UIC CODE 897-23

2nd edition, June 2004

Translation

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Technical specification for the execution and control of test joints in aluminium and aluminium alloys (mock-ups)

Spécification technique pour l'exécution et le contrôle des assemblages d'essais en aluminium et alliages d'aluminium (maquettes)
Technische Lieferbedingungen für die Ausführung und Prüfung der Schweißverbindungen aus Aluminium und Aluminiumlegierungen (Arbeitsproben)

UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

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V - Rolling Stock

VI - Traction
VIII - Technical Specifications

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Summary

This leaflet defines the method of approval for the Welding Procedure Specification used for manufacturing test assemblies and sub-assemblies in aluminium and aluminium alloys.

1 - Purpose

This leaflet defines the method of approval for the Welding Procedure Specification used for manufacturing test assemblies and sub-assemblies.

The procedure for manufacturing test assemblies and sub-assemblies must be approved according to the provisions of this leaflet.

Once a welding procedure specification (DMOS) has been approved, it may be used in manufacture.

Any manufacturing irregularity noted in production may be confirmed under the provisions of this leaflet.

2 - Test joints

2.1 - Definition

A test joint shall be an assembly including welded areas subject to large forces and/or to be executed under extremely difficult conditions (e.g. in terms of accessibility).

Such a test joint is referred to as a "mock-up".

It is the responsibility of the customer Railway to request the production of test joints.

2.2 - Preparation of test joints

Test joints must be prepared in accordance with the provisions of *UIC Leaflet 897-22* (see Bibliography - page 10).

2.3 - Execution of test joints

Test joints shall be executed in the presence of a representative of the customer Railway.

Weld test joints must be produced using approved welding processes as per *UIC Leaflet 897-21* (see Bibliography - page 10) for Class B and Class C welds.

The materials used and their thicknesses shall be the same as those to be used in the actual assemblies.

The preparation and protection of surfaces before or during welding and methods of producing welding preparations shall be carried out as prescribed for each part.

Welding must be carried out in accordance with the welding requirements contained in *UIC Leaflet 897-22, point 3.4*. However, the use of final production mock-ups is recommendatory rather than mandatory.

Welding test joints must be produced using identical welding equipment and in accordance with the same operating conditions as for actual manufacture (welding process, filler product, welding position and parameters, etc.).

For each type of weld, welding must be stopped and restarted, the position of the stop/start being marked.

If the difference between the maximum and minimum dimensions for root gaps and root faces of weld preparations prescribed by the fabricator exceeds 1/10 of the thickness of the thinnest component in the assembly, it will be carried out on the test joint in order to obtain in one area the minimum root gap and the maximum root face and in another area the maximum root gap and minimum root face. These areas may be situated on separate welds but they must include the tacking prescribed for the actual manufacture of the parts.

Heat treatment, where prescribed, shall be carried out on the test joint under the same conditions as for manufacture before any test pieces are removed.

2.4 - Examinations and inspections on test joints

The number and types of examinations and inspections to be carried out on the test joint are given in the following table:

Weld examinations and tests	Class B welds		Class C welds		Class D welds[a]	
	Butt weld	Fillet weld	Butt weld	Fillet weld	Butt weld	Fillet weld
Non-destructive checks on all welds	YES	YES[b]	YES[b]	NO	NO	NO
Visual and dimensional checks on all welds	YES	YES	YES	YES	YES	YES
Bend tests with excess weld metal removed - upper side in tension - under side in tension	1[c]		1[c]			
Fillet weld fracture test[d]		4[c]		3c		2
Macrographic test[e]	2[c]	2[c]	2[c]	2[c]	1	1

a. To be carried out after agreement between the customer Railway and the fabricator.
b. This test may be replaced by 3 fracture samples.
c. In the area where test joints include an area with minimum root gap and maximum root face and an area with maximum root gap and minimum root face, a sample shall be taken from each of these areas.
d. Samples for the fillet weld fracture test shall have the same dimensions as those defined in Appendix A.
e. The shapes and dimensions of samples for a macroscopic or hardness test are given in UIC Leaflet 897-21. The macroscopic examination may be supplemented by a microscopic examination.

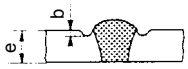
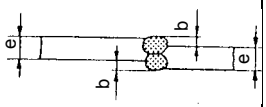
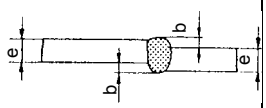
3 - Results of the examinations and inspections

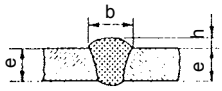
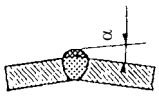
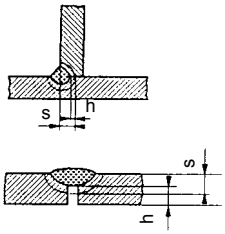
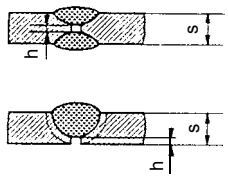
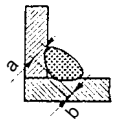
The results to be obtained for the different examinations and inspections carried out on test joints are given in Appendix to *UIC Leaflet 897-22*.

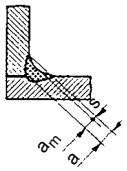
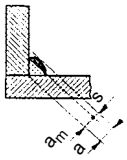
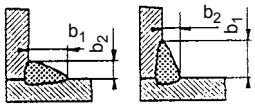
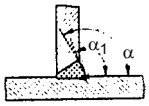
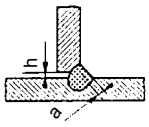
The quality level of test joints must be at least equal to that specified for production and must be compatible with the values laid down in *UIC Leaflet 897-22*.

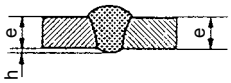
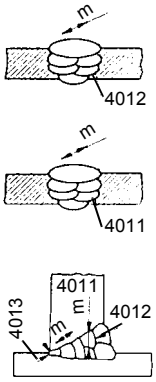
Where these standards are not met, the test joint or relevant part of the test joint shall be repeated.

Appendix A - Acceptance criteria for welded butt and fillet joints

Defect	Type of defect	ISO 6520	Limits for: (dimensions in mm)		
			Class B High requirement	**Class C Medium requirement**	**Class D Moderate requirement**
1	Cracks	101 to 106	Defect not permitted	Defect not permitted	Defect not permitted
2	Gas pores	2017	Defect not permitted	Dimension ≤ 2 Not more than three pores over a length of 200	Dimension ≤ 3 Not more than six pores over a length of 200
3	Shrinkage of craters	2024	Defect not permitted	Defect not permitted	Defect permitted if no sharp notch
4	Solid inclusions at surface	300	Defect not permitted	Defect not permitted	No tolerance given
5	Undercut Sharp 	5011 5012	Defect not permitted	Defect not permitted	Defect permitted
	Undercut Smooth 		b ≤ 0,3	b ≤ 0,5	b ≤ 1
				Continuous length ≤ 50 Over a length of 300 Cumulative length ≤ 50	Continuous length ≤ 60 Over a length of 300 Cumulative length ≤ 80
6	Tool marks	603 to 606	Defect not permitted	Defect not permitted without progressive joint	Defect permitted unless deep notch > 1 mm
7	Misalignment of edges  	507	The limits shown concern deviation in relation to the correct position. What is meant by "correct position" depends on the case concerned. In the absence of any indication to the contrary, sheets shall be considered in the correct position when their centre-lines meet at mid-thickness. Alignment defects measured on the surface may be larger or smaller according to variations in sheet thickness, tube diameter and wall thickness.		
			b ≤ 0,1 x e max : 2	b ≤ 0,15 x e max : 3	No tolerance given

Defect	Type of defect	ISO 6520	Limits for: (dimensions in mm)		
			Class B High requirement	**Class C Medium requirement**	**Class D Moderate requirement**
8	Weld overfill (excessive thickness of weld) 	502	A smooth transition is required.		
			h ≤ 1 + 0,1 x b max : 2	h ≤ 1 + 0,15 x b max : 3	h ≤ 1 + 0,25 x b max : 5
9	Insufficient thickness of weld 	511	Defect not permitted	h ≤ 0,1 x e max : 1 Continuous length ≤ 50 Over a length of 300 Cumulative length ≤ 50	h ≤ 0,2 x e max : 2 Continuous length ≤ 60 Over a length of 300 Cumulative length ≤ 80
10	Angular misalignment 	508	tg. α ≤ 0,1 or 6°	tg. α ≤ 0,15 or 9°	tg. α ≤ 0,2 or 12°
11	Lack of penetration 	402	Defect not permitted	h ≤ 0,1 x s max : 1,5 Continuous length ≤ 50 Over a length of 300 Cumulative length ≤ 50	No tolerance given
	 s = intended penetration h = lack of penetration		Defect not permitted	Permitted if defect localised h ≤ 0,1 x s max : 1,5 Continuous length ≤ 50 Over a length of 300 Cumulative length ≤ 50	h ≤ 0,2 x s Continuous length ≤ 60 Over a length of 300 Cumulative length ≤ 80
12	Lack of penetration 		Defect not permitted	b ≤ 1	b ≤ 0,25 x a Continuous length ≤ 60 Over a length of 300 Cumulative length ≤ 80

Defect	Type of defect	ISO 6520	Limits for: (dimensions in mm)		
			Class B High requirement	**Class C Medium requirement**	**Class D Moderate requirement**
13	Insufficient thickness a : specified throat a_m : throat produced Insufficient thickness  Convexity and concavity 	503	$a_m \geq a$ $s \leq 0,1 \times a + 0,5$ max : 2	$a_m \geq a$ $s \leq 0,1 \times a + 1$ max : 3	$a_m \geq a$ $s \leq 0,2 \times a + 1$ max : 4
14	Assymetrical weld 	512	$\frac{b_1}{b_2} \leq 1,2$	$\frac{b_1}{b_2} \leq 1,4$	$\frac{b_1}{b_2} \leq 2$
15	Inclination defect  α = measured value α_1 = value requested on drawing	-	$\alpha > 105°$ or $\alpha > \alpha_1$	$\alpha > 105°$ or $\alpha > \alpha_1$	No tolerance given
16	Poor positioning 		$h \leq 0,5 + 0,1 \times a$ max : 2	$h \leq 0,5 + 0,2 \times a$ max : 3	$h \leq 1 + 0,3 \times a$ max : 4
17[a]	Fine porosity	2011 2012 2014 2017	The blowholes must not exceed 1% of the projected surface. The size of one cavity must not be greater than 2 mm.	The blowholes must not exceed 2% of the projected surface. The size of one cavity must not be greater than 4 mm.	The blowholes must not exceed 4% of the projected surface. The size of one cavity must not be greater than 5 mm.
18[b]	Coarse porosity	2013	Blowholes must not exceed 4% of the projected surface. The size of one cavity must not exceed 2 mm.	Blowholes must not exceed 8% of the projected surface. The size of one cavity must not exceed 4 mm.	Blowholes must not exceed 10% of the projected surface. The size of one cavity must not exceed 5 mm.

Defect	Type of defect	ISO 6520	Limits for: (dimensions in mm)		
			Class B High requirement	**Class C Medium requirement**	**Class D Moderate requirement**
19	Elongated blowhole	2015	Continuous defects are not permitted	Continuous defects are not permitted	Continuous defects are not permitted
	Wormholes	2016	The height and breadth of local defects must not exceed 2 mm.	The height and breadth of local defects must not exceed 3 mm.	The height and breadth of local defects must not exceed 5 mm.
	Crater shrinkage	2024	Defect not permitted.	The length must be less than the weld thickness.	No tolerance given.
20	Excessive penetration 	504	Penetration must be continuous. The height of penetration h must not exceed 3 mm and under no circumstances 1 mm + 30% of the width of penetration.	In areas without lack of penetration, the height of penetration h must not exceed 4 mm and under no circumstances 1 mm + 60% of the width of penetration. Continuous length ≤ 50 Over a length of 300 Cumulative length ≤ 50	No tolerance given.
21	Lack of fusion Adhesion 	401	Not permitted	Permitted if the defects are localised	Authorised though intermittently and without emergence at surface.

a. See remarks in Appendix 4 of UIC Leaflet 897-11 concerning defect 3.
b. See remarks in Appendix 4 of UIC Leaflet 897-11 concerning defect 4.

Bibliography

1. UIC leaflets

International Union of Railways (UIC)
UIC Leaflet 897-20: Technical specification for the approval of welders for fusion-welding of aluminium and aluminium alloys, 1st edition of 1.1.93

UIC Leaflet 897-21: Technical specification for the approval of a procedure for fusion welding on aluminium and its alloys, 1st edition of 1.1.93

UIC Leaflet 897-22: Technical specification for the quality control of welded joints on rolling stock in aluminium and aluminium alloys, 1st edition of 1.1.94

2. Minutes of meetings

International Union of Railways (UIC)
Traction and Rolling Stock Committee (Question 5/SA/FIC - Approval of Leaflet 897-23 "Technical specification for the execution and control of test joints in aluminium and aluminium alloys (mock-ups)", May 1993

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