

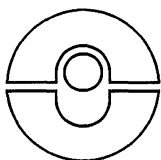
UIC Code

8 9 7 - 20

O

1st edition , 1.1.1993

**Technical specification
for the approval of welders
for fusion-welding of aluminium
and aluminium alloys**



International Union of Railways

8 9 7 - 2 0

- 2 -

O R

Leaflet to be classified in volumes:

- V - Transport stock
- VI - Traction
- VIII - Technical specifications

Amendments

Preliminary remarks:

The double line (||) in the margin denotes amendments made on the date shown at the foot of the page.

Enforcement of this leaflet is governed by the provisions shown under the heading "Application" at the end of the document.

Contents

- 1 - Subject
- 2 - Scope of application
- 3 - Range of skill
 - 3.0 - General
 - 3.1 - Welding processes
 - 3.2 - Types of welded joints
 - 3.3 - Parent metals and filler metals
 - 3.4 - Dimensions of the test welds
 - 3.5 - Welding positions
- 4 - Approval of welder or welding machine operator
 - 4.0 - General
 - 4.1 - Test joints
- 5 - Inspection of welded joints and approval criteria
 - 5.1 - Inspection of joints
 - 5.2 - Inspection during the test
 - 5.3 - Inspection after completion
- 6 - Result of testing and validity of approvals
 - 6.1 - Approval
 - 6.2 - Validity
 - 6.3 - Renewal conditions
 - 6.4 - Re-testing
- 7 - Approval symbols

Appendices

1 - Subject

This leaflet specifies the tests to be performed, and the requirements to be met, by a welder or welding machine operator (1) in order to demonstrate his ability to produce pre-defined welded joints by a given process and conforming with the required quality criteria.

2 - Scope of application

This leaflet applies to any welding operation (fabrication and repair) carried out by welders working on welded constructions of:

- Railway rolling stock,
- Ducts or pipe work and ancillary equipment of these vehicles,
- Welded component sections of these vehicles,
- Containers.

3 - Scope of approval

3.0 - General

The scope of approval, permitting a welder or welding machine operator to work to a given degree of skill (B or C) covers all of the following functions:

- the welding procedure

(1) Except robot operators

O

- the type of joints,
- the parent metal and filler metal,
- the dimension of the test joint,
- the welding position.

The degrees of skill are defined in Appendix 4.

Unless stated otherwise in the specification, where a different class may be stipulated, the degree of skill demanded by the design is determined by mutual agreement between the railway and the manufacturer.

Being the competent authority, the examiner is authorised to issue the approval of a welder or machine operator. He may be a representative of the railway or of an outside inspection body approved by the railway.

The results of the approval examination must be embodied in a document and certified by the examiner under his sole responsibility.

This document must contain, apart from the personal data on the welder or operator, all information pertaining to the tests and the examination results.

The document prepared by a manufacturer is accepted as far as it contains the requested information.

In the tests for the approval examination, the welder or operator shall be assessed for suitable practical skill, ability to apply a welding process, the knowledge of safety regulations and equipment.

No provision is made for a theoretical examination. It is a matter for the examiner to satisfy himself in advance that the welder or operator has acquired his skill by adequate training.

Within the provisions of Point 6.3 "Renewal conditions" it is permissible to waive a new approval test.

3.1 - Welding processes

3.1.1 - This leaflet applies to the coded (1) welding processes enumerated below (2).

Depending on the conditions, each welding process can be carried out manually, semi-automatically or automatically:

- (131) MIG welding,
- (141) TIG welding,
- (15) plasma arc welding.

Special test programmes must be established for the other welding processes not listed above.

3.1.2 - Each approval normally covers only one welding process. A change of process requires a new approval test. However, a welder or an operator may be approved for more than one process by a single test or by two separate tests to cover the case of a welded connection, where more than one process is used.

3.2 - Types of welded assemblies

3.2.1 - The test pieces to be made are fillet welds (FW) and butt welds (BW) on sheets and tubes.

The preparation of the pieces depends on their thickness, the welding process and technical factors.

(1) According to standard ISO 857

(2) According to standard ISO 4063

O

3.2.2 - The work, for which the welder or operators is approved, is set out in Table 1 in relation to the type of welded joint.

A welder or operator approved for a welded joint type A is also approved for the other types of joint listed in Table 1.

Table 1 - Butt welds

Weld joint for the approval examination			Approval range					
			Butt welds					
			On plate				On tubes	
			on one side		on both sides		on one side	
			Backing		Gouging		Backing	
		with	w/o	with	w/o	with	w/o	
Butt weld on plate	weld on one side	with backing	A	-	x	-	(1)	-
		w/o backing	x	A	x	x	(1)	(1)
	weld on both sides	with gouging	x	-	A	-	(1)	-
		w/o gouging	x	-	x	A	(1)	-
Butt weld on tube	weld on one side	with backing	x	-	x	-	A	-
		w/o backing	x	x	x	x	x	A
(1) see article b)								

The following guiding criteria shall be employed:

- a) The welding approval for butt welding of tubes also covers butt welding on plate, except joints of thin plate $t = 2$ mm.
- b) The welding approval for butt welding of plate in all welding positions also covers butt welding of tubes with an outer diameter D_e exceeding 500 mm.

The approval for butt welding of flat bar steel with a flat weld (PA) or horizontal weld (PC) also covers butt welding of tubes with an outer diameter D_e of at least 150 mm or a similar weld position in accordance with Table 6.

The approval for butt welding of plate covers butt welding of XXXX

- c) Welding on one side without backing also covers welding on one side with backing as well as welds on both sides with or without back gouging.
- d) Welding on plate or tubes with backing also covers welds on both sides, but not welds without backing.
- e) Butt welding also covers fillet welds carried out under similar conditions.

In the case of production work, where fillet welds predominates, it is recommended to submit the welder or operator to approval for this process.

- f) Welding on both sides without back gouging also covers welds on one side with backing and welds made on both sides with back gouging.

O

- g) Approval for butt welding a tube without backing also covers a tube branch connection in the same position and with the same range of thickness and diameter.

In the case of a tube branch connection the approved diameter range is governed by the diameter of the branch pipe.

In certain cases, an approval test for tube branch connection is essential.

3.3 - Parent metals and filler metals**3.3.1 - Parent metals - Types of filler metals**

Considered are rolled, extruded, drawn, forged and cast materials.

The materials are classified in 3 groups.

This classification shall be used for determining the type of filler metal, which shall be compatible with the type used for the welding of the welded metals from the same group.

Table 2, which shows these groups, shall also be applied to the filler metals.

Group	Materials
21	High-grade aluminium Aluminium containing less than 1% of impurities or elements Al 99.5 Al 99.8 Al 99.0 AlMn 1 High-grade aluminium casting
22	Alloys without thermal treatment Aluminium alloys with up to 5.6% of Mg. AlMg 1 AlMg 2 AlMg 3 AlMg 3 Mn AlMg 4.5 Mn Al-Si casting alloys Al-Mg casting alloys
23	Alloys with thermal treatment AlMgSi 0.5/1 AlMg 1 SiCu AlMgSi 0.7 AlSiMgMn AlZn 4.5 Mg 1 (1) Al-Si-Mg moulded alloy Al-Si-Cu moulded alloy

(1) May be thermally treated or age-hardened naturally after welding.



Documents

Document Sharing Hub

3.3.2 - Approval related to the parent material

Table 2

A welded or machine operator approved for a given material group A is also approved for the other material group(s) listed in Table 2.

Groups of materials used for approval	Range of validity of the approval		
	Group 21	Group 22	Group 23
Group 21	A	X	
Group 22	X	A	
Group 23	X	X	A

Welding of any material in a group means the approval of the welder or operator for welding any other material of the same group, provided the welding material used during the test can be used for the other aluminium alloys of this group.

However, in the case of mixed joints comprising base materials from two different groups not compatible with the terms of Table 2 , approval of the mixed joint or two groups shall be carried out separately.

In cases where an aluminium alloy is not mentioned in any of the groups, the alloy shall be subjected to a specific approval procedure.

Approval of a group of welded materials also covers the founding materials and mixes of cast and welded materials from the same group.

3.3.3 - Filler materials and shielding gas

The filler material and shielding gas used, including plasma gas, shall be compatible with the parent metal and the procedure employed and comply with the description of the welding process.

A separate test shall be carried out for each gas or type of gas mixture.

3.4 - Dimensions of the test welds (plates or pipes)

3.4.1 - Thickness of test joints

Unless otherwise indicated in the specification, the approval test shall be carried out with a material thickness "t" (plate or, in the case of tubes, wall thickness) as shown in Table 3.

Table 3

Thickness "t" of test joint in mm	Approval range mm
t = 2	from 0.5 to 2 t (1)
t = 6	from 0.5 to 2.5 t
t = 15	from t mm to 40 (1)
(1) Materials of a thickness in excess of 40 mm shall be subject to special testing.	

A specific test of this kind shall be mentioned on the approval certificate.

3.4.2 - Diameters of tubes and branch connections for the test joints

Unless otherwise indicated in the specification, the approval test shall be carried out with a diameter, D_e as shown in Table 4.

Table 4

External diameter "De" (1) of test joint	Range of approval
De < 25 mm (2)	from De to 2 De
De = 100 mm ($25 \leq \text{De} < 150$ mm) (2)	from 0.5 De to 2 De
De = 200 mm ($\text{De} \geq 150$ mm)	from 0.5 De and all greater diameters
(1) In the case of mono-cylindrical hollow cross-sections De is the smallest diameter. (2) The tube diameter is the one used for the design of brake pipes.	

3.5 - Welding positions

The test piece must be made in the positional and angular conditions encountered in production.

The angles of inclination and rotation to be adhered to during the tests are specified in the standard ISO DIS 6947.

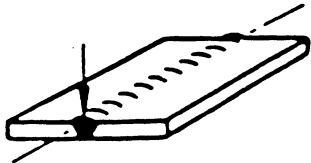
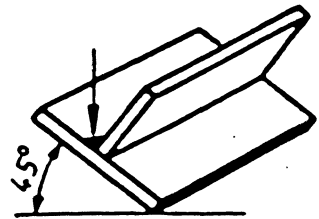
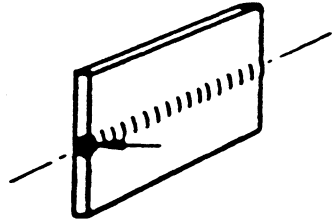
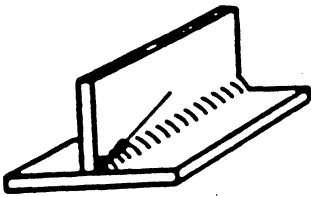
The elements of the test joint are fixed, while welding is in progress, except when a rotating tube is welded.

3.5.1 - Butt and fillet welds on plates

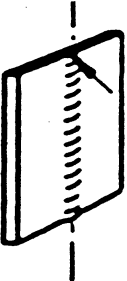
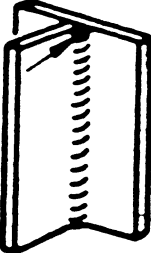
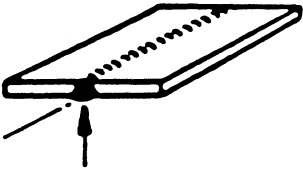
The welding positions are specified in Fig. 1.

Welding positions on plates

Fig. 1

BUTT WELDS	FILLET WELDS
Flat weld: the plates are in a horizontal plane, the filler metal is brought in from above.  PA	Fillet weld in H.V. positions: the plates are arranged so that the weld runs horizontally while the throat is vertical.  PA
Horizontal vertical weld: the plates stand in a vertical plane, the weld runs horizontally.  PC	Flat weld: one plate lies horizontally, the other is vertical. The weld between the two plates is made in a horizontal plane.  PB

Positions for welding on plates Fig. 1

BUTT WELDS	FILLET WELDS
Vertical weld: the plates and the axis of the weld are in a vertical plane.  Vertical-upwards weld: the filler metal is deposited from the bottom towards the top PF PF Vertical-downwards weld: the filler metal is deposited from the top towards the bottom. PG PG	Vertical weld: the plates and the axis of the weld are vertical. 
Overhead weld: the plates are in a horizontal plane, the filler metal is deposited from below.  PE PD	Overhead weld: one plate is horizontal, the other vertical, the weld bead is deposited from below in a horizontal plane. 