



NOTE

This leaflet is part of a set which includes:

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

CONTENTS

1 - PURPOSE

2 - CHARACTERISTICS

- 2.1 - Wire electrode and gas
  - 2.1.1 - Physical characteristics
  - 2.1.2 - Chemical characteristics
  - 2.1.3 - Geometrical characteristics of the wire electrode
  - 2.1.4 - Marks
- 2.2 - Deposited metal and welded connection
  - 2.2.1 - Limits of permissible defects
  - 2.2.2 - Chemical characteristics
  - 2.2.3 - Mechanical characteristics
  - 2.2.4 - Output

3 - MANUFACTURE

4 - INSPECTION

- 4.1 - General
- 4.2 - Submission for acceptance
  - 4.2.1 - Condition of welding products when submitted for acceptance
  - 4.2.2 - Grouping into batches for inspection of supplies
  - 4.2.3 - Advice of submission
- 4.3 - Type and number of checks and tests
  - 4.3.1 - For acceptance
  - 4.3.2 - On inspection of supplies
- 4.4 - Selection and preparation of samples and testpieces
  - 4.4.1 - Sampling
  - 4.4.2 - Welding of samples
  - 4.4.3 - Preparation of testpieces

- 4.5 - Execution of checks and tests
  - 4.5.1 - Dimensional inspection
  - 4.5.2 - Deposition test
  - 4.5.3 - X-ray examination
  - 4.5.4 - Tensile test
  - 4.5.5 - Resilience test
  - 4.5.6 - Bend test
  - 4.5.7 - Hot-cracking test
  - 4.5.8 - Test of nominal output and coefficient of deposition
  - 4.5.9 - Hydrogen content
- 4.6 - Conclusion of the inspections

5 - DELIVERY

- 5.1 - Preparation
- 5.2 - Protection
- 5.3 - Guarantee

APPENDIX 1 : Tests on deposited metal

APPENDIX 2 : Tests on welded connection

1 - PURPOSE

This specification governs the acceptance of combinations of wire electrodes (solid or cored) and gases and also the supply of wire electrodes (solid or cored) for the automatic and semi-automatic gas-shielded welding of plain-carbon or low-alloy steels used in the construction and repair of rolling stock.

It defines the minimum conditions laid down both for their acceptance and for checking that the supply conforms to the approved qualities.

The wire electrodes (solid or cored), the gases and the wire-electrode and gas combinations are defined in the order or in the associated documents by the symbols specified in UIC Leaflet 897-7.

2 - CHARACTERISTICS

2.1 - Wire electrode and gas

2.1.1 - Physical characteristics

The wire electrode must be of uniform quality, without traces of segregation or oxides, flaws or other irregularities.

The surface of the wire electrode must be free from all impurities such as oil, grease, paint, etc.

The covering must be uniform, adhesive and regular and shall not exhibit any fissures or shelling.

The wire electrode and the spool shall not present any defect making it difficult to unreel.

The solid wire electrode shall satisfy the mechanical characteristics requirements specified in the table below:

| Diameter of wire (mm)                                                                                                | 0.6<br>0.8 | 0.9    | 1.0  | 1.2  | 1.6<br>2.0 | 2.4<br>3.2 |
|----------------------------------------------------------------------------------------------------------------------|------------|--------|------|------|------------|------------|
| Tensile strength (1) (N/mm <sup>2</sup> )                                                                            | ≥1,100     | ≥1,000 | ≥950 | ≥900 | ≥700       | ≥600       |
| (1) For bobbins 100 mm in diameter the tensile strength of the wire may be 50 to 70% of the minimum value indicated. |            |        |      |      |            |            |

In the conditions of use corresponding to the diameter of the wire electrode there should be no difficulty in striking and re-striking an arc nor any possibility of the accidental extinction of the arc.

The slag deposited by the cored wire electrode shall be easy to remove when cold by means of a hand tool.

### 2.1.2 - Chemical characteristics

The purity of the shielding gas must correspond to the normal requirements for welding if not specified by the purchasing railway.

The chemical composition of the solid wire electrode shall conform to the order and the associated documents; in the absence of any indication in these documents, the chemical composition to be complied with is given in UIC Leaflet 897-7. The test is carried out on the wire complete with its protective coating.

In case of solid wires, the supplier shall provide for each batch number a certificate giving the chemical analysis.

### 2.1.3 - Geometrical characteristics of the wire electrode

The tolerances on the nominal diameter of the wire electrode must conform to those specified in the order and its associated documents; in the absence of any indication in these documents, the tolerances to be met are those indicated in the following table:

|                      | d<br>nominal diameter<br>of wire electrode<br>(mm) | tolerance<br>(mm) |
|----------------------|----------------------------------------------------|-------------------|
| solid wire electrode | $0.6 \leq d < 1.0$                                 | + 0.01<br>- 0.03  |
|                      | $1.0 \leq d \leq 2.0$                              | + 0.01<br>- 0.04  |
|                      | $2.0 < d \leq 3.2$                                 | + 0.01<br>- 0.07  |
| cored wire electrode | $1.0 \leq d < 2.0$                                 | + 0.01<br>- 0.04  |
|                      | $2.0 \leq d \leq 3.0$                              | + 0.01<br>- 0.07  |
|                      | $3.0 < d \leq 4.0$                                 | + 0.10<br>- 0.20  |

The wire electrode shall be coiled in one continuous length coming from the same manufacturing batch and, in the case of solid wire, from the same cast. The wire shall consist of a length not butt-jointed on the final drawing diameter. There shall be no bends, corrugations, folds or other irregularities. The wire must be wound in such a way that the coils can unwind without becoming entangled or crossing each other.

The terminal end of the wire electrode shall be firmly and visibly fixed.

In the case of a solid wire electrode 0.6 to 1.6 mm in diameter, the twist of the free turn must satisfy the values indicated in the following table:

| Reel size                                      | Twist of turn                           |
|------------------------------------------------|-----------------------------------------|
| $\phi < 200$ mm<br>$\phi > 300$ mm             | $\phi_{\text{residual}} < 100$ mm<br>5  |
| $200 \text{ mm} \leq \phi \leq 300 \text{ mm}$ | $\phi_{\text{residual}} < 100$ mm<br>10 |

2.1.4 - Marks

Each individual reel or package must bear the following manufacturing marks:

- name of manufacturer, firm and trade name of the product,
- number of manufacturing batch,
- symbols for product in accordance with UIC Leaflet 897-7,
- diameter of the wire electrode (in mm),
- nett weight of the wire electrode, excluding bobbin and packing,
- in the case of cored wire electrodes, the drying requirements.

The date of manufacture or a code enabling this date to be determined shall also be indicated if specified in the order or its associated documents.

Each solid wire electrode bobbin shall bear the cast number.

2.2 - Deposited metal and welded connection

2.2.1 - Limit of permissible defects

During acceptance and inspection of the supplies no defect due specifically to the combination of solid wire electrode or cored wire electrode and gas is acceptable.

The limits on permissible defects are those of categories B1S and A1 in UIC Leaflet 897-12, appendices 2 and 3.

2.2.2 - Chemical characteristics

2.2.2.1 - Chemical analysis

The deposit of the metal and the sampling shall be in accordance with the instructions of the purchasing railway.

2.2.2.2 - Hydrogen content

The hydrogen content is verified using the method covered by document IIS-IIW 11-602.71. The order and associated documents may specify another method.

2.2.3 - Mechanical characteristics

2.2.3.1 - On deposited metal (values recorded on testpieces covered by appendix 1 to this specification)

| Symbol of tensile strength | Tensile strength Rm (N/mm <sup>2</sup> ) | Yield strength Re (apparent limit or conventional limit at 0.2%) (N/mm <sup>2</sup> ) | Elongation after fracture A (%) |
|----------------------------|------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------|
| 47                         | 470-610                                  | >400                                                                                  | ≥22                             |
| 52                         | 520-660                                  |                                                                                       |                                 |
| 57                         | 570-710                                  |                                                                                       |                                 |

Resilience: the test temperatures are:

| First resilience figure | Test temperature (°C) |
|-------------------------|-----------------------|
| 0                       | -                     |
| 1                       | + 20                  |
| 2                       | 0                     |
| 3                       | - 20                  |
| 4                       | - 30                  |
| 5                       | - 40                  |

The average value (of three tests) of the fracture energy relating to the first resilience figure must be no lower than 28 J, with no individual value lower than 20 J.

| Second resilience figure | Test temperature (°C) |
|--------------------------|-----------------------|
| 1                        | + 20                  |
| 2                        | 0                     |
| 3                        | - 20                  |
| 4                        | - 30                  |
| 5                        | - 40                  |

The mean value (of three tests) of the fracture energy relating to this second resilience figure must not be lower than 47 J, with no individual value below 32 J.

2.2.3.2 - On welded connection (values recorded on testpieces covered by appendix 2 to this specification)

The tensile strength shall be greater than the minimum tensile strength of the parent metal.

Resilience: See 2.2.3.1 above.

Bending: Face and reverse bending to 180° over a former twice as thick as the plate in the case of steel grades Fe 360 to Fe 430, and three times the thickness of the plate in the case of steel grade Fe 510 and low-alloy steels, shall not reveal any cracks or fissures. Small superficial cracks which do not increase in depth when the bending operation is continued shall not be regarded as defects.

If larger cracks are observed during acceptance an additional examination will be made involving a further and last bending operation.

2.2.4 - Output

The values obtained for the nominal output and the coefficient of deposition of the cored wire electrodes shall be in accordance with the values specified by the order and associated documents.

3 - MANUFACTURE

The method of preparation and manufacture of the products shall be left to the choice of the manufacturer.

At the request of the purchasing railway the manufacturer shall give details of the nature of the manufacturing process and the principal characteristics of the cored wire electrodes (drying before use, minimum arc voltage, etc.).

The manufacturer may not modify the manufacturing conditions without advising the purchasing railway.

#### 4 - INSPECTION

##### 4.1 - General

The manufacturer shall maintain a constant quality control of his production. He must have the necessary facilities and equipment for this purpose.

Before submission, each batch of the combination of wire electrode and gas must undergo, at the responsibility of the supplier, the tests specified.

The representative of the purchasing railway shall check the inspection of the manufacturer. For this purpose he is authorised to select specimens.

##### 4.2 - Submission for acceptance

##### 4.2.1 - Condition of the welding products upon submission for acceptance

The wire electrode shall be submitted as ready for delivery.

##### 4.2.2 - Grouping into batches for inspection of supplies

The wire electrode shall be submitted for acceptance grouped into batches; each batch shall contain only products from the same manufacture, with the same nominal diameter and the same symbol. The size of the batch is specified by the order and associated documents.

##### 4.2.3 - Advice of submission

The date of submission shall be advised to the representative of the purchasing railway in writing.

This written advice shall indicate the quantity submitted in each batch, the references of the order in question and also the welding gas approved for use in combination with the wire. Upon submission for acceptance a certificate testifying that the provisions of this specification have been complied with shall be handed to the representative of the purchasing railway.

##### 4.3 - Type and number of checks and tests

The combination of wire electrode and gas recommended or specified by the order shall be subjected to the following checks and tests.

For a combination of wire electrode and gas approved for automatic and semi-automatic welding the tests shall, upon approval and upon inspection of the supplies, be carried out in accordance with the semi-automatic welding method.

4.3.1 - For acceptance

| Type of checks and tests                                  | Number of checks and tests |            |
|-----------------------------------------------------------|----------------------------|------------|
|                                                           | solid wire                 | cored wire |
| A - Check on wire electrode                               |                            |            |
| - chemical characteristics                                | 1                          |            |
| - geometrical characteristics                             | 1                          | 1          |
| - physical characteristics                                | 1                          | 1          |
| - deposition test                                         |                            | 1          |
| B - Tests on deposited metal<br>(Appendix 1)              |                            |            |
| - chemical analysis (1)                                   |                            | 1          |
| - check of hydrogen content or equivalent check (1)       |                            | 1          |
| - tensile test                                            | 1                          | 1          |
| - resilience test                                         | 6                          | 6          |
| C - Tests on welded connection<br>(Appendix 2)            |                            |            |
| - X-ray examination (1)                                   |                            | 1          |
| - tensile test                                            |                            | 1          |
| - resilience test                                         |                            | 6          |
| - bend test                                               |                            | 2          |
| - hot-cracking test (1)                                   |                            | 1          |
| D - Tests of nominal output and<br>deposition coefficient |                            | 1          |
| (1) To be specified by the order or associated documents. |                            |            |

4.3.2 - On inspection of supplies

The checks and tests are the same as upon approval. The purchasing railway shall fix the nature and the number of checks and tests to be carried out.

4.4 - Selection and preparation of samples and testpieces4.4.1 - Sampling

The representative of the purchasing railway shall select at random from each batch presented the welding materials for testing and shall mark the packages indelibly. No rewinding is permitted.

4.4.2 - Welding of samples4.4.2.1 - General

The approval process is the same as for the wire/gas combinations.

The welded samples intended for testing shall be obtained by semi-automatic welding using the products selected for this purpose.

The steels used shall be as follows, in accordance with ISO/R 630:

- grade Fe 360 to Fe 430 for combinations of wire electrodes and gases with a tensile strength of 470 to 610 N/mm<sup>2</sup>; these grades shall be at least of quality B,
- grade Fe 510 or low-alloy steel for combinations of wire electrodes and gases with a tensile strength of 520 to 660 N/mm<sup>2</sup> or 570 to 710 N/mm<sup>2</sup>; these grades shall be at least of quality C.

The dimensions of the samples shall be in accordance with the stipulations of Appendices 1 and 2.



The welding shall be carried out in accordance with the accepted code of practice. The direction of welding must be reversed for each run or pass.

A run shall consist of a normal seam; each run must not be more than 16 mm wide.

An adequate flow of shielding gas must be provided during the tests.

Between each pass the weld must be cooled in still air down to a temperature of 250°C measured on the surface midway along the testpiece and 30 mm from the edges of the weld.

The welding parameters (current and welding speed) must be kept within the limits indicated by the manufacturer.

It is recommended that the weld passes begin and terminate on separate plates attached to the test plates.

No retouching is permissible.

#### 4.4.2.2 - Type of samples and testpieces

The samples shall conform to Appendices 1 and 2.

The conventional welding position adopted for the different tests is the flat position.

#### 4.4.3 - Preparation of testpieces

##### 4.4.3.1 - X-ray examination

The X-ray examination shall be carried out on the welded samples before cutting up takes place.

#### 4.4.3.2 - General

The weld seams shall be dressed flush.

The cutting up and machining of the testpieces shall be carried out cold and with the necessary precautions to ensure that no substantial heating of the metal takes place.

The edges shall be dressed with file or tool.

The samples and testpieces shall not undergo any heat or mechanical treatment (1).

#### 4.4.3.3 - Hydrogen content

The sample intended for checking the hydrogen contents shall be that referred to in document IIS-IW 11 602-71, unless otherwise stipulated in the order or associated documents.

#### 4.4.3.4 - Tension, resilience and bending

The various testpieces shall be selected as indicated:

- in Appendix 1 to this specification in the case of tests on deposited metal,
- in Appendix 2 to this specification in the case of tests on welded connections.

#### 4.5 - Execution of checks and tests

##### 4.5.1 - Dimensional inspection

The diameter of the wire electrode shall be checked over a length of one metre. A micrometer shall be used for this purpose.

(1) However, in order to speed up the hydrogen diffusion process, the tensile testpiece for tests on deposited metal may, by agreement with the railway, be heated before the test to a temperature of 250°C for at least 6 hours but not more than 16 hours.

The residual diameter and the twist of the turn shall be measured on the free turn taken after at least four turns on the reel. The turn shall be laid unconstrained on a flat surface.

4.5.2 - Deposition test

The technological deposition test shall be carried out in the positions specified when the testpieces are welded for tests on deposited metal or on welded connections.

4.5.3 - X-ray examination

The X-ray examination shall be carried out on the welded joints; the order and associated documents must specify the image quality index for appraising the radiographic sensitivity.

At least one image quality index (I.Q.I.) per film is required.

The X-rayed parts must be clearly marked and this mark should be visible on the print.

4.5.4 - Tensile test

The tensile test shall be carried out in accordance with the provisions of ISO/RB2. In particular, the testpiece used shall be the "proportional testpiece" for which the ratio of the gauge length  $L_0$  to the straight section  $S_0$  of the calibrated part is:  $L_0 = 5.65 \sqrt{S_0}$ , the transverse dimensions of the calibrated section being as follows:

4.5.4.1 - for the test on deposited metal:  
- diameter: 10 mm.

4.5.4.2 - for the test on a welded connection:  
- those indicated in Appendix 2 to this specification.

4.5.5 - Resilience test

The resilience testpiece and the test procedure shall be in accordance with the provisions of ISO/R 148.

4.5.6 - Bend test

The bend test shall be carried out in accordance with the provisions of ISO/R B5.

The dimensions of the testpieces shall be those stipulated in Appendix 2 to this specification.

4.5.7 - Hot-cracking test

The hot-cracking test shall be carried out in accordance with the instructions of the purchasing railway.

4.5.8 - Test of nominal output and coefficient of deposition

The procedure is specified in UIC Leaflet 897-8.

4.5.9 - Hydrogen content

The hydrogen content may be determined using the method given in document IIS I1W 11-602-71.

The method of testing under mercury should be used.

4.6 - Conclusion of the inspections

Any result which is unsatisfactory shall entail refusal of acceptance or rejection of the supply.

Where the result of the visual examination, the X-ray examination or the sulphur-print examination, is inadequate, the sample shall be rejected.

A fresh sample may only be welded with the prior agreement of the representative of the purchasing railway.

## S - DELIVERY

### 5.1 - Preparation

The wire electrode may be supplied on a reel, bobbin or drum.

The dimensions of the reels, bobbins and drums and the tolerance on them must conform to those stipulated in the order and associated documents. In the absence of any indication in these documents, the dimensions shall conform to the provisions of ISO/R 864.

### 5.2 - Protection

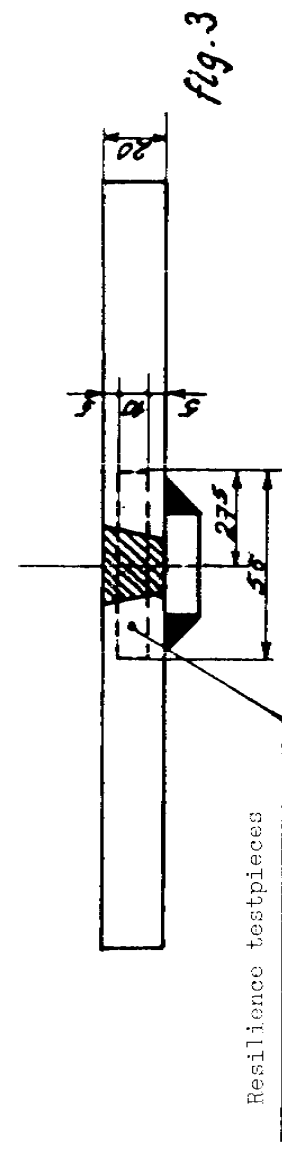
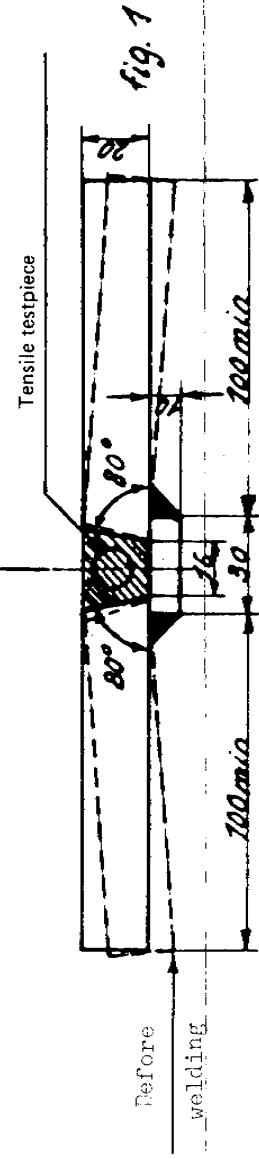
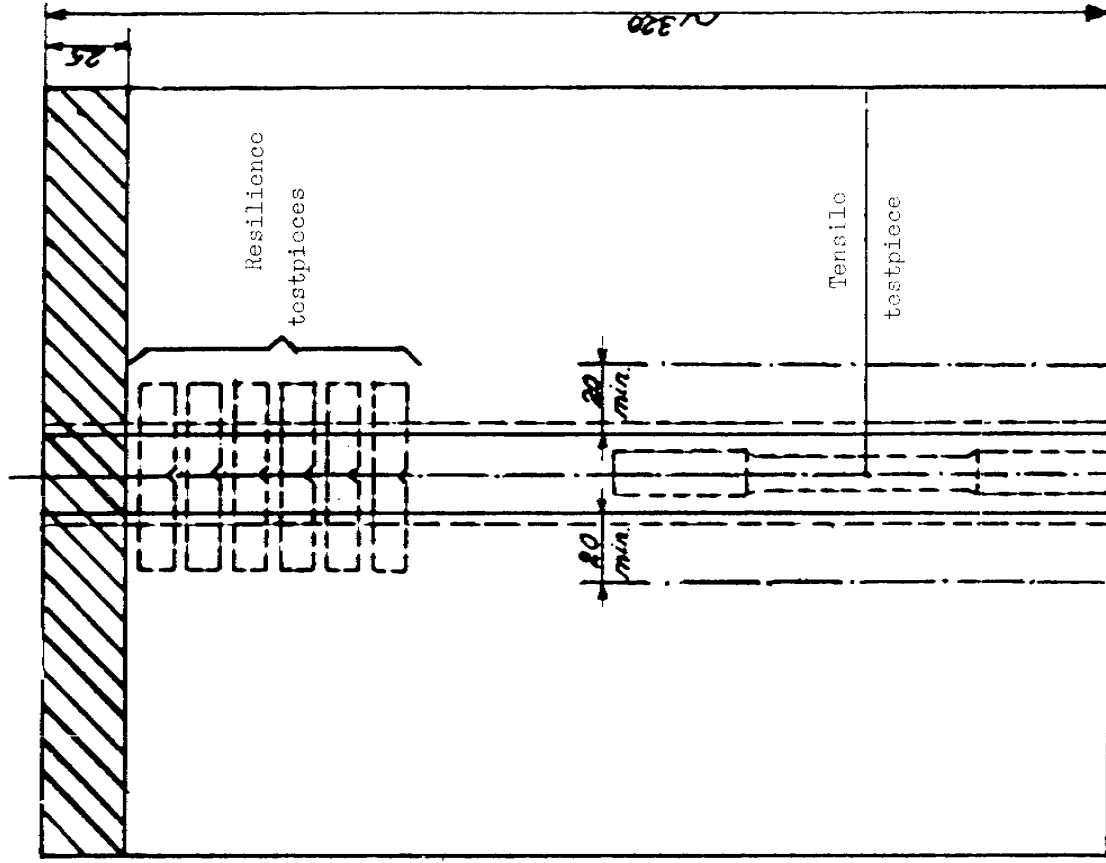
The packing shall afford protection during transport and storage against any damage, particularly that which may be caused by dampness.

### 5.3 - Guarantee

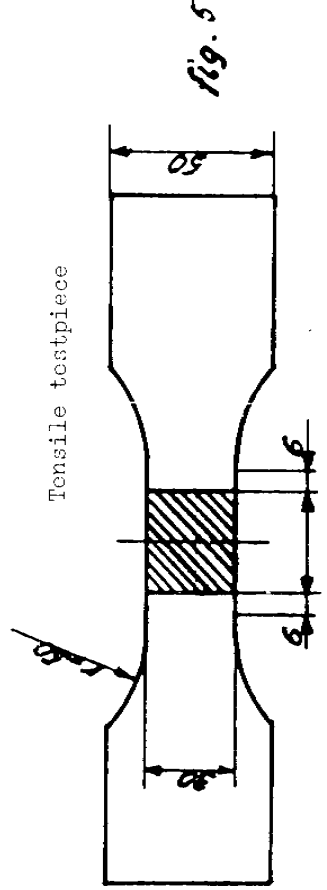
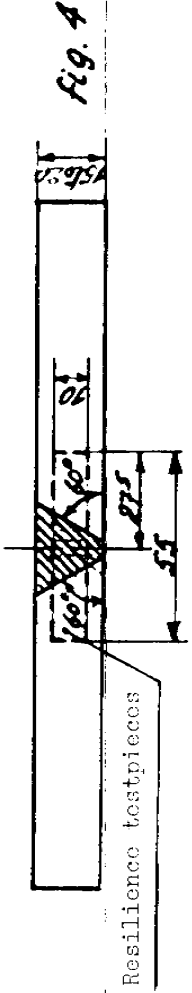
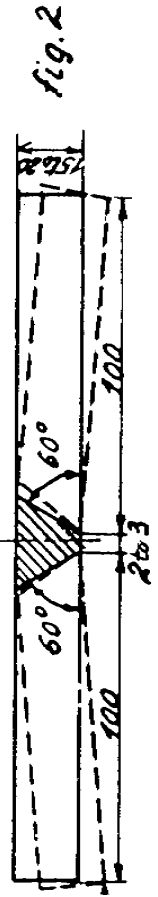
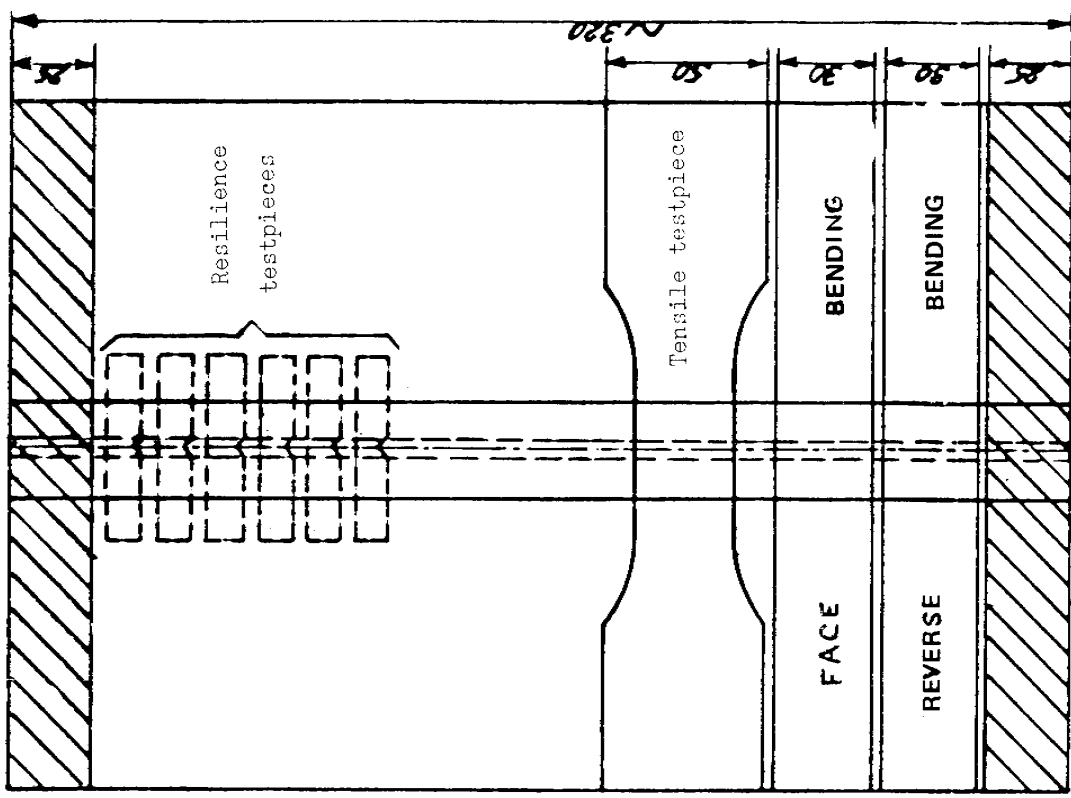
In the event of difficulties in use, the supplier shall undertake to exchange the defective bobbin(s).

---

TESTS ON DEPOSITED METAL



TESTS ON WELDED CONNECTION



### APPLICATION

Effective from 1st January 1986.

All Railways belonging to the Union.

---

### RECORD REFERENCES

Headings under which the question has been dealt with:

- Standardisation of weld materials (electrodes, etc.)  
(Specifications Sub-Committee: Paris, January 1973).

- Question 5/S/27 - Standardisation of weld materials  
    III) Modifications to existing leaflets  
(Specifications Sub-Committee: Paris, January 1977).

- Question 5/Sa/FIC - Approval of the revised 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 the automatic  
and semi-automatic gas-shielded welding of plain-carbon or  
low-alloy steels".  
(Motive Power and Rolling Stock Committee: Dublin,  
June 1985).