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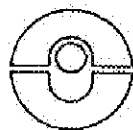
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3rd edition, 1.1.93

Technical specification for the  
quality control of welded joints  
on steel rolling stock

**NUMERISATION DANS  
L'ETAT DU DOCUMENT**



International Union of Railways

897 - 13

- 2 -

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Leaflet to be classified in volumes:

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

Amendments

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Preliminary remarks:

The double vertical line (||) in the margin denotes modifications introduced at the date shown at the foot of the page.

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

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**Note**

This Leaflet is part of a series which also includes:

- Leaflet 800-51      Permissible variations on dimensions when no tolerances are given for welded structures
  
- Leaflet 897-4      Technical specification for the acceptance and supply of combinations of wire electrodes and flux for automatic submerged arc welding of carbon, carbon-manganese and low-alloy steels
  
- Leaflet 897-6      Technical specification for the acceptance of combinations of wire electrodes (solid or cored) and gases and also for the supply of wire electrodes (solid or cored) for automatic and semi-automatic gas-shielded welding of plain carbon or low-alloy steels
  
- Leaflet 897-8      Technical specification for determining the nominal output and coefficient of deposition of cored wire electrodes for automatic and semi-automatic gas-shielded welding of plain carbon or low-alloy steels
  
- Leaflet 897-11     Technical specification for the acceptance of welders for fusion welding of steels

- Leaflet 897-12     Technical specification for the acceptance of welding procedures for arc welding in steels
  
- Leaflet 897-14     Technical specification for the execution and control of test joints in steel (test pieces)

## 1 - Purpose and classification

### 1.1 - Purpose

This Leaflet defines the conditions for the welding and inspection of welded joints already defined using an accepted welding procedure.(1)

It shall apply to welded joints on steel structures (1)

It shall define:

- the classification of welded joints

It shall include:

- the acceptance of welding procedures (1),
- inspection of welding conditions on test joints (mock-ups),
- inspections made before, during and after the weld is executed.

For special applications, the customer railway may also stipulate special rules of execution in the specification.

This Leaflet shall apply to the arc welding procedures coded below. Each welding procedure may be manual, semi-automatic or automatic, as the case may be.

- 11 arc welding with core wire (without shielding gas)
- 12 arc welding in powdered flux

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(1) In accordance with UIC Leaflet 897-12

- 13 arc welding with core wire and shielding gas
- 14 welding with refractory electrode and shielding gas
- 15 plasma arc welding.

For other procedures not mentioned above, a special acceptance program shall be made out.

### 1.2 - Classification of welded joints

The class of a welded joint shall be decided by the study bureaux taking into account the stresses undergone by the joints in service, and approved by the technical department of the user.

The class of a welded joint shall correspond to an admissible level of defects tolerated, as indicated on the drawing.

**Class B:** high-quality welded joints exposed to severe conditions and subject to dynamic stress in service. For certain limited areas heavily subjected to fatigue, post-welding treatment may be performed (Area of Post-Welding Treatment) (1)

**Class C:** quality welded joints concerning assemblies, sub-assemblies or parts affecting the resistance of a material.

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(1) Post-Welding Treatment is not part of the thermal treatment. It includes operations such as removal of waste metal, shot blasting, remelt of the weld using a process such as TIG, etc.

Class D: standard quality welded joints.

The permitted tolerances for defects in these classes are covered in the Appendix to this Leaflet.

## 2 - Characteristics

### 2.1 - Physical characteristics of the welds

#### 2.1.1 - Appearance

The appearance of the welds shall be such that the acceptability criteria given in the Appendix are respected.

#### 2.1.2 - Internal condition

The internal condition of the weld shall be such that the nature, form, number and frequency of the hidden defects comply with the acceptability criteria laid down in the Appendix.

### 2.2 - Geometric characteristics of the welds

The geometry of the welds shall be such that their form and dimensions comply with the values laid down by the drawings (1) and the acceptability criteria.

In the absence of any indication in the specification, the defects and tolerances to be respected shall be those given in the Appendix to this Leaflet.

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(1) According to ISO 2553

### 2.3 - Geometric characteristics of the welded joints

After welding, the geometry of the welded parts, sub-assemblies and assemblies shall comply with the dimensions and tolerances determined by the drawings.

### 2.4 - Mechanical characteristics of the welded joints

The mechanical characteristics shall be guaranteed by the acceptance of the WP and by specimen lengths if required in the order.

#### 2.4.1 - Tensile strength across the weld

The tensile strength across the weld, measured on a standard test piece (1), shall be equal to at least the minimum guaranteed tensile strength of the parent metal.

#### 2.4.2 - Fracture test

The broken cross-sections of the test pieces shall not show defects exceeding the limits defined in the Appendix.

#### 2.4.3 - Included angle tests on fillet welds

The included angle of the test pieces shall show no crack or latent fissure particularly at the join between the weld and the sheet.

The penetration and the fusion at the root shall be examined on included angle test pieces.

This examination must not reveal defects that exceed the limits laid down in the Appendix.

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(1) According to ISO 4316

**2.4.4 - Macrographic examination of cross-sections**

This examination must not reveal defects that exceed the limits laid down in the Appendix.

The penetration and fusion at the root shall be examined on macrographic cross-sections of the welds.

In case of doubt, a micrographic examination shall be carried out.

**2.4.5 - Vickers hardness under the weld bead**

The Vickers hardness under the weld bead (1) for Group 1 steels shall be lower than 350 HV10. For steels in Groups 2, 3 and 4 it shall be lower than 380 HV10.

**3 - Execution**

**3.1 - Approval of welders or operators**

All welds must be executed by welders or operators previously approved under the terms of UIC Leaflet 897-11.

**3.2 - Approval of welding procedures**

For class B and C welds, the procedures used shall have been approved beforehand in accordance with UIC Leaflet 897-12.

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(1) The hardness shall be measured in accordance with documents CEN/TC 121/WG 5A N 61 "Welded joints in metallic materials hardness testing" and ISO 9015.6.

**3.3 - Approval of filler products**

Only filler products approved by the railways may be used (1).

**3.4 - Welding**

**3.4.1 - General conditions**

Welding operations shall be executed under shelter.

If the temperature of the parts to be welded is lower than 10°C for steels with minimum yield strength greater than or equal to 300 MPa (except stainless austenitic steels) or 5°C for other steels, the parts shall be fired.

Where gaseous flux is used, special protection shall be required if the welding process is at risk from draughts.

Where pre-heating is necessary, the minimum preheat temperature shall be maintained throughout all the welding operations.

At the moment when the parts are applied, irrespective of the preparation procedure used, the welding grooves and the area in their immediate vicinity shall be clean, free from rust, grease, oil, marking chalk, paint and any other impurity, with the exception of specially-approved paints.

Where the use of a primary paint suitable for welding is required, the maximum value shall be agreed between the manufacturer and the customer railway. In the absence of any such agreement, the maximum value shall be set at 15µm.

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(1) According to UIC Leaflets 897-1, 897-4, 897-6, 897-8 and 897-12.

The ends of butt welds shall be lent particular care. In certain cases, the representative of the railway may require that the weld begin and end outside the working length of the joint, adding appendages at each end which contain bead ends. These appendages shall be removed after completion of the joint, either mechanically, or by cutting with a blow-pipe, to be followed compulsorily by grinding. This procedure shall also be required for removal of attachment parts.

For multi-pass welds, before a covering pass is made, the underlying pass shall be cleaned vigourously with a metallic brush to obtain a clean surface. If this underlying pass shows slag defects, gas pockets, dirtying, cold slugs or narrow grooves, it shall be cleaned up by grinding, milling, graver or file, so that the defects are removed and the covering pass can be made on clean metal throughout.

Any fissure hidden in a pass shall be completely removed before any new pass or any repair by welding is made using a suitable welding procedure.

With manual arc welding, the electrodes shall be sufficiently warmed or even preheated in accordance with the supplier's instructions. Arcing shall only be effected in the joint, on the appendage or on a specially designed part.

If a sealing run is planned, it must be preceded by gouging, except in some cases where the representative of the customer railway authorises a sealing run without gouging. The reverse side of the weld must be cleaned vigourously using a suitable method so that a clean surface is obtained. Gouging must remove the defects inherent in the first pass to be made at the root of the joint, particularly a lack of penetration, possible fissures, end craters, tack beads, etc.

When a sealing run is impossible, the welds may be required to be executed on supporting parts of a temporary or permanent nature.

With automatic submerged arc welding (12) and automatic welding with shielding gas (13) the parts must be correctly positioned using suitable structures.

Sealing runs may be executed without prior gouging provided that the acceptance tests were carried out in the same manner, that the examinations of the test section revealed no defects and that the inspections during execution were satisfactory.

#### 3.4.2 - Edge preparation

The physical and geometric characteristics of the weld edges must comply with those laid down by the WPD. In the absence of any instructions in these documents for arc welding with coated electrodes or with shielding gas, the characteristics shall be those covered by the provisions of standard ISO/DIS 9692.

#### 3.4.3 - Preparation of the parts to be welded

The procedure used for shaping the edges to be welded shall be the object of a prior agreement between the factory and the customer railway.

It may not be modified without the renewed agreement of the latter.

When the parts are cut to length, additional lengths shall be provided such that once shrinkage has been taken into account, the geometric characteristics of the finished weld parts meet the conditions laid down in the drawings.

Manual oxygen cutting shall be permitted. The cutting surface shall be free of all irregularities. Any irregularity on the surface greater than that laid down by the customer railway shall be removed by mechanical machining.

Oxygen cutting operations shall be followed by removal of the oxide layer by a suitable method. Sharp edges shall be eliminated.

Repairs using arc welding shall be permitted. The repair shall be subject to the prior agreement of the customer railway.

Shearing on rectilinear cross-sections up to a maximum thickness of 15 mm shall only be permitted for Group 1 steels.

The maximum permitted tolerance for the inclination of the sheared face shall be 1/10 of the thickness of the part. However, for class B T-welds, the faces shall be stood at right angles. Any defect shall be removed by grinding.

Application for thicknesses greater than 15 mm and for other procedures shall be subject to the prior authorisation of the customer railway, following completion of a program of tests on the parent metal prepared in this way, as well as on the appearance and quality of the welds executed.

#### 3.4.4 - Mounting

##### 3.4.4.1 - Welding jigs

The manufacturer shall possess welding jigs, templates and manipulators to enable the following operations to be effected mechanically:

- sufficiently accurate positioning of the parts to be welded;
- optimal position for a clean weld;
- easy and effortless removal of the finished assembly.

The mounting apparatus may only be used to keep the component parts of the joint on the templates and jigs during the tack weld and/or weld proper.

The positioning, tacking or welding jigs shall be sufficiently rigid to ensure that the geometry of the parts is correct after welding.

The specification shall give details of any special requirements to be met by the templates or mounting apparatus.

##### 3.4.4.2 - Saddle joints

Saddle joints shall be executed in a carefully-determined order to prevent fissuring and giving rise to damaging residual tensions in the joint.

The tack welders shall have received training and must prove themselves capable of making quality tack welds suitable for the parent material and in the appropriate weld class.

In principle, tacking shall be carried out on the right side of the welding groove.

For class B and C welds, no saddle joints shall be executed at the ends of the weld lines or of the gusset, nor in bend curves of radius less than or equal to  $10e$ , where "e" is the thickness of the element bent.

The length and separation of the tack welds shall depend on the dimensions of the joint.

For class B welded joints, the specification may require the removal of the tack welds as the welding advances.



#### 3.4.4.3 - Removal of saddle joints

The remelting of the saddle joints shall not cause defects that exceed the limits laid down in the Appendix.

Defects that are not permitted for the weld class concerned must be totally and carefully removed before execution of the final weld.

The preparation shall be reconstituted if necessary.

### 3.5 - Welding of joints

#### 3.5.1 - General

The welding work itself shall under no circumstances be undertaken before the appropriate drawings, conditions of execution, WPD and non-destructive inspection program have been drawn up.

#### 3.5.2 - Welding program

Before execution of the weld, the manufacturer shall draw up a welding program. This welding program shall be sent to the representative of the customer railway.

The welding program must specify:

- recommended types of preparation for the weld edges;
- phases of manufacture after which a non-destructive inspection may be systematically effected;
- the welds to be completed;
- any possible thermal treatment to be performed.

A program of welding sequences shall be drawn up for each important joint, and include the position and order of succession of the tack welds, the order of succession of the various joints, and the turning of the parts.

After examination of the welding program, the customer railway shall send its remarks and counter-proposals to the manufacturer. However, the whole responsibility for the work carried out shall rest with the manufacturer.

The customer railway must also be informed of any modification made to the welding program during execution of the order.

The method of execution of the welding procedures shall be defined by the specification; reference may be made to the provisions of UIC Leaflet 897-12.

#### 3.5.3 - Conditions of execution of welds

The welding parameters and conditions defined by the welding program shall be respected.

In the case of non-compliance with these factors, a new test joint shall be executed (mock-up) with the parameters and conditions really used.

Arcing outside the joint shall be prohibited.

For class B butt welds, the weld shall be begun and ended outside the working length of the joint by providing appendages at each end, maintained by mechanical or magnetic means.

The thickness of these appendages shall be at least equal to that of the part itself and must undergo the same edge preparation. The appendages shall be removed once the joint is finished, either mechanically or by manual oxygen cutting, followed compulsorily by longitudinal grinding.

Any break by impact shall be prohibited.

For other class B welds and all class C welds, when the ends of the first parts are seen not to meet the requirements of the Appendix, the representative of the customer railway may require the use of appendages in welding the following parts.

Two continuous lateral corner beads, aligned on either side of the element, shall be linked at their far ends by return runs over a length at least equal to the thickness of the element.

For multi-pass welds, slag from intermediate passes shall be removed by a mechanical process. Any defect in the compactness of an intermediate weld shall be removed by a mechanical process or with an open arc process, so that the covering pass may be made on clean metal.

No cold hammering shall be permitted on the final weld passes.

Grinding of the open faces shall be performed in order to remove the superficial layer which results from the use of an open arc process on steels with a carbon content greater than 0.20%.

Should a welding incident occur during manufacture, the defective part may be removed by a mechanical process or by the open arc process, and the weld re-executed.

#### 3.5.4 - Cleaning and finishing of welds

The welds and the immediately surrounding areas shall be cleaned so that a smooth surface is obtained, free of any spatter greater than that defined in the Appendix.

Welds requiring particular finishing shall be indicated on the drawing and on the welding program.

#### 3.5.5 - Straightening of joints

Any straightening of joints shall be subject to the prior agreement of the customer railway. This agreement shall only be given when the manufacturer has proven his ability to perform the technique he wishes to employ. In particular, for steels whose minimum yield strength is greater than or equal to 300 MPa, an inspection should be made after localised straightening under heat that the hardness does not exceed 320 HV10 for steels in groups 1 and 2 and that the micrographic structure is not altered.

Straightening of finished welded parts in a cold press shall be permitted provided this does not lead to the deterioration of the welded joints.

At the request of the customer railway, a non-destructive inspection may be required to ensure the absence of fissuring.

#### 3.5.6 - Thermal treatment for stress relief

Where the specification requires thermal treatment, this fact should be included in the welding program, which shall specify the cycle for the treatment concerned.

Localised stress relief treatment shall only be permitted once preliminary tests have been completed and the agreement of the customer railway obtained.

For manufacture, the following conditions for thermal stress relief treatment shall apply, in the absence of any instruction in the drawing or product specification and for group 1 steels:

- putting into oven at maximum oven temperature: 200°C; average heating speed: 150°C/h;

- length of time to keep part at annealing temperature: 2 minutes per millimetre of thickness, with minimum length of time of one hour;
- annealing temperature:  $590^{\circ}\text{C} \pm 20^{\circ}\text{C}$ ;
- maximum cooling speed:  $120^{\circ}\text{C}/\text{h}$ ;
- maximum temperature for removing parts from oven:  $200^{\circ}\text{C}$ .

The manufacturer shall possess the appropriate facilities, in particular ovens fitted with recording pyrometers, the graphs of which shall be made available to the representative of the customer railway.

### 3.6 - Finishing of welds

Welds requiring a special finish (T.P.S.) shall be indicated on the drawings and in the welding programme. Where the finishing is effected mechanically, this should be done as far as possible parallel to the direction of the stresses.

### 3.7 - Repair of welds

The manufacturer shall, once the agreement of the customer railway has been obtained, correct those welds which show unacceptable defects for the corresponding weld class.

Cold hammering of weld beads shall be prohibited.

For sheets of thickness less than or equal to 3 mm, cold hammering shall only be permitted for straightening.

This may be performed using only such tools as have the form and material appropriate to reduce the traces produced.

For sheets of thickness greater than 3 mm, cold straightening by hammering must be subject to the prior agreement of the customer railway.

Hot straightening and distortion removal by heating shall only be applied with caution.

Sudden cooling of the heated parts shall be prohibited.

Straightening by weld bead shall be prohibited.

## 4 - Inspection

### 4.1 - General

The manufacturer's inspection service shall possess the installations and equipment to enable the welded joints to be inspected on a permanent basis.

The manufacturer or his authorised representative shall inform the customer railway by means of a signed note and the person in charge of the inspection of all the conditions agreed or required by the specification.

Inspection of preparation and welding work shall be performed before and during the welding, as well as after execution of the welds.

The representatives of the customer railway shall have freedom of access to all the manufacturing workshops concerned and shall be allowed to perform their monitoring function before and during the work, as well as after its completion.

All safety and hygiene measures required by law shall be taken to their benefit.

The manufacturer shall keep a written record of the names of his approved welders and keep it at the disposal of the customer railway.

#### 4.2 - Number and nature of the inspections to be performed

The order and its accompanying documents shall indicate for each type of joint the number and nature of the inspections to be performed.

The manufacturer may, subject to the agreement of the customer railway, propose other methods of non-destructive inspection to replace or complement the radiographic inspection (dye penetration test, fluorescent or not, magnetic tests, ultrasound, etc.).

The non-destructive inspection program must define the areas to be inspected.

For destructive testing, the representative of the railway shall choose the areas to be inspected.

A weld bead requiring correction shall be re-inspected after repair.

#### 4.3 - Execution of inspection

##### 4.3.1 - General

The manufacturer's inspection service shall use inspection equipment that is in perfect working order and entrusted to staff who are competent, qualified and perfectly familiar with the technology of the process used.

#### 4.3.2 - Pre-manufacture inspection

##### 4.3.2.1 - Inspection of component parts

The characteristics of all the materials, including the filler products used in the manufacture of the welded parts, assemblies or sub-assemblies, must satisfy the provisions of the leaflets, the standards shown on the drawings or the product specification and have been inspected by the customer railway under the conditions defined by these documents.

##### 4.3.2.2 - Inspection of approval of welders or operators

The welders or operators required to execute the welding operations shall have been approved under the terms of UIC Leaflet 897-11.

##### 4.3.2.3 - Inspection of approval of a procedure on a test joint

The approval of a welding procedure may be effected with the agreement of the customer railway in accordance with the provisions of Leaflet 897-14.

##### 4.3.2.4 - Inspection of approval of a welding procedure

The approval of a welding procedure must be effected in accordance with the provisions of UIC Leaflet 897-12.

##### 4.3.3 - Inspection during manufacture

During manufacture, the manufacturer shall ensure that the conditions laid down in paragraph 3 are respected.

The inspector of the customer railway shall ensure compliance with the conditions by selective sampling. If the order requires the execution of specimen lengths from the joint, the representative of the customer railway shall ensure they comply with the conditions. To this end, should the quality prove lacking, all or part of the tests designed for the approval of a welding procedure or for test joints shall be performed. These tests shall be carried out either on an actual part or on a sample appendage executed at the same time as the part.

Should repeated defects occur in the welds executed by a welder or an operator, the representative of the customer railway may require that the person concerned be submitted for renewed approval.

#### 4.3.4 - Inspection of finished parts

The visual appearance of the welds must not reveal any defects exceeding the acceptability criteria in the Appendix of this Leaflet.

##### 4.3.4.1 - Dimensional inspection of welds

The dimensional inspection of the welds shall be performed using suitable calipers. It must not reveal defects exceeding the acceptability criteria in the Appendix to this Leaflet.

##### 4.3.4.2 - Dimensional inspection of welded joints

In the absence of any indication to the contrary in the drawings, the permitted distances shall be those defined by the provisions of Leaflet 800-51 OR of the UIC Code.

##### 4.3.4.3 - Inspection of the internal condition of the welds

Inspection of the compactness of the welds shall be performed by means of non-destructive examination. The methods for the non-destructive inspection shall be approved by the customer railway.

The inspection must not reveal defects exceeding the acceptability criteria in the Appendix to this Leaflet.

#### 4.3.4.4 - Radiographic inspection

The radiographic inspection program shall be drawn up by joint agreement with the representative of the customer railway or laid down in the special specification.

The inspection must not reveal defects exceeding the acceptability criteria defined in the Appendix.

The total length to be inspected shall be defined in accordance with documents approved by joint agreement between the customer railway and the manufacturer.

#### 4.3.4.5 - Ultrasound inspection

Subject to the agreement of the customer railway, an ultrasound examination may replace the radiographic examination. The length to be examined by ultrasound shall not be less than that intended for the radiographic inspection.

#### 4.3.4.6 - Additional inspections

Additional inspections to those laid down by this Leaflet, such as examination by magnification, dye penetration, video tape recording, ultrasound or other means, may be required by the drawing, the product specification or the specification, or required in the case of hidden defects in parts of similar manufacture which render them unfit for use.

#### 4.3.5 - Conclusion of inspections

##### 4.3.5.1 - Conclusion of tests

Any test result that does not meet the requirements of this Leaflet shall result in refusal of the part of the test joint or the parts concerned.

Only those tests rendered invalid by a fault in their execution may be restarted. A "fault in execution" shall be taken to mean faulty machining of the test pieces, incorrect set-up in the test machine or a malfunction of the test machine.

Where a faulty test piece gives an unsatisfactory result, the manufacturer may be authorised to effect a retest, subject to the agreement of the customer railway.

#### 4.3.5.2 - Conclusion of inspections before welding

If the preparation of the surface and edges of a part to be welded does not comply with that used for the test joint, that part may not be used in manufacture.

If the surface treatment of a part is not equivalent to that of the test joint, that part may not be used in its current form.

#### 4.3.5.3 - Conclusion of inspections during manufacture

Non-compliance with the conditions stipulated in Section 3 shall lead to the part on which the defect has been noted being refused.

This refusal shall extend to all parts manufactured under the same conditions.

Any welded element executed by a welder or operator who is not approved or has a lower classification than that required for the weld class concerned shall be refused.

#### 4.3.5.4 - Conclusion of inspection of completed welded joints

##### 4.3.5.4.1 - Appearance and dimensions of the welds

Any defect in the appearance or dimensions of a weld which cannot be removed by a mechanical process within the acceptability criteria given in the Appendix shall result in refusal of the welded joint.

#### 4.3.5.4.2 - Internal condition

The existence of defects exceeding the acceptability criteria in the Appendix shall result in refusal of the joint concerned.

When, in the course of a localised examination of the internal condition of a joint, the existence of an unacceptable defect is noted, the inspection shall be extended to another joint on a part of the weld which is at least as long as that which has just been inspected.

If this examination gives rise to the discovery of a new unacceptable defect, the inspection shall be extended to all the welds executed under the same conditions.

The repair of an internal defect on a completed joint may not be carried out until a procedure has been established and accepted by the representative of the customer railway.

The customer railway may ask that a test joint be executed to simulate the repair.

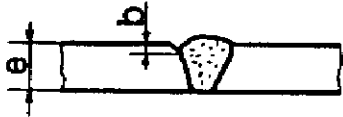
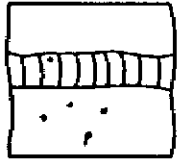
After the repair, the welded joint shall again undergo an examination of its internal condition.

#### 4.3.5.4.3 - Geometry of completed parts

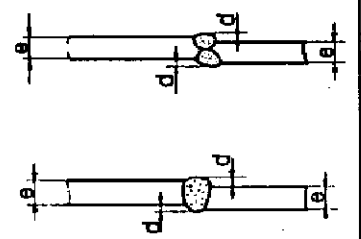



The existence of any defective geometric characteristics or the use of a straightening procedure not previously approved by the representative of the customer railway shall result in refusal of the corresponding parts.

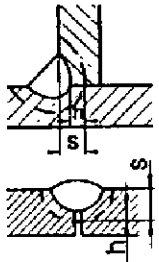
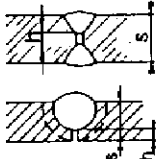
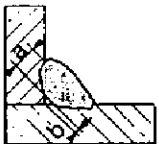
## ACCEPTANCE CRITERIA FOR WELDED BUTT AND FILLET JOINTS

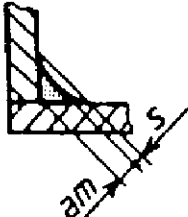
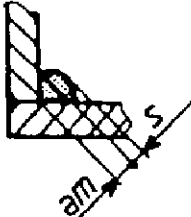
Defect	Type of defect	ISO 6520	Limits for: (dimensions in mm)		
			Class B High requirement	Class C Medium requirement	Class D Moderate requirement
1	Fissuring	101 to 106	Defect not permitted	Defect not permitted	Defect not permitted
2	Gas bubbles/pores	2017	dimension $\leq 1$ No more than 2 pores over a length of 200	dimension $\leq 2$ No more than 2 pores over a length of 200	dimension $\leq 3$ No more than 2 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	Surface covered by a circle of diameter $\leq 3$ .  No more than 5 over a length of 300


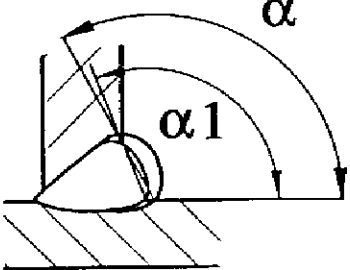
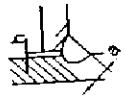
5	Undercut Smooth transition required	5011 5012	Defect not permitted	Defect not permitted	Defect permitted
			$b \leq 0.3$	$b \leq 0.5$	$b \leq 1$
	Penetration notches Smooth transition required			Continuous length $\leq 50$ Over a length of 300 Cumulative length $\leq 50$	Continuous length $\leq 60$ Over a length of 300 Cumulative length $\leq 80$
6	Adhering spatter 	602	dimension $\leq 2$ No more than four on a surface of 50 x 50	dimension $\leq 2$ No more than eight on a surface of 50 x 50	No more than twelve on a surface of 50 x 50
7	Arc burn	601	Defect not permitted	Defect not permitted	Defect not permitted
8	Descaling tool marks	603 to 606	Defect not permitted	Defect not permitted without progressive join	Defect permitted unless deep notch $> 1$ mm



9	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 variation in sheet thickness, tube diameter and wall thickness.		
			$b \leq 0.1e$ max : 2	$b \leq 0.15e$ max : 3	No tolerance
10	Weld overfill (Excessive thickness of weld) 	502	Smooth transition is required		
			$h \leq 1 + 0.1b$ max : 2	$h \leq 1 + 0.15b$ max : 3	$h \leq 1 + 0.25b$ max : 5
11	Insufficient thickness of weld 	511	Defect not permitted	$h \leq 0.1e$ max : 1	$h \leq 0.2e$ max : 2
				Continuous length $\leq 50$ Over a length of 300 Cumulative length $\leq 50$	Continuous length $\leq 60$ Over a length of 300 Cumulative length $\leq 80$
12	Angular misalignment 	508	$\text{tg. } \alpha \leq 0.1$ or $6^\circ$	$\text{tg. } \alpha \leq 0.15$ or $9^\circ$	$\text{tg. } \alpha \leq 0.2$ or $12^\circ$

<p>13</p>	<p>Lack of penetration</p> 	<p>402</p>	<p>Defect not permitted</p>	<p><math>h \leq 0.1s</math> max : 1.5</p> <p>Continuous length <math>\leq 50</math> Over a length of 300 Cumulative length <math>\leq 50</math></p>	<p>No tolerance given</p>
	 <p>s = intended penetration h = penetration lacking</p>		<p>Defect not permitted</p>	<p>Permitted if defect localised</p> <p>Continuous length <math>\leq 50</math> Over a length of 300 Cumulative length <math>\leq 50</math></p>	<p><math>h \leq 0.2s</math></p> <p>Continuous length <math>\leq 60</math> Over a length of 300 Cumulative length <math>\leq 80</math></p>
<p>14</p>	<p>Lack of penetration</p> 		<p>Defect not permitted</p>	<p><math>b \leq 1</math></p>	<p><math>b \leq 0.25a</math></p> <p>Continuous length <math>\leq 60</math> Over a length of 300 Cumulative length <math>\leq 80</math></p>


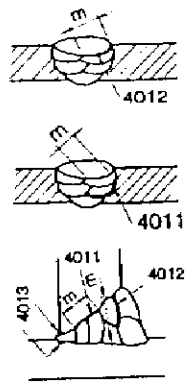
<p>15</p>	<p>Insufficient thickness  <math>a</math> : specified throat  <math>a_m</math> : throat produced                  Insufficient thickness</p>  <p>Convexity                  and                  Concavity</p> 	<p>503</p>	<p><math>a_m \geq a</math></p> <p><math>s \leq 0.1a + 0.5</math></p>	<p><math>a_m \geq a</math></p> <p><math>s \leq 0.1a + 1</math></p>	<p><math>a_m \geq a</math></p> <p><math>s \leq 0.2a + 1</math></p>
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<p>16</p>	<p>Assymmetrical weld</p> 	<p>512</p>	<p><math>\frac{b_1}{b_2} \leq 1.4</math></p>	<p><math>\frac{b_1}{b_2} \leq 1.7</math></p>	<p><math>\frac{b_1}{b_2} \leq 2</math></p>
<p>17</p>	<p>Inclination defect</p>  <p><math>\alpha</math></p> <p><math>\alpha_1</math></p> <p><math>\alpha</math> : value measured <math>\alpha_1</math> : value stipulated in drawing</p>	<p>-</p>	<p><math>\alpha &gt; 105^\circ</math> or <math>\alpha &gt; \alpha_1</math></p>	<p><math>\alpha &gt; -105^\circ</math> or <math>\alpha_1 &gt; \alpha_1</math></p>	<p>No tolerance given</p>
<p>18</p>	<p>Poor positioning</p> 		<p><math>h \leq 0.5 + 0.1a</math> max : 2</p>	<p><math>h \leq 0.5 + 0.2a</math> max : 3</p>	<p><math>h \leq 0.5 + 0.3a</math> max : 4</p>

19 1)	Fine porosity	2011 2012 2014 2017	The pores must not exceed 1 % of the projected surface. The size of one cavity must not be greater than 2 mm.	The pores must not exceed 2 % of the projected surface. The size of one cavity must not be greater than 3 mm.	The pores must not exceed 4 % of the projected surface. The size of one cavity must not be greater than 5 mm.
20 2)	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 3 mm.	Blowholes must not exceed 10 % of the projected surface. The size of one cavity must not exceed 5 mm.
21	Elongated pores	2015	Continuous defects are not permitted.	Continuous defects are not permitted.	Continuous defects are not permitted.
	Tubular pores	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 cracks	2024	Length must be less than the thickness of the weld.	Length must be less than the thickness of the weld.	No tolerance.

1) See remarks in Appendix 4 to UIC Leaflet 897 - 11 concerning defect 3.

2) See remarks in Appendix 4 to UIC Leaflet 897 - 11 concerning defect 4.

<p>22</p>	<p>Excessive penetration</p> 	<p>504</p>	<p>Penetration must be continuous. The height of penetration must not exceed 3 mm and under no circumstances 1 mm + 30 % of the width of penetration.</p>	<p>The height of penetration must not exceed 3 mm and under no circumstances 1 mm + 60 % of the width of penetration.</p> <p>Continuous length ≤ 50 Over a length of 300 Cumulative length ≤ 50</p>	<p>No tolerance</p>
<p>23</p>	<p>Lack of fusion/adhesion</p> 	<p>401</p>	<p>Not permitted</p>	<p>Permitted if the defect is localised</p>	<p>Authorised though intermittently and without emergence at surface.</p>

## Application

With effect from 1 January 1993

All UIC Railways

## Record references

*Heading under which the question has been dealt with:*

- *Question 5/SA/FIC - Point 8.3 - Approval of Leaflet 897-13*  
(Traction and Rolling Stock Committee, Paris, June 1992).

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