	+0.5 0	+0.7 0	+1.0 0
	$0.6 \leq t < 1.0$	+0.5 0	+0.6 0	+0.9 0	+1.2 0
	$1.0 \leq t < 2.0$	+0.6 0	+0.8 0	+1.1 0	+1.4 0
	$2.0 \leq t \leq 3.0$	+0.7 0	+1.0 0	+1.3 0	+1.6 0
	$3.0 < t \leq 5.0$	+0.8 0	+1.1 0	+1.4 0	+1.7 0
	$5.0 < t \leq 6.5$	+0.9 0	+1.2 0	+1.5 0	+1.8 0
Special (s)	$t < 0.6$	+0.2 0	+0.2 0	+0.3 0	+0.5 0
	$0.6 \leq t < 1.0$	+0.2 0	+0.3 0	+0.4 0	+0.6 0
	$1.0 \leq t < 2.0$	+0.3 0	+0.4 0	+0.5 0	+0.7 0
	$2.0 \leq t \leq 3.0$	+0.4 0	+0.5 0	+0.6 0	+0.8 0
	$3.0 < t \leq 5.0$	+0.5 0	+0.6 0	+0.7 0	+0.9 0
	$5.0 < t \leq 6.5$	+0.6 0	+0.7 0	+0.8 0	+1.0 0

Tolerances by size and shape



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Length tolerances

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Nominal length	Normal tolerance	Special tolerance (s)
< 2000	+6 0	+3 0
≥ 2000 and ≤ 8000	+0.3 of the length 0	+0.15% of the length 0
> 8000	by agreement	

Flatness tolerances for steels with minimum specified yield strength R_e or $R_{p0.2} < 260 \text{ MPa}$

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Tolerance class	Nominal width w	Maximum wave height for nominal thickness t			
		t < 0.7	0.7 ≤ t < 1.6	1.6 ≤ t < 3.0	3.0 ≤ t ≤ 6.5
Normal	w < 1200	10	8		15
	1200 ≤ w < 1500	12	10		18
	w ≥ 1500	17	15		23
Special (FS)	w < 1200	5	4	3	8
	1200 ≤ w < 1500	6	5	4	9
	w ≥ 1500	8	7	6	12

Flatness tolerance for steels with minimum specified yield strength $260 \text{ MPa} \leq R_{p0.2} \leq 360 \text{ MPa}$ and for DX51D and S550GD degrees

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Tolerance class	Nominal width w	Maximum wave height for nominal thickness t			
		t < 0.7	0.7 ≤ t < 1.6	1.6 ≤ t < 3.0	3.0 ≤ t ≤ 6.5
Normal	w < 1200	13	10		18
	1200 ≤ w < 1500	15	13		25
	w ≥ 1500	20	19		28
Special (FS)	w < 1200	8	6	5	9
	1200 ≤ w < 1500	9	8	6	12
	w ≥ 1500	12	10	9	14

Tolerances by size and shape



Relevant steelmaking regulation
EUROPEAN STANDARD: UNI EN 10131 : 2006

ATTENTION:

They come in the form of thin metal sheets, wide strips, sheared wide strips, or cut-to-length strips (bands) made from sheared wide strips or thin sheets. **The standards involved are UNI EN 10292, UNI EN 10326, UNI EN 10327, and hot dip-coated products are according to prEN 10336.**

The standard applies to flat products with a coating applied by continuous hot dipping of zinc (Z), zinc-iron alloy (ZF), zinc-aluminum alloy (ZA), aluminum-zinc alloy (AZ), and aluminum-silicon alloy (AS), of cold-forming high-strength low-carbon steels, and of structural steels with a minimum thickness of 0.20 mm and a maximum thickness of 6.50 mm

Out-of-square tolerance

10

The out-of-square (u) is the orthogonal projection of the transverse side along the longitudinal side (see Figure 1).

Out-of-square must not exceed 1% of the sheet width.

Lapping tolerance

11

The lapping (q) is the maximum distance between the longitudinal edge and a reference straight side (see Figure 1).

The lapping should be measured on the concave side. The base of the measurement should be 2 meters, taken on any point on the concave edge.

If the metal sheet has a length of less than 2 meters, the base of the measurement should be equal to its length.

Lapping should not exceed 5 mm over a length of 2 meters. For lengths of less than two meters, the lapping should not exceed 0.25 percent of the length itself.

For strips less than 600 mm wide, a special lapping tolerance (CS) of maximum 2 mm on a length of 2 meters can be specified.

This special tolerance is not applicable to strips with minimum yield strength $R_{p0.2} \geq 280$ MPa.

Figure 1

