INTERNATIONAL UNION OF RAILWAYS

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Leaflet to be classified in Volumes: V - TRANSPORT STOCK VI - TRACTION VIII - TECHNICAL SPECIFICATIONS

897-5 OR

2nd edition, 1-1-1987

TECHNICAL SPECIFICATION FOR A SYSTEM OF SYMBOLS FOR WIRE ELECTRODES AND FLUX FOR AUTOMATIC SUBMERGED ARC WELDING OF CARBON, CARBON-MANGANESE AND LOW ALLOY STEELS

1) This leaflet is:

- *obligatory* for all technical documents prepared by the UIC and the ORE,
- *recommended* for technical documents of the UIC Member Railways:

REVISIONS

Leaflet 897-5, 2nd edition, 1-1-1987

Amendment		Amendment	
No.	date	No.	date

NOTE

This leaflet is part of a set which also includes:

- Leaflets in sub-section 89 (897): Welding

CONTENTS

1 - PURPOSE

This specification covers the identification of wire electrodes and flux for automatic submerged arc welding of carbon, carbon-manganese and low alloy steels, used for the manufacture and repair of rolling stock.

2 - DESIGNATION

2.1 - The abbreviated designation comprises letters and numbers in a specific order.

2.1.1 - Symbols for the wire electrodes

2.1.1.1 - Symbol for the product

The general symbol for wire electrodes is "S".

The symbol for wire electrodes for automatic submerged arc welding with flux is "PS".

2.1.1.2 - Symbol for the chemical composition

The symbol used to define the chemical composition is shown in the following table:

Symbol	C	Si	Mn	P ≤	S ≤	Mo	Ni	Cu (1) ≤
SA1	0.06-0.12	≤ 0.15	0.35-0.60	0.025	0.025	-	0.15	0.30
SA2	0.07-0.15	≤ 0.15	0.80-1.20	0.025	0.025	-	0.15	0.30
SA3	0.07-0.15	0.05-0.25	1.30-1.70	0.025	0.025	-	0.15	0.30
SA4	0.08-0.16	0.05-0.25	1.75-2.25	0.025	0.025	-	0.15	0.30
SA6	0.08-0.16	0.15-0.35	2.75-3.25	0.025	0.025	-	0.15	0.30
SA1Si	0.06-0.12	0.15-0.50	0.35-0.60	0.025	0.025	-	0.15	0.30
SA2Si	0.07-0.15	0.15-0.40	0.80-1.20	0.025	0.025	0.45-0.65	0.15	0.30
SA2Mo	0.08-0.15	0.05-0.25	0.80-1.20	0.025	0.025	0.45-0.65	0.15	0.30
SA3Mo	0.08-0.15	0.05-0.25	1.30-1.70	0.025	0.025	0.45-0.65	0.15	0.30
SA4Mo	0.08-0.15	0.05-0.25	1.75-2.25	0.025	0.025	-	0.15	0.30
SA2Ni1	0.07-0.15	≤ 0.15	0.80-1.20	0.015	0.015	-	1.10-1.60	0.30
SA2Ni2	0.07-0.15	≤ 0.15	0.80-1.20	0.015	0.015	-	2.00-2.50	0.30

(1) The copper content includes the copper coating.

2.1.2 - Symbols for the flux

2.1.2.1 - Symbol for the manufacturing method of the flux

The manufacturing method is symbolised by a letter, as follows:

F: for fused flux
B: for agglomerated or sintered flux
M: for mechanically mixed flux.

2.1.2.2 - Symbol for the principal chemical constituents of the flux

Two letters are used as shown in the following table:

Symbol	Type of flux	Principal constituents
MS CS	Manganese silicate Calcium silicate	$MnO + SiO_2$ ⩾50% $CaO + MgO^2 = SiO_2$ ⩾60%
AR AB	Rutile-aluminium Basic-aluminium	$Al_2O_3 + TiO_2$ ⩾45% $Al_2O_3 + CaO^2 + MgO$ ⩾45% Al_2O_3 ⩾20%
FB	Basic fluoride	$CaO + MgO + MnO + CaF_2$ ⩾50% SiO_2 ⩽ 20% CaF_2 ⩽ 15%

NOTE: Definition of the basicity index is given in Appendix 1.

2.1.3 - Symbol for weld deposit characteristics

2.1.3.1 - Symbol for the tensile strength of the weld deposit

The tensile strength ranges are given in the following table:

Symbol	Tensile strength (N/mm^2) (1)	Elasticity limit (N/mm^2)	Minimum lengthening (%)
43	430 - 510 (2)	⩾ 355	22
51	510 - 610	⩾ 380	22
57	570 - 770	⩾ 420	20
65	⩾ 650	⩾ 480	18

(1) As regards tensile strength, the values are reference values.

(2) Tolerance: + 40 N/mm^2

2.1.3.2 - Symbol for the notched bar impact strength of the weld deposit

The first digit denotes the temperature required to achieve an absorbed energy value of 28J, within V 150/R 146 as follows:

Symbol	Test temperature (°C)
0	-
1	+ 20
2	0
3	- 20
4	- 30
5	- 40

The second digit denotes the temperature required to achieve an absorbed energy value of 47 J, within V 150/R 146, as follows:

Symbol	Test temperature (°C)
0	-
1	+ 20
2	0
3	- 20
4	- 30
5	- 40

3 - APPLICATION

The system of symbols for combinations of electrode wires and flux is divided into the following parts:

3.1 - Part relating to the wire

The part relating to the wire comprises symbols in the following order:

- the type of product
- the chemical composition.

3.2 - Part relating to the flux

The part relating to the flux comprises symbols in the following order:

- the manufacturing method
- the chemical composition.

3.3 - Part relating to the combination

The part relating to the combination comprises symbols in the following order:

- tensile strength of the weld deposit
- notched bar impact strength of the weld deposit.

3.4 - Example

SA4 FMS 51 43, UIC 897.

4 - MARKING

The order or its appended documents shall indicate the marking to be provided for the wire-flux combination.

APPENDIX 1

The flux symbols are based on chemical composition.

The basicity index is expressed by the ratio:

$$\frac{\%\ \text{total of basic oxides}}{\%\ \text{total of acid oxides}}$$

or

$$\text{Basicity index} = \frac{CaO + MgO + BaO + SrO + Na_2O + K_2O + Li_2O + CaF_2 + 1/2\ (MnO + FeO)}{SiO_2 + 1/2\ (Al_2O_3 + TiO_2 + ZrO_2)}$$

APPLICATION

Effective from 1 January 1987.

All Railways in the Union.

RECORD REFERENCES

Heading under which the question has been dealt with:

- Question 5/SA/FIC - Approval of revised leaflet 897-5 "Technical specification for a system of symbols for wire electrodes and flux for automatic submerged arc welding of carbon, carbon-manganese and low alloy steels".
(Traction and Rolling Stock Committee, Paris, June 1986).