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Lasersko varjeni posebej prilagojeni spoji - Tehnični dobavni pogoji

Laser welded tailored blanks - Technical delivery conditions

Laserstrahlgeschweißte Tailored Blanks aus Stahlfeinblech - Technische Lieferbedingungen

Flans raboutés laser - Conditions techniques de livraison

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Laser welded tailored blanks - Technical delivery conditions

Flans raboutés laser - Conditions techniques de livraison

Laserstrahlgeschweißte Tailored Blanks aus Stahlfeinblech - Technische Lieferbedingungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 459/SC 9.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 10359:2022) has been prepared by Technical Committee CEN/TC 459 “ECISS - European Committee for Iron and Steel Standardization”[1], the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 10359:2015.

In comparison with the previous edition, the following technical modifications have been made:

— addition of three definitions;

— modification of the convexity requirement when filler wire is added for cold stamped LWB;

— addition of a requirement in the case of hot stamped LWB:

— modification of the convexity requirement;

— heat treatment guidelines;

— modification of the destructive testing requirement (tensile test and hardness test);

— modification of the cross section measurement method: exclusion of coating;

— definition of the weld cross section measurement method;

— suppression of the weld sagging defect as being redundant with other existing defects.

[1] Through its sub-committee SC 9 “Coated and uncoated flat products to be used for cold forming” (secretariat: AFNOR).

1 Scope

This document specifies the requirements for laser welded tailored blanks (LWB) made of steels for all cold or hot forming processes.

This document applies to all steel grades with or without metallic and/or organic coatings, having uniform or different sheet thickness, welded with or without extra material addition.

After the welding process, LWB are further processed to pressed parts by forming operations under the responsibility of the processor.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10131, *Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming — Tolerances on dimensions and shape*

EN 10143, *Continuously hot-dip coated steel sheet and strip — Tolerances on dimensions and shape*

ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
laser welded tailored blanks
LWB
laser welded metal sheets of uniform and/or different thickness and/or uniform or different steel grades, both with and without surface coating

3.2
part submission warrant
PSW
technical report used in the automotive industry when submitting a new car part to a car part manufacturer for approval as part of a production car part approval process

Note 1 to entry: The part manufacturer can be a carmaker or a subcontracting company delivering car parts to the carmaker.

3.3
supplier
manufacturer of LWB

3.4
customer
purchaser of LWB

4 Requirements

As far as the properties of the components are concerned, the general rules of engineering apply. The suitability of LWB for the processes of the customer shall be guaranteed in case of appropriate execution of the welding seam, suitable positioning of the weld seam in the part to be formed and appropriate lay out of sheet thicknesses and steel grades taking into consideration the requirements of known further processing steps. The criteria laid down in Table 1 have proved to be a practical basis for ordering and shall be applied. Additional specific deviations can be permitted and shall be agreed upon at the time of ordering.

5 Tolerances on dimensions, shape and packaging

Regarding tolerances on dimensions and shape the agreements of EN 10131 and EN 10143 shall apply for cold rolled and surface coated wide coils, cut to length sheets and slit coils, which are used for the manufacturing of LWB.

The relevant tolerance classes for width, flatness and thickness shall be agreed upon between producer of LWB, steel producer and customer.

For the general tolerances regarding lengths, angles, coaxiality and symmetry, the precision class c according to ISO 2768-1 shall apply.

If not all edges of the blank were cut, the definition of the dimension shall be according to EN 10143 and EN 10131 also.

Specific requirements and other beyond that valid special customer agreement shall be agreed upon between producer of LWB /steel producer and customer.

Packaging requirements for LWB are defined in Figure 6.

6 Destructive testing of weld joints

6.1 Cup test

Destructive testing of the weld joints with cup test is considered as best practice procedure for cold stamped blanks.

The evaluation of weld quality shall be done in accordance with the Figures 3, 4 and 5.

Frequency of the cup test is minimum once a run.

6.2 Cross section

Samples shall be taken minimum 5 mm from both ends of welds. For measurements, Figure 7 and Figure 8 apply.

Additional criteria for press hardening steel LWB, ferritic and intermetallic phases are acceptable as long as they have no negative influence on the weld strength measured with the tensile test.

6.3 Heat treatment for hot stamped blanks

Heat treatment shall be conducted to have base material meeting minimal and maximal customer strength requirements measured either with tensile or hardness testing.

6.4 Tensile testing for hot stamped blanks

Destructive testing of weld joints with tensile testing is considered as a best practice procedure for hot stamped blanks.

This test shall be carried out after heat treatment. The tensile test samples are taken across the seam.

The shape of the tensile specimen may be in accordance with EN ISO 6892-1 or the relevant JIS or ASTM standard. Another shape may also be agreed between supplier and customer.

The weld seam shall be positioned in the middle of the specimen and perpendicular to the applied load.

Ultimate tensile strength of the specimens shall exceed base material minimum tensile strength of the weaker substrate.

The tensile test result can be considered as good if one of the three following failure modes occurs:

— fracture occurs in base material not affecting at all the weld seam (see case 1 in Annex A);

— the crack starts at the notch base of the weld seam and continues in the base material (see case 2 in Annex A);

— in the case of same gauge and same thickness, a ductile fracture occurs in the weld provided the minimum strength, the hardness and the weld geometry meet the requirements of this document (see case 3 in Annex A).

The tensile test is not good if a brittle fracture perpendicular to the load occurs (see case 4 in Annex A).

6.5 Hardness test for hot stamped blanks

The hardening process shall be carried out as specified in 6.3.

The hardness test shall be carried out in accordance with EN ISO 6507-1, ASTM E92-16 or another equivalent standard. HV 0,5 is recommended as the best compromise to have enough measurements in the weld seam and not too high dispersion (see Figure B.1).

The hardness shall not be measured in the decarburized area (see Figures B.2.1 and B.2.2). Therefore, hardness measurement points shall have a minimum distance from the surface of at least 150 µm.

Due to the scattering of hardness values an average value from at least 9 measurement points in the weld seam (WS), the base material 1 (BM1) and the base material 2 (BM2) shall be determined (see Figure B.2.1).

Minimum hardness value of the weld seam

The average hardness of the weld shall not drop below average softer material hardness value minus 30 HV 0,5.

See Figures B.3.1 and B.3.2.

Maximum hardness value of the weld seam

— higher strength material with ultimate tensile strength higher than 1200 MPa. Exceeding the maximum value of higher strength base material by 15 % is permissible in average. See Figure B.4.

— higher strength material with ultimate tensile strength below 1200 MPa. The maximum average value is set to 500 HV 0,5. See Figure B.5.

6.6 Tensile and hardness quality inspection interval for hot stamped LWB

The quality inspection interval requirements on the weld seam are specified in Table 1, column “Frequency”.

Table 1 — Requirements

Dimensions, surface			
Criterion	**Figures**	**Assessment**	**Frequency**
Shape inspection (Tolerance)	—	Tolerances for linear and angular dimensions without individual tolerance indications according to ISO 2768-1, class c, EN 10143, EN 10131 or customer specification.	—
Shape inspection (Method of measurement)	—	Master sample (initial sample): Reference points should be agreed with the customer. Production: measuring of the influential dimensions.	Initial parts or master sample for PSW. Production sample each run.
Flatness of the entire blank	Figure 1 a)	Deviation *h* guaranteed acc. to EN 10131 and EN 10143. Furthermore, the "processability" criterion shall apply. Tighter specification should be agreed between customer and supplier.	Initial parts or master sample for PSW. Production samples each run. Visual.
Burr of the entire LWB	—	Customer specification.	Production samples each run. Visual.
Surface quality of LWB	—	According to relevant technical delivery conditions for flat products.	Production samples each run. Visual.
Oiling of LWB	—	The entire blank shall be free from corrosion products. Oil type and amount of oil at time of steel strip production acc. to customer specification. More than 1,5 g/m^2 is not state of the art due to process ability.	Initial parts or master sample for PSW. Visual each run.
Offset of sheets	Figure 1 b)	maximal offset ± 1,5 mm	Initial parts or master sample for PSW. Production sample one each run.
Requirements on weld seam			
Cracks / Pores / Inclusions / Craters / Lack of fusion	—	Pores, inclusions: Maximum size of imperfection ≤ 0,3 x t_2 Pore nests: $f \leq 0{,}7$ %. No cracks, craters or lack of fusion are allowed. f = surface of pores measured over a length of 100 mm along the weld (longitudinal section)	Additional minimum one destructive test (cross section) once a year.
Ferritic and inter-metallic phases	—	Additional criteria for press hardening steel LWB, ferritic and intermetallic phases are acceptable so long as they have no negative	Initial parts or master sample for PSW (If required).

Dimensions, surface			
Criterion	**Figures**	**Assessment**	**Frequency**
		influence on the weld strength measured with the tensile test.	
Hardness in the area of the weld and HAZ	Annex B	Hardness depends on the defined steel grades.	Initial parts or master sample for PSW (If required).
Spatter	—	Scale and smoke residues as well as welding spatter shall not negatively affect the processability or the downstream processes.	Initial parts or master sample for PSW. Production samples each run.
Burning of zinc coating (total)	—	The maximum width of the entire zinc-free zone is 3 mm for $t_1 \leq 2$ mm, and 1+ t_1 for $t > 2$ mm	Customer specification
Undercut (Definition: un-fused edge that reduces the carrying cross section)	Figure 2 a)	$t_2 \leq 1$ mm: $h \leq 0{,}1$ mm; $t_2 > 1$ mm: $h \leq 0{,}1 \times t_2$	Additional minimum one destructive test (cross section) once a year. Checked by online systems.
Excess weld metal	Figure 2 b)	For LWB welded without extra material: $t_2 \leq 1$ mm: $h \leq 0{,}1$ mm, $t_2 > 1$ mm: $h \leq 0{,}1 \times t_2$ For LWB welded with extra material: Cold stamped LWB: $t_2 \leq 1{,}2$ mm; $h \leq 0{,}2 \times t_2$ $t_2 > 1{,}2$ mm; $h \leq 0{,}15 \times t_2$ For the first 30mm at the beginning and end of the weld $h \leq 0{,}2 \times t_2$ Hot stamped LWB all along the weld: $h \leq 0{,}2 \times t_2$	Additional minimum one destructive test (cross section) once a year. Checked by online systems.
Excessive root penetration	Figure 2 c)	For LWB welded without extra material: $t_2 \leq 1$ mm: $h \leq 0{,}1$ mm, $t_2 > 1$ mm: $h \leq 0{,}1 \times t_2$ For LWB welded with extra material: $t_2 \leq 1{,}2$ mm; $h \leq 0{,}2 \times t_2$ $t_2 > 1{,}2$ mm; $h \leq 0{,}15 \times t_2$ For the first 30mm at the beginning of the weld $h \leq 0{,}2 \times t_2$ Hot stamped LWB all along the weld	Additional minimum one destructive test (cross section) once a year. Checked by online systems.

Dimensions, surface			
Criterion	**Figures**	**Assessment**	**Frequency**
		$h \leq 0{,}2 \times t_2$	
Upper weld concavity	Figure 2 d)	$t_2 \leq 1$ mm: $h \leq 0{,}1$ mm, $t_2 > 1$ mm: $h \leq 0{,}1 \times t_2$	Additional minimum one destructive test (cross section) once a year. Checked by online systems.
Root concavity	Figure 2 e)	$t_2 \leq 1$ mm: $h \leq 0{,}1$ mm, $t_2 > 1$ mm: $h \leq 0{,}1 \times t_2$	Additional minimum one destructive test (cross section) once a year. Checked by online systems.
Mismatch	Figure 2 g) and Figure 2 h)	negative mismatch: $t_2 \leq 1$ mm: $h \leq 0{,}1$ mm, $t_2 > 1$ mm: $h \leq 0{,}1 \times t_2$ positive mismatch: $t_2 \leq 1$ mm: $h \leq 0{,}2$ mm, $t_2 > 1$ mm: $h \leq 0{,}2 \times t_2$ Furthermore, the “processability” criterion shall apply.	Additional minimum one destructive test (cross section) once a year. Checked by online systems.
Weld cross section	Figure 2 i)	The remaining cross section due to weld defects (Undercut, Root concavity, Upper weld concavity, negative mismatch) should not be smaller than: $g \geq 0{,}80 \times t_2$ In the case of hot stamped LWB, with same gauge and same material, $g \geq 0{,}90 \times t_2$	Initial parts or master sample for PSW (If required).
Beginning/end of weld	Figure 2 j)	At the beginning and end of the weld areas with a max. length of 2 mm each may occur where the laser beam is without effect. Furthermore, the “processability” criterion shall apply.	Production sample each run. Visual.
Lack of penetration	Figure 2 f)	Lack of penetration is not allowed.	Additional minimum one destructive test (cross section) once a year. Checked by online systems.
Testing			
Testing of weld seam (non- destructive)	Figure 2 j)	Each LWB is tested with appropriate and ensured test procedures (online). Additional visual inspection is possible. Up to max. 5 mm at the beginning and end of the weld cannot be monitored by state-of-the-art online test procedures.	100 % by online- system

Dimensions, surface			
Criterion	**Figures**	**Assessment**	**Frequency**
Weld seam testing (mechanical and technological) for the series delivery of cold stamped LWB	Figures 3, 4 and 5	Using ensured test procedures with appropriate testing frequency (offline): In the case of cold stamped LWB, the cup test according to Figures 3, 4 and 5.	Once per run
Weld seam testing (mechanical and technological) for the series delivery of hot stamped LWB	Annex A	Using ensured test procedures with appropriate testing frequency (offline): In the case of hot stamped LWB, the tensile test according to Annex A	Tensile test or hardness test shall be carried out in the context of initial parts or master sample for PSW, product audits and the prescribed requalification. In addition, specific agreements for frequency between supplier and customer are possible.
Process assurance by traceability	—	Traceability from stack label back to the batch number of steel sheet or coil.	—
Packaging			
Packaging	—	As specified by the customer and complying with “stacking deviation” and “stacking height deflection” as defined below.	Each stack Visual
Stack deviation	Figure 6 a)	*h* ≤ 5,0 mm provided that the pallet has been designed adequately	Each stack
Stack height deflection (deflection of LWB on top)	Figure 6 b) and Figure 6 c)	The height deviation *h* of the dimpled blanks in the stack shall be less than ± 30 mm compared to the undimpled blank whenever it is technically feasible with respect to the blank geometry, and design of pallet. For blanks welded with extra material, the height deviation *h* in the stack shall be less than ± 80mm. Furthermore the “processability” criterion shall apply.	Each stack Visual
t_1 = thickness of thicker sheet t_2 = thickness of thinner sheet *h* = deviation in mm *g* = remaining weld thickness *f* = porosity projection fraction			