BS EN 10359:2015

BSI Standards Publication

Laser welded tailored blanks — Technical delivery conditions

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National foreword

This British Standard is the UK implementation of EN 10359:2015.

The UK participation in its preparation was entrusted to Technical Committee ISE/109, Coated and Uncoated Flat Products to be Used for Cold Forming.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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English Version

Laser welded tailored blanks - Technical delivery conditions

Flans raboutés laser - Conditions techniques de livraison

Laserstrahlgeschweißte Tailored Blanks aus Stahlfeinblech - Technische Lieferbedingungen

This European Standard was approved by CEN on 20 June 2015.

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European foreword

This document (EN 10359:2015) has been prepared by Technical Committee ECISS/TC 109 “Coated and uncoated flat products to be used for cold forming”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2016 and conflicting national standards shall be withdrawn at the latest by January 2016.

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1 Scope

This European Standard describes the requirements for laser welded tailored blanks made of alloyed and unalloyed steels, of uniform or different steel grades and with or without metallic and/or organic coatings, having uniform or different sheet thickness. It applies only to the (Tailored Blanks) as-supplied condition of tailored blanks.

After the welding process, tailored blanks are further processed to pressed parts by forming operations under the responsibility of the processor. In the design of the component due consideration should be given to the fact that the weld seam is less formable in comparison to the base material.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 term and definition applies.

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

4 Requirements

As far as the properties of the components are concerned, the general rules of engineering apply. The suitability of tailored blanks for the processes of the customer is guaranteed in case of appropriate execution of the welding seam, suitable positioning of weld seam in the part to be formed and appropriate lay out of sheet thicknesses and steel grades under 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. Additional specific deviations are admissible and have to be agreed upon at the time of ordering.

5 Tolerances on dimensions and shape

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 tailored blanks.

The relevant tolerance classes for width, flatness and thickness have to be agreed upon between producer of tailored blank and steel producer.

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 has to be according to EN 10143 and EN 10131 also.

Specific requirement and other beyond that valid special customer agreement have to be agreed upon between producer of tailored blank / steel producer and customer.

6 Destructive testing of weld joints

6.1 Cup test

Destructive testing of weld joints with cup test is considered as best practice procedure.

The evaluation of weld quality is done according to the pictures in Table 2.

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, Table 3 applies.

Table 1 — Requirements

Dimensions, surface			
Criterion	**Figures**	**Assessment**	**Frequency**
Shape inspection (Tolerance)	–	Tolerances for linear and angular dimensions without individual tolerance indications according ISO 2768-1, class c, EN 10143, EN 10131 or customer specification	
Shape inspection (Method of measurement)	–	Master sample (Initial sample): Reference points have to be agreed with the customer. Production: measuring of the influential dimensions.	Initial parts or master sample for PSW[a] Production sample each run
Flatness of the entire blank	Figure 1	Deviation h guaranteed acc. to EN 10131 and EN 10143. Furthermore, the “process ability” criterion shall apply. Tighter specification should be agreed between customer and supplier.	Initial parts or master sample for PSW[a]. Production samples each run. Visual.
Burr of the entire laser welded blank	–	Customer specification.	Production samples each run. Visual.
Surface quality of laser welded blanks	–	According to relevant technical delivery conditions for flat products.	Production samples each run. Visual.
Oiling of tailored blanks	–	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[a]. Visual each run.

Offset of sheets	Figure 13	maximal Offset ± 1,5 mm	Initial parts or master sample for PSW[a]. Production sample one each run.
Requirements on weld seam			
Criterion	**Figures**	**Assessment**	**Frequency**
Cracks / Pores / Inclusions / Craters / Lack of fusion	–	Pores, Inclusions: Maximum size of imperfection ≤ 0,3 x t_2 Pore nests: f ≤ 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 (parallel cross section)	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Hardness in the area of the weld and HAZ	–	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 nor 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 ≤ 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	t_2 ≤ 1 mm: h ≤ 0,1 mm; t_2 > 1 mm: h ≤ 0,1 x t_2	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Excess weld metal	Figure 3	t_2 ≤ 1 mm: h ≤ 0,1 mm; t_2 > 1 mm: h ≤ 0,1 x t_2	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Excessive root penetration	Figure 4	t_2 ≤ 1 mm: h ≤ 0,1 mm, t_2 > 1 mm: h ≤ 0,1 x t_2	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Upper weld concavity	Figure 5	t_2 ≤ 1 mm: h ≤ 0,1 mm, t_2 > 1 mm: h ≤ 0,1 x t_2	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Root concavity	Figure 6	t_2 ≤ 1 mm: h ≤ 0,1 mm, t_2 > 1 mm: h ≤ 0,1 x t_2	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Weld sagging	Figure 7	t_2 ≤ 1 mm: h ≤ 0,1 mm, t_2 > 1 mm: h ≤ 0,1 x t_2	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.

Mismatch	Figure 8 and 9	negative mismatch: t_2 ≤ 1 mm: h ≤ 0,1 mm, t_2 > 1 mm: h ≤ 0,1 x t_2 positive mismatch: t_2 ≤ 1 mm: h ≤ 0,2 mm, t_2 > 1 mm: h ≤ 0,2 x t_2 Furthermore, the processability criterion shall apply.	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Weld cross section	Figure 10	The remaining cross section due to weld defects (Undercut, Root concavity, Upper weld concavity, negative mismatch) should not be smaller than: t_2 ≤ 1mm: g ≥ 0,80 x t_2 t_2 > 1 mm: g ≥ 0,80 x t_2	
Beginning/end of weld	Figure 12	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 11	Lack of penetration is not allowed	Checked by online-systems. Additional minimum one destructive test (cross section) once a year.
Testing			
Criterion	**Figures**	**Assessment**	**Frequency**
Testing of weld seam (non- destructive)	Figure 12	Each tailored blank 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
Weld seam testing (mechanical and technological) for the series delivery	Table 2	Using ensured test procedures with appropriate testing frequency (offline), e.g. the cup test according to EN ISO 20482 or other appropriate standards	Once per run
Process assurance by traceability		Traceability from stack label back to the batch number of steel sheet or coil.	
Packaging			
Criterion	**Figures**	**Assessment**	**Frequency**
Packaging		As specified by the customer and complying with “stacking deviation” and “stacking height deflection” as defined below.	Each stack Visual
Stack deviation	Figure 14	h ≤ 5,0 mm provided that the palette has been designed adequately	Each stack

Stack height deflection (deflection of tailored blank on top)	Figure 15 and 16	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 regard to blank geometry and design of palette, 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			
[a] PSW = Part Submission Warrant.			

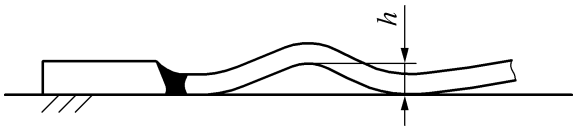


Figure 1 — Flatness of the blank

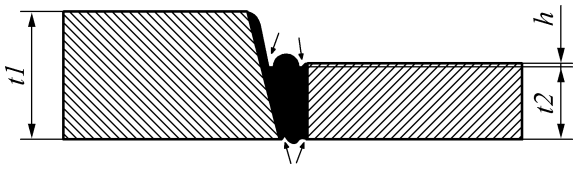


Figure 2 — Undercut

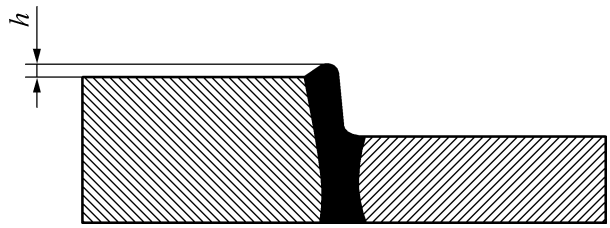


Figure 3 — Excess weld metal

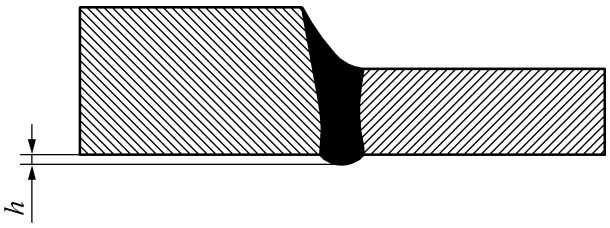


Figure 4 — Excess root penetration

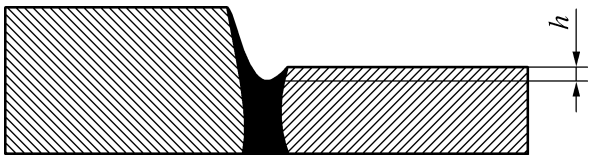


Figure 5 — Upper weld concavity

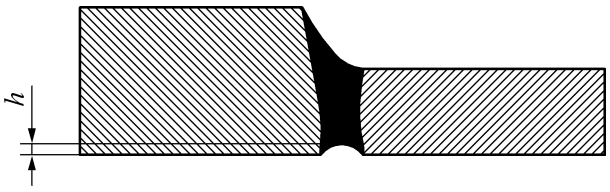


Figure 6 — Root concavity

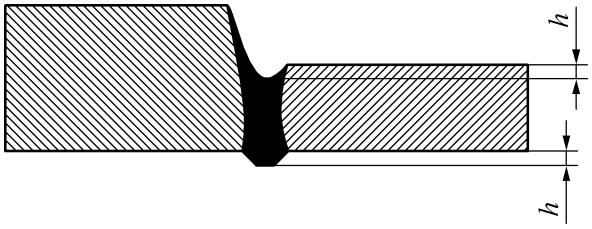


Figure 7 — Weld sagging

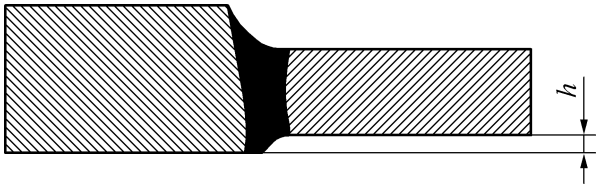


Figure 8 — Positive mismatch

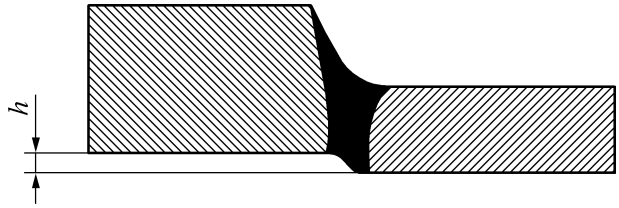


Figure 9 — Negative mismatch with weakening of the weld section

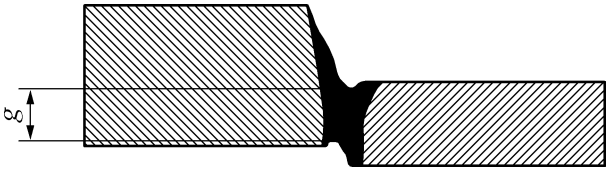


Figure 10 — Weld cross section

Key (from Figure 1 to Figure 10)

t_1 thickness of thick sheet

t_2 thickness of thin sheet (dimpled sheet)

h deviation

g remaining weld thickness

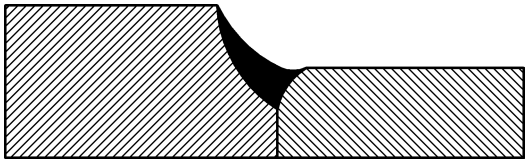


Figure 11 — Lack of penetration

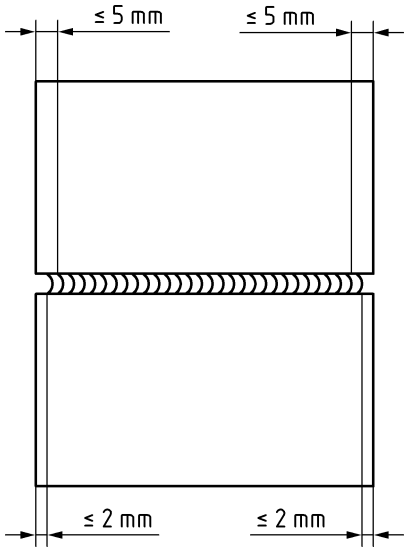


Figure 12 — Beginning/end of weld seam

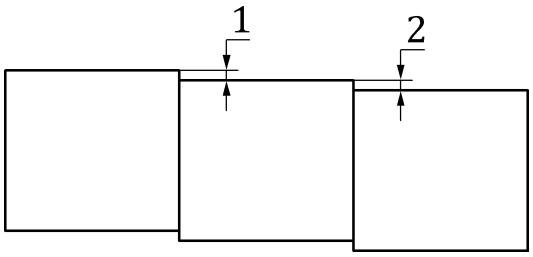


Figure 13 — Offset of the sheets

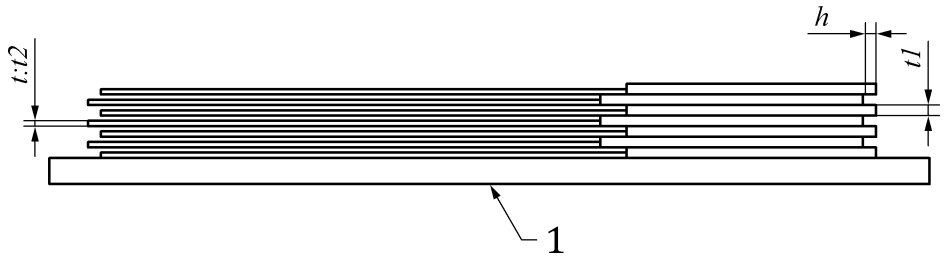


Figure 14 — Stack deviation

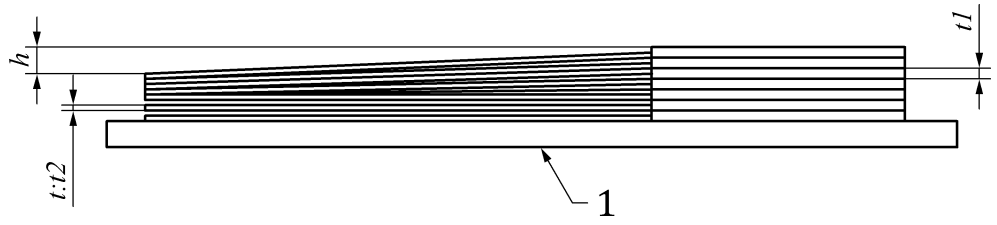


Figure 15 — Stack height deflection

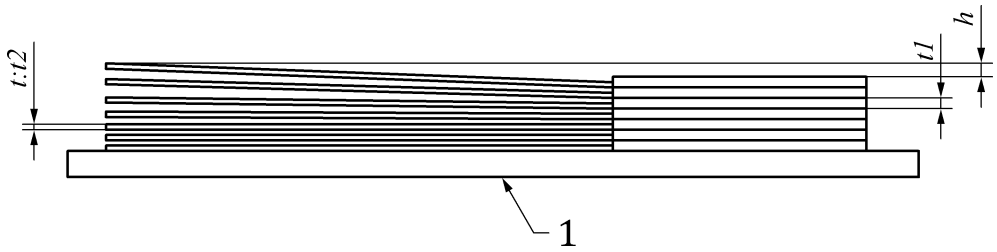


Figure 16 — Stack height deflection

Key (from Figure 14 to Figure 16)

t_1 thickness of thick sheet

t_2 thickness of thin sheet (dimpled sheet)

h deviation

1 palette

Table 2 — Weld seam testing

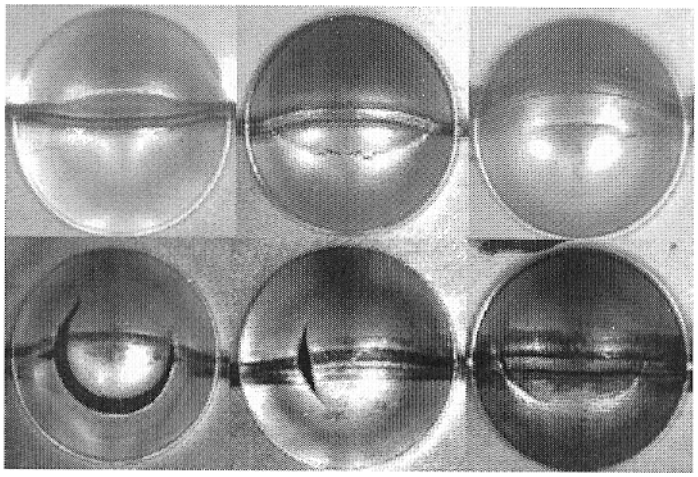
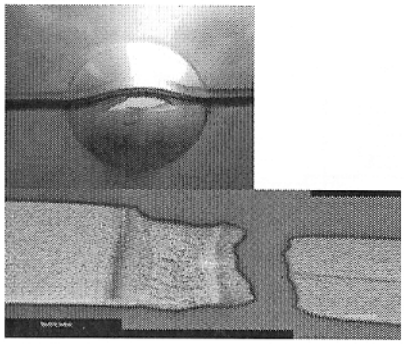
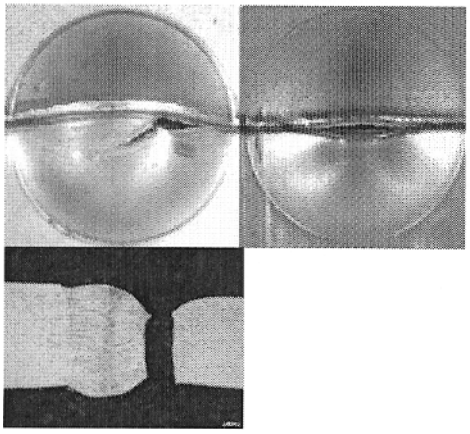
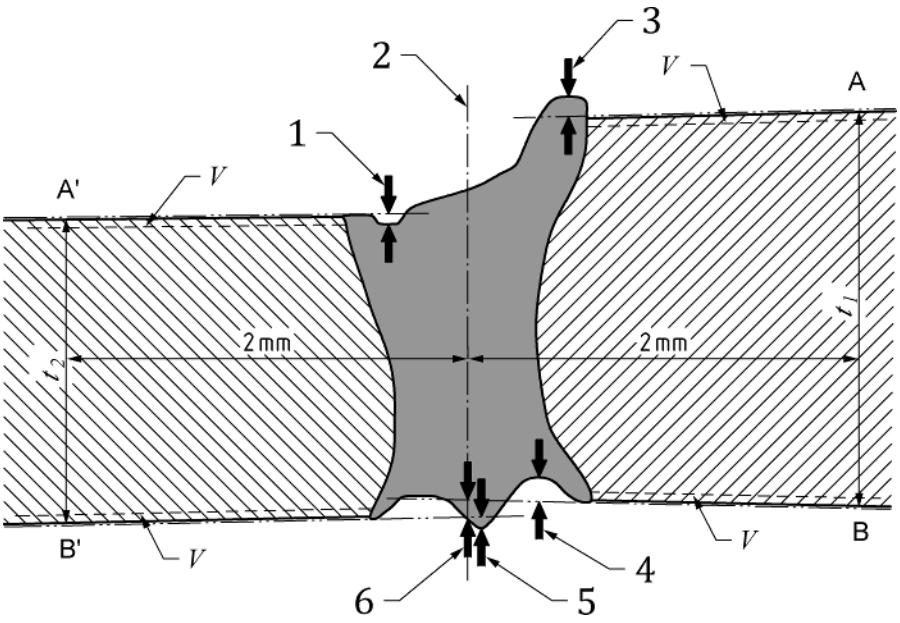
	**Results** Welding OK Welding OK
	If the crack is beside the weld in the heat affected zone the weld is good. In case of doubt a cross section has to be done. Judgement of responsibility for cracks in the welding area, shall include consideration of the role of component design.
	The welds are not accepted - able if the crack is in the welding. In case of doubt a cross section has to be done. Judgement of responsibility for cracks in the welding area, shall include consideration of the role of component design.

Table 3 — Cross section measurement method (including the coating)

Before measurement can be done, the following 5 lines shall be defined:

1) Middle of the molten zone
2) Tangent A,A' (top) and B,B' (bottom side) at 2 mm each side from middle of molten zone

All measurements shall include coating if present.



Key

t_1 = thickness of thick sheet

t_2 = thickness of thin sheet (dimpled sheet)

V = coating

1 = upper concavity measurement from lower tangent to the deepest point

2 = middle of the molten zone

3 = excess weld metal measurement from upper tangent to the highest point

4 = root concavity measurement from upper tangent to the deepest point

5 = weld sagging measurement from lower tangent to the lowest point

6 = mismatch measurement between both tangent lines at the middle of the melted zone

Bibliography

EN ISO 20482, *Metallic materials — Sheet and strip — Erichsen cupping test (ISO 20482)*

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