



This leaflet includes four sections :

- Section 1 : Cast-steel solid automatic coupler heads.
  - Section 2 : Automatic-coupler heads formed of two weld-assembled cast-steel parts.
  - Section 3 : Automatic-coupler heads made of spheroidal-graphite cast iron.
  - Section 4 : Mechanically-welded automatic-coupler heads.
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- SECTION 1 -

CAST-STEEL  
SOLID AUTOMATIC COUPLER HEADS

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Section 1

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1 - PURPOSE

1.1 - This specification governs the supply of heads for UIC type automatic couplers with centre buffer, for tractive and trailing stock.

The provisions set out below apply to solid automatic coupler heads made of cast steel from grades A, B or C.

All relevant instructions for implementing the contract, especially those concerning the application of the following paragraphs in this specification :

- 2.2.1.2
- 2.2.2 ; 2.2.3
- 3.2.5
- 4.2 ; 4.2.3.3

must be indicated in the order and its appended documents.

1.2 - List of reference documents

Reference is made, in this specification, to the following documents :

- UIC Leaflets 829-3, 840-2 ;

- International standard : ISO 82
- ISO Recommendations : ISO/R 79, ISO/R 148  
ISO/R 81  
ISO/R 404, ISO/R 1027
- ASTM E 71-64

## 2 - CHARACTERISTICS

### 2.1 - Materials

#### 2.1.1 - Standard grades

The coupler heads shall be made of cast steel from grade A, B or C.

#### 2.1.2 - Chemical properties (on products)

Grade A steel (1) % C  $\leq$  0.15

Grade B steel (2) : 0.15 < % C  $\leq$  0.24 and C<sub>eq</sub>  $\leq$  0.50 (3)

Grade C steel (4) : 0.24 < % C  $\leq$  0.30 or C  $\leq$  0.24 and C<sub>eq</sub> > 0.50

For these three grades S  $\leq$  0.035 %

P  $\leq$  0.035 %

- (1) This grade is weldable without any special precautions.  
 (2) This grade is weldable without preheating, on condition that the welding energy is higher than 1.5 kJ/mm, that it produces low hydrogen percentages and that the welding-induced constraints are limited, as is the case during re-loading.

$$(3) \text{ C}_{eq} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15}$$

- (4) This grade is weldable subject to certain special precautions being taken (preheating). The fact that the carbon content might not be as high as it could be shall not justify rejection of the steel grade.

The chemical composition shall be decided by the manufacturer, who must specify, in the manufacturing programme, the standard grade used as well as the permissible limits for each of the chemical properties including residual traces (see 3.2.1).

### 2.1.3 - Mechanical properties :

- Tensile strength  $\geq$  600 N/mm<sup>2</sup>
- 0.2 % proof stress  $\geq$  450 N/mm<sup>2</sup>
- Elongation percentage after fracture  $\geq$  17 %
- Notched bar impact test at - 50 ° C on V-shape notch test-pieces : the average value (of three tests) of the fracture energy must be higher than 20 Joules, each individual value not being less than 2/3 of the value laid down.
- Brinell hardness :

The hardnesses recorded on parts in the same batch ball-tested in the same place must not show any differences of more than 40 Brinell units.

The hardness recorded on the test bar (see 3.2.3) must fall within the range of values for hardnesses obtained with parts from the same batch.

### 2.1.4 - Weldability properties

The properties imposed as regards the weldability tests, forming part of the acceptance of the different grades of steel, are given in Appendix 3.

The values of Vickers hardnesses under bead (see 4.2.3.4) for steels from standard grades B and C must be less than or equal to 450.

## 2.2 - Parts

### 2.2.1 - Physical properties

#### 2.2.1.1. - Appearance

The coupler heads must be thoroughly cleaned, fettled and free from loose oxide or scale. All risers, gates, feeder heads and vents must be carefully removed. These different operations must be carried out in a manner that ensures satisfactory appearance of the parts and does not impede their functioning.

#### 2.2.1.2 - Soundness

The coupler heads must be sound throughout and must not show any defect detrimental to their use.

The magnetic particle crack test must not reveal any traces of defect in the heavily-stressed areas (1). Cracks of less than 20 mm in length shall be permitted in the other areas examined.

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(1) See Appendix 1 (sheets 1 and 2).

No residual magnetism, likely to bring about the persistent presence of magnetic dust detrimental to satisfactory behaviour in service, must exist in the parts after examination.

The films obtained from the radiographic examination of heavily stressed areas (1) must not show any defects more serious than those shown on the films in class 3 of Standard ASTM E 71-64 to which the order or its appended documents must refer, for defects in types A, B and C; no defect in types D, E, F and G shall be allowed.

#### 2.2.1.3 - Texture

The texture must be fine, uniform and free of any shiny crystals.

### 2.2.2 - Geometrical properties

The shape, dimensions and the tolerances allowed on the dimensions must be in conformity with those laid down in the order or its appended documents; failing any indication on these documents, the tolerances to be complied with are those given in UIC Leaflet 840-2.

### 2.2.3 - Marks

Each part leaving the foundry must bear, in the position and to the dimensions given in the order or its appended documents, the following embossed manufacturing marks :

- the mark of the supplier,

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(1) See Appendix 2.

- the reference number of the part,
- the identification mark,
- the date of manufacture (month and last two figures of the year of manufacture),
- the standard grade of the steel (A, B or C).

### 3 - MANUFACTURE

#### 3.1 - Preparation of the steel

The steel used for the manufacture of the coupler heads must be melted by the electric furnace, the open hearth process, by a top blown oxygen process, or by any other process recognised as equivalent by the purchasing Railway.

#### 3.2 - Manufacture of the parts

The manufacture of the coupler heads may only be entrusted to suppliers who have received the prior approval of the purchasing Railway.

#### 3.2.1 - Manufacturing and inspection programme

Before commencing manufacture, the supplier must indicate which standard grade is to be used, as well as the permitted limits, on product, for each of the chemical properties, including residual traces, together with the possible preheating thermal cycle to be arranged during the welding process.

The supplier must also submit to the purchasing Railway, for approval, a manufacturing programme specifying the methods employed particularly as regards casting techniques (sizes of gates, risers, feeder heads, air vents, denseners, etc), and the type of heat treatment (maximum temperature, the period during which the temperature is maintained, cooling conditions) which he intends to use.

In addition, the supplier must submit a programme of the envisaged inspections to the purchasing Railway for approval.

Any alteration to this programme must be submitted to the purchasing Railway for approval.

#### 3.2.2 - Prototypes

Before commencing mass production, the supplier must manufacture three prototype heads in strict conformity with the approved manufacturing programme.

*Section 1*

This operation must be monitored and checked by the representative of the purchasing Railway, who shall subsequently carry out, on the manufacturer's premises or in his laboratories, all the examinations (magnetic particle crack testing, radiography, sectioning of certain areas, etc.) which he considers necessary to ensure that the manufacturing programme followed enables sound parts to be obtained.

He shall also check the chemical, mechanical and geometrical properties stipulated in Article 2, according to the process laid down for mass production.

In addition, he shall carry out all the weldability tests as stipulated in Appendix 3 for acceptance of the steel.

Only when all these examinations and tests have given satisfactory results may the purchasing Railway authorise mass production.

**3.2.3 - Mass production**

The method used in mass production must be strictly identical to that approved after tests on prototypes.

Any modification to the manufacturing process shall cause the procedure laid down in 3.2.1 and 3.2.2 above to be set in motion again.

Each coupler head leaving the foundry must have at least two cast-on test bars still attached. These shall be about 15 mm x 20 mm in section, and are for the texture test. One of these test bars must be positioned on the thickest part of the coupler head, and must remain attached to it until completion of the full heat cycle.

*Section 1*

Each casting shall be represented by at least two test blocks measuring 400 mm x 100 mm x 25 mm for the tensile, notched bar impact and hardness-under-bead tests, as well as the sample for chemical analysis.

These test blocks shall be marked and cast at the same time as the castings, with metal from the same cast, in a mould formed in the same way as that of the part.

They shall undergo the same thermal cycle as the parts, and shall be placed in the furnace adjacent to them.

The representative of the purchasing Railway shall have the possibility to check that the metal of the castings is identical to that of the test blocks representing the cast by comparing the analysis of these blocks with that effected on a test bar for the texture test taken from a casting chosen at random in the batch.

**3.2.4 - Heat treatment**

The coupler heads shall undergo the heat treatment in accordance with the conditions laid down by the manufacturing programme.

**3.2.5 - Machining**

Machining shall be carried out in accordance with the indications given in the order or its appended documents.



### 3.2.6 - Repairs

Minor defects may be repaired by welding, after approval of the process by the representative of the purchasing Railway.

Any repair intended to hide a defect is strictly forbidden and shall result in rejection of the entire batch.

## 4 - INSPECTION

### 4.1 - Manufacturing inspection

The representative of the purchasing Railway must be able to check any phase in the manufacture by random checks. He shall examine the prototype after stripping from the mould, before removal of the gates, risers and feeder heads, to check that the manufacturing programme has been strictly observed.

On mass-produced coupler heads, he may carry out the same checks, as he thinks fit.

He must have access to all documents prescribed in the inspection programme, in particular to the charts plotted by correctly-calibrated recording pyrometers, in order to check the characteristics of the heat treatments.

Before presentation, the supplier shall carry out, under his own responsibility, a magnetic crack test on each coupler head and a Brinell hardness test on at least 10 % of the heads in each batch.

### 4.2 - Inspection of the parts

The inspection of the parts shall be carried out by the representative appointed by the purchasing Railway. However, if the order or its appended documents so stipulate, delivery of coupler heads may, merely, be accompanied by an inspection certificate for the products, issued by the factory, as defined in paragraph 4.1.3 of ISO Recommendation R 404.

#### 4.2.1 - Presentation

##### 4.2.1.1 - Condition of the parts on presentation

The coupler heads shall be presented in delivery condition, before protective treatment.

4.2.1.2 - Grouping into batches

The coupler heads shall be presented grouped into batches ; each batch shall include parts from the same cast only, which have undergone the same heat treatment.

In the event of a second annealing requiring to be carried out, the batch shall consist of parts from the same cast and emanating from a charge having undergone the same heat treatment. The size of the batch may not exceed 20 tonnes.

4.2.1.3 - Advice of presentation

The presentation date shall be advised to the representative of the purchasing Railway by written note, signed by the director of the producing factory or his authorised representative. This note must indicate the number of parts presented in each cast, also the references of the order covering them. At the time of presentation, the supplier shall hand to the representative of the purchasing Railway, a certificate giving the results of the full chemical analysis carried out on the casting, including residual traces, and stating that the prescribed conditions of manufacture have been complied with and that the prescribed magnetic particle crack test and Brinell hardness test have been satisfactorily carried out.

Section 1

4.2.2 - Nature and proportion of the checks and tests

The coupler heads shall be subjected to the following checks and tests :

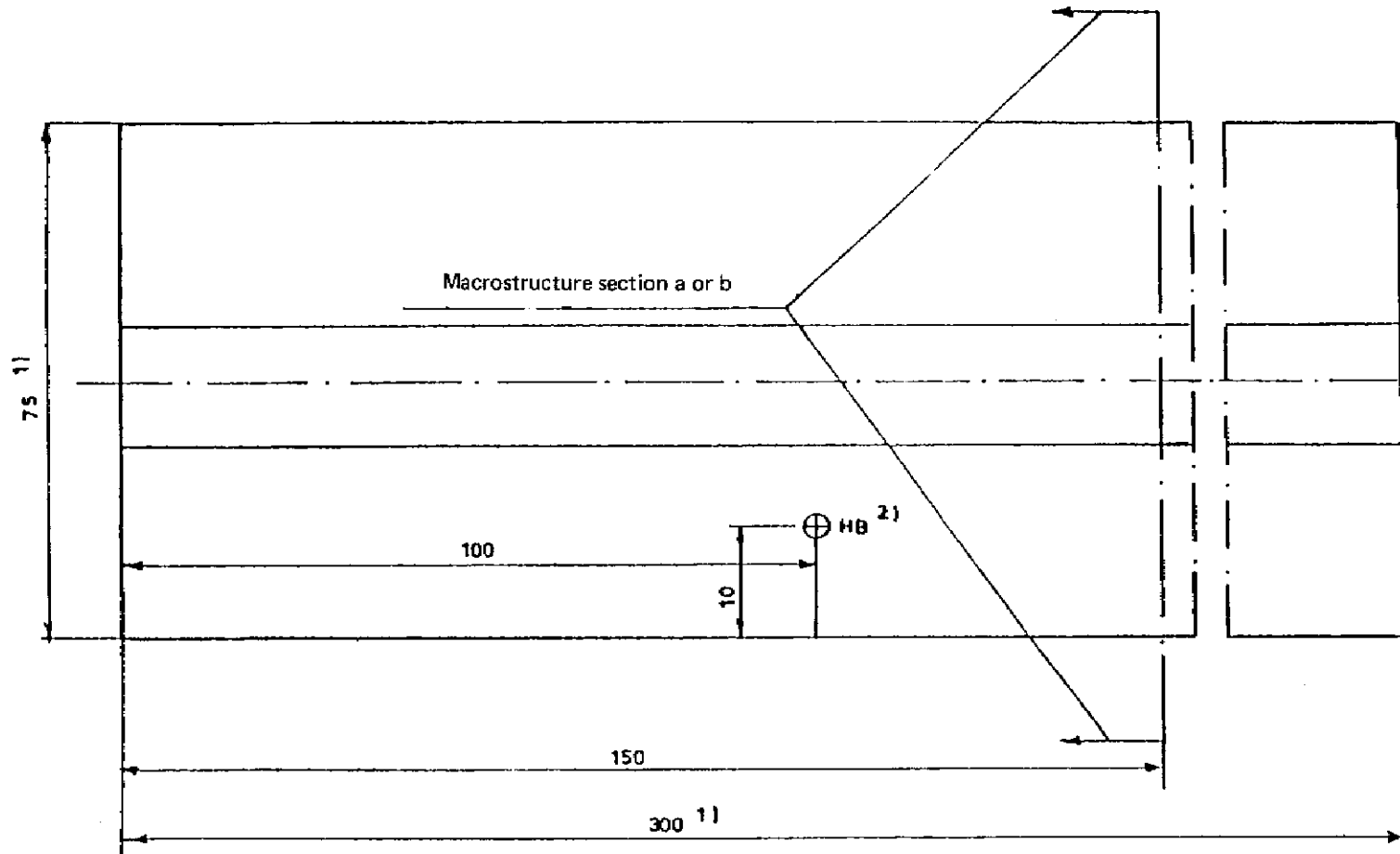
Nature of the checks and tests	Number of the checks or tests per batch
- Chemical analysis (1).	1
- Tensile test	1
- K.V. impact test at - 50°C	1 (2)
- Brinell hardness test	- on 10 % of the parts (3) - on the test blok
- Texture tests	- on each part
- Magnetic particle crack test	- on 10 % of the parts(3)
- Radiographic examination	- 1 for 4 batches
- Vickers hardness test under bead	
(4)	1
- Appearance and dimensional checks	- as the purchasing Railway thinks fit

(1) The chemical analysis, including residuals, must be consistent with the chemical analysis as presented during acceptance.

(2) Each test includes a series of 3 test-pieces.

(3) Before presentation, at least 10 % of the parts must have undergone, under the responsibility of the supplier, the Brinell hardness test, and all parts the magnetic particle crack test.

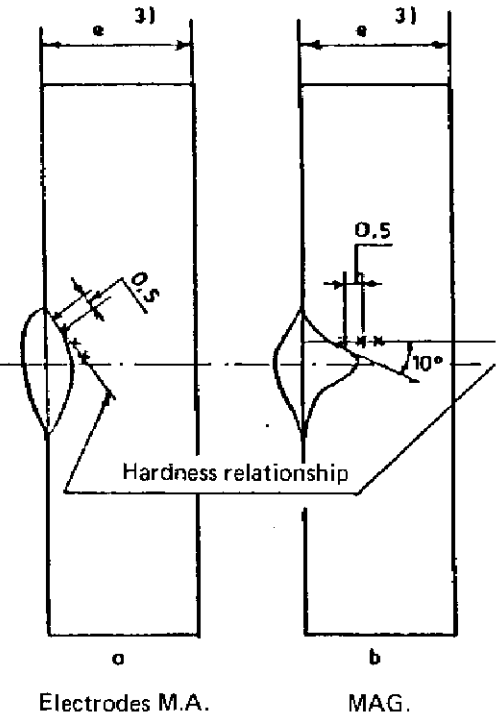
(4) The test is carried out only on B and C grade steels.



1) For mass production :  
Length = 400 mm  
Width = 100 mm

2) HB = Brinell hardness measurement

Fig. 1



3) Prototype :  
 $e$  = side thickness  
Mass production :  
 $e$  = 25 mm

**4.2.3 - Removal and preparation of the samples and test-pieces.**

The representative of the purchasing Railway shall remove at random, from each batch presented, the test blocks and castings which he intends using for the tests, and shall mark them indelibly.

The cutting up of the samples and the machining of the test pieces must be carried out in the cold condition, and conducted with care, so that no appreciable heating of the metal occurs. The samples shall be removed in such a way that additional tests can be carried out with the metal left over.

The samples and test pieces must retain the stamps of the representative of the purchasing Railway ; any transfer of marks may only be effected by him.

**4.2.3.1 - Chemical analysis**

The sample for chemical analysis shall consist of a section about 10 mm in thickness of a test block.

**4.2.3.2 - Tensile and impact tests**

The test pieces for the tensile and impact tests shall be taken from the axis of the test block.

**4.2.3.3 - Brinell hardness**

The Brinell hardness test shall be carried out on the parts in the position indicated in the order or its appended documents, and on the test block as indicated in Figure 1.

**4.2.3.4 - Brinell hardness test under bead**

A welding bead shall be laid in one run on one of the test blocks measuring 400 x 100 x 25 mm, as indicated in figure 1. The net welding energy to be used shall be :

$$E = 1.5 \text{ kJ/mm} \pm 15 \% \text{ where}$$

$$E = \frac{0.85 \times \text{arc voltage (Volt)} \times \text{welding current (Amp)}}{1000 \times \text{welding speed (mm/sec)}}$$

**4.2.3.5 - Texture**

The test bars for the texture test shall be notched on one face only and as near as possible to the points where they were attached to the casting. The depth of this notch must be less than 1/2 of the thickness of the bar.

**4.2.3.6 - Radiographic examination**

The radiographic examination shall be effected on a part chosen by the representative of the purchasing Railway.

**4.2.4 - Performance of the checks and tests****4.2.4.1 - Tensile test**

The tensile test-piece and the test itself must be in accordance with ISO Standard 82. The length between marks shall be calculated by the formula:

$$L_0 = 5.65 \sqrt{S_0}$$

**4.2.4.2 - Notched bar impact test**

The notched bar impact test-piece and the test itself must be in accordance with the provisions of ISO Recommendation R 148.

**4.2.4.3 - Brinell hardness test**

The Brinell hardness test must be conducted in accordance with ISO Recommendation R 79.

**4.2.4.4 - Vickers hardness test under bead**

The Vickers HV 5 hardness tests shall be carried out every 0.5 mm as indicated in figure 1.

The test must be conducted in accordance with ISO Recommendation R 81.

**4.2.4.5 - Texture test**

The test bars for the texture test shall be broken with a hammer, the blow being applied on the notched side.

**4.2.4.6 - Magnetic particle crack test**

The magnetic particle crack test effected on parts which have been previously cleaned and either shot-peened or correctly sand-blasted, shall be carried out in accordance with Appendix 1 (Sheets 1 and 2) which indicates the heavily-stressed areas where no defect can be allowed, and stressed-areas where the presence of lines not exceeding 20 mm can be tolerated. The detection process using magnetic ink shall be used.

The magnetization and demagnetization test procedures must be approved by the purchasing Railway.

Magnetization by current flow through the casting is not authorised; its use shall result in rejection.

**4.2.4.7 - Radiographic examination**

The radiographic examination shall be carried out in the heavily-stressed areas indicated in Appendix 2; the image quality index shall be assessed by means of one of the wire or step indicators defined by ISO Recommendation R 1027.

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Section 1

All the parts on which a radiographic test is performed must carry a mark clearly visible on the film.

Parts where this examination show defects not permitted in 2.2.1.2 can be cut up, at the manufacturer's request, to determine the seriousness of the defects with accuracy.

**4.2.4.8 - Dimensional check**

Checking of the dimensions shall be carried out by any suitable means, especially by means of gauges supplied by the manufacturer and conforming to those defined by the UIC.

The gauges must be periodically checked by an approved laboratory.

**4.3 - Conclusion of inspection**

Any result of a texture test which is not satisfactory, also any appearance or dimensional defects, shall lead to rejection of the part.

Any result of chemical analysis, tensile, impact, Brinell hardness or Vickers hardness test under bead, which is not satisfactory, shall lead to rejection of the corresponding batch.

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Section 1

Further tests may only be carried out, at the request of the manufacturer, with or without improvement treatment, with the prior agreement of the purchasing Railway.

If any unacceptable defect is revealed by the magnetic particle crack test, the casting shall be rejected and a systematic examination of the area in which the defect(s) were found shall be made on all castings in the batch ; each one found similarly defective shall be scrapped.

If any unacceptable defect is revealed by the radiographic examination, the casting shall be rejected and a systematic examination of the area in which the defect(s) were found shall be made on all castings in the four batches.

**5 - DELIVERY**

**5.1 - Protection against oxidation**

After checking and stamping by the representative of the purchasing Railway, the parts shall receive, before storage or dispatch, a coating approved by this Railway.

**5.2 - Guarantee**

The coupler heads shall be guaranteed for a period of 5 (five) years against any manufacturing defect. This period shall run with effect from the end of the month marked on the parts.

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If the coupler heads are fitted to new stock, the date of delivery of the vehicles to which they are fitted shall be considered as the beginning of the guarantee. If the coupler heads are fitted to stock in use at the time of reconversion to automatic coupling, the date of fitting which shall be advised to the supplier, shall be considered as the beginning of the guarantee.

Coupler heads which, during the guarantee period, show defects rendering them unsuitable for service or reducing their service life, shall be rejected.

Before being finally rejected, the defective coupler heads may, however, be subjected to a check examination between the purchasing Railway and the supplier, if the latter so requests.

When the check examination confirms that the defects are truly imputable to the manufacture, the defective coupler heads shall be finally rejected.


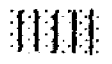
In cases where the results of the check examination do not enable an agreement to be reached between the purchasing Railway and the supplier, recourse shall be had to experts approved by both parties to settle the dispute. The costs shall then be borne by the party finally held responsible.

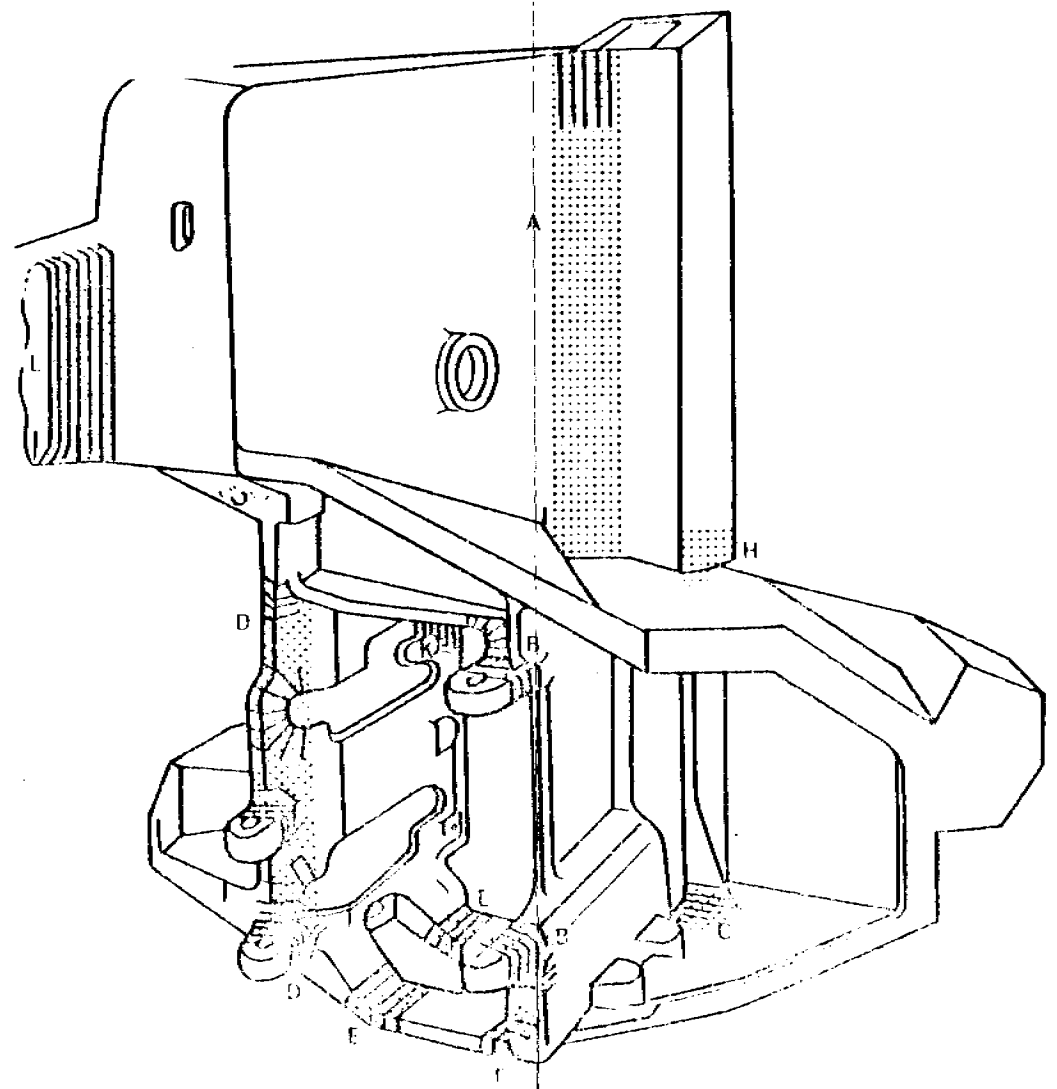
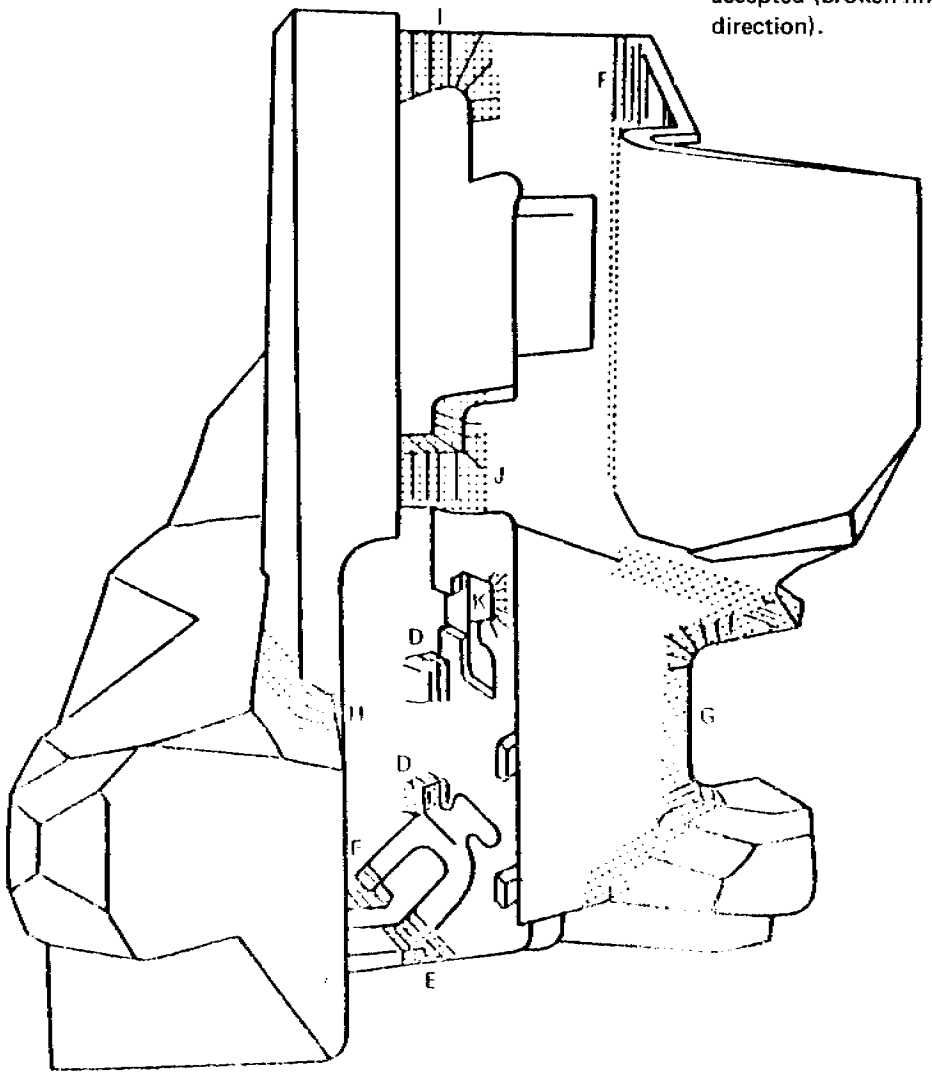
When more than 5 % of parts from the same cast show defects resulting in rejection, the purchasing Railway may reject the whole of the cast.

Rejected coupler heads shall be made available to the supplier, with a view to their replacement or their reimbursement at their value, in new condition, at the time of withdrawal.

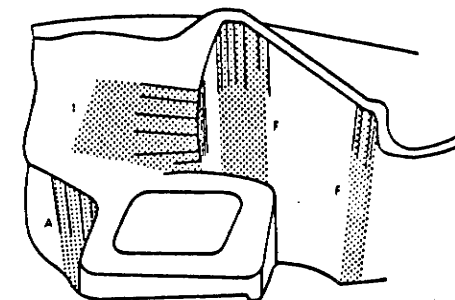
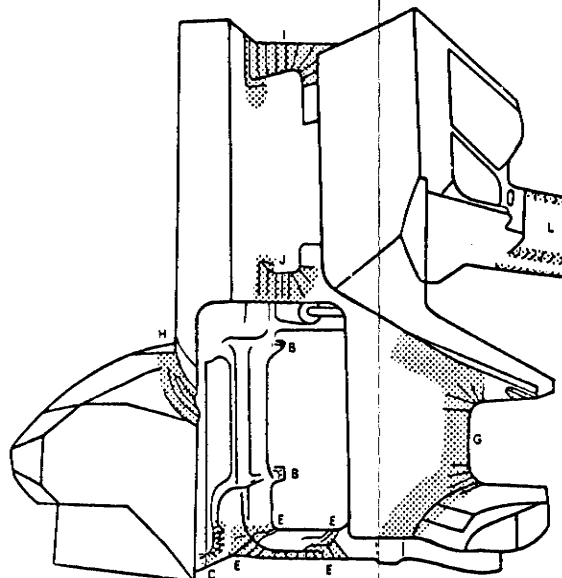
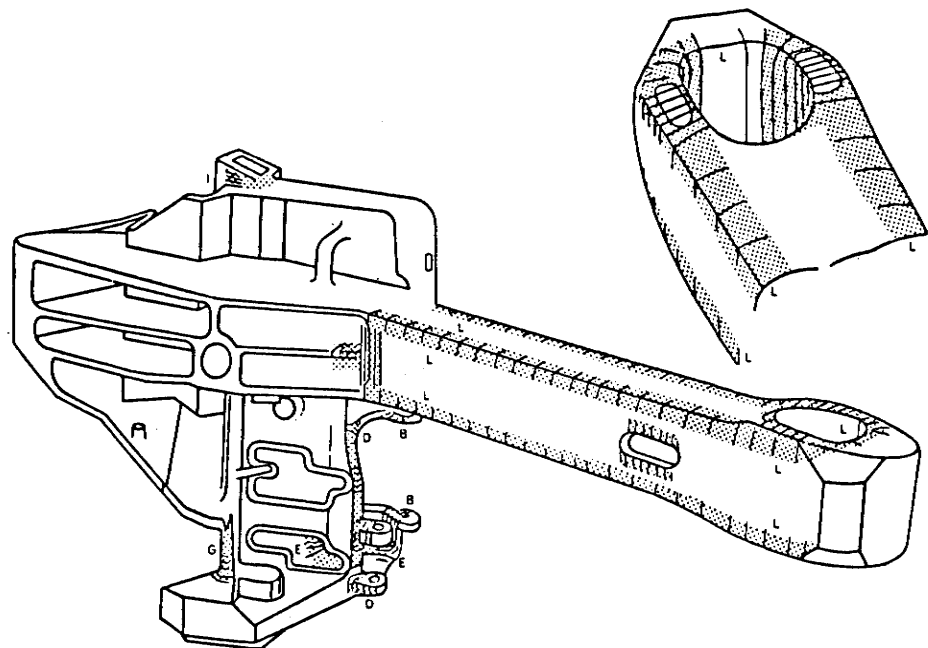
### AUTOMATIC COUPLER HEAD

Magnetic particle crack test


- on the «stressed» areas where the presence of lines } not exceeding 20 mm can be tolerated. 
- on «heavily stressed» angles where no defect can be } accepted (broken lines indicate the unfavourable } direction). 





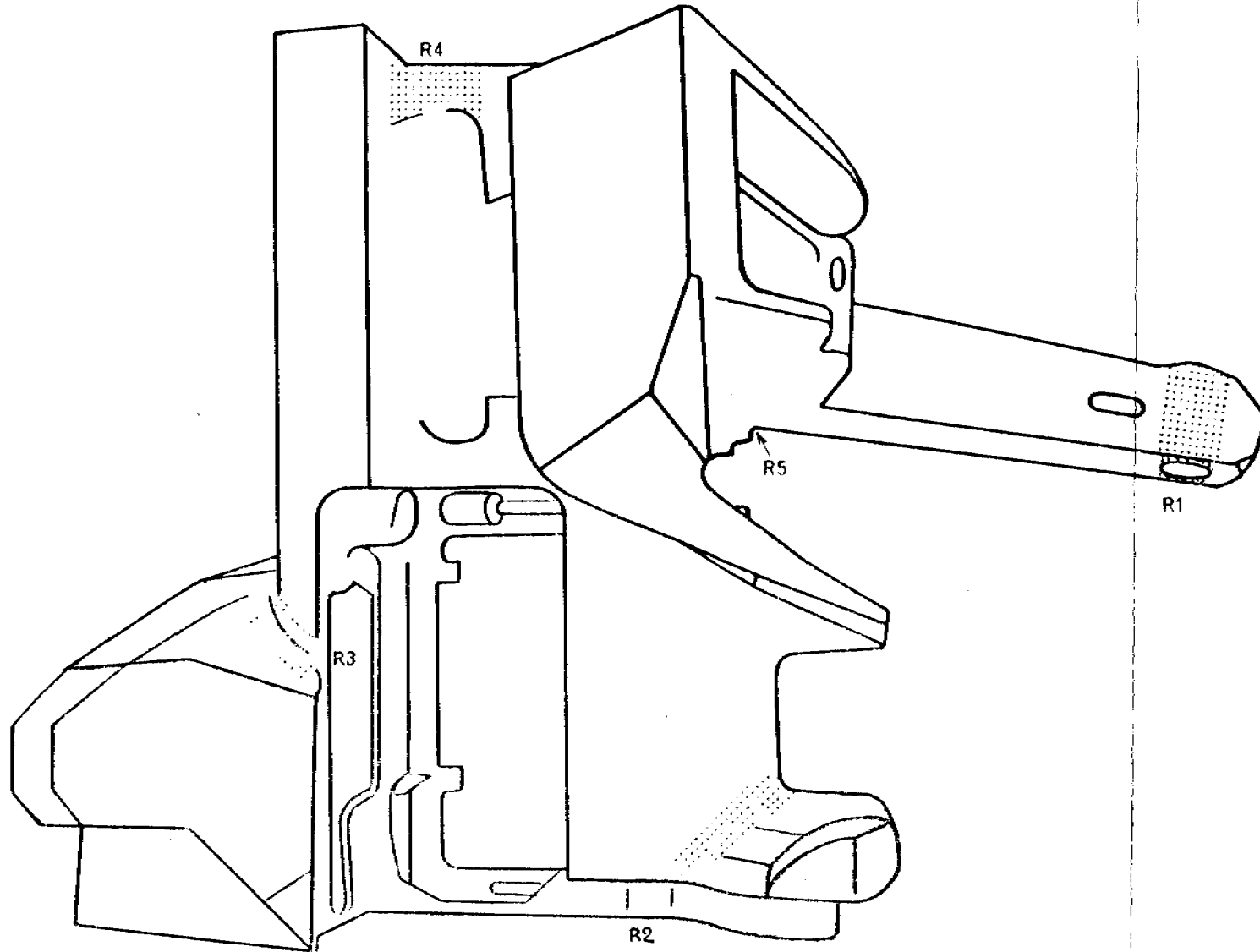


**AUTOMATIC COUPLER HEAD**  
Radiographic examination

Heavily-stressed areas : 

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*Section 1*  
*Appendix 2*



R5 : Head-arm connect-  
ion

## WELDABILITY TESTS FOR ACCEPTANCE OF THE STANDARD-GRADE STEELS

The standard grade of steel proposed must be subjected to the following weldability tests before acceptance.

### 1 - CHARACTERISTICS TO BE OBTAINED

Grade	Type of test	Tests	Results to be obtained	Fig.
Steel A	Weldability test at high temperature	HV 5 hardness test in the ZAT (1)	≥ 90 % HV 5 of base metal	1
		KV impact test at -30°C in the ZAT (2) (KV-shape notch)	KV ≥ 27 J	1
Steel B and C (3)	Test at low temperature	KV impact test at -30°C in the ZAT (2) (KV-shape notch)	KV ≥ 27 J	1
		HV 5 hardness test under bead	HV 5 ≤ 450	2

(1) ZAT = Heat-affected zone

(2) Average for the 3 samples; no individual value must be less than 20 J.

(3) Tests with steel C are carried out under the conditions of preheating as provided for during acceptance.

## 2 - REMOVAL AND PREPARATION OF THE SAMPLES AND TEST-PIECES

### 2.1 - Removal

The representative of the purchasing Railway shall arrange for samples measuring 75 x 300 mm to be removed from the arm of the prototype coupler bodies. The thickness of these samples shall be the same as that of the side of the coupler head arm.

### 2.2 - Preparation of the samples

#### 2.2.1 - Weldability test at high temperature (Steel A)

HV 5 hardness and notched-bar impact tests.

Two samples shall be prepared and welded as indicated in figure 1.

All the weld-bead runs shall be deposited with the same net welding energy of  $E = 3 \pm 10\%$  kJ/mm where

$$E = 0.85 \times \frac{\text{arc voltage (Volt)} \times \text{welding current (Amp)}}{1000 \times \text{welding speed (mm/s)}}$$

**2.2.2 - Weldability test at low temperature (Steels B and C)**

**2.2.2.1 - Notched-bar impact test**

Two samples shall be prepared and welded as indicated in figure 1.

All the weld-bead runs shall be deposited with the same net welding energy of  $E = 1.5 \pm 15\%$  kJ/mm.

The temperature between runs shall not exceed 150°C.

**2.2.2.2 - Vickers hardness test under bead**

A weld bead shall be deposited on a sample in a single run (figure 2).

The net welding energy to be used shall be  $E = 1.5 \pm 15\%$  kJ/mm.

**3 - PERFORMANCE OF THE TESTS**

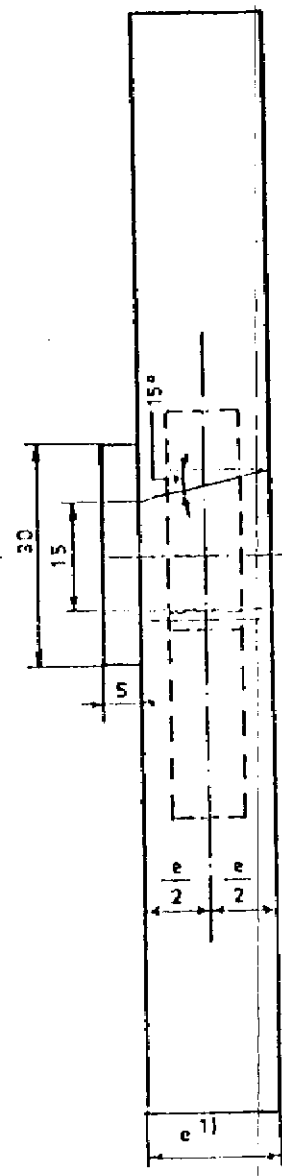
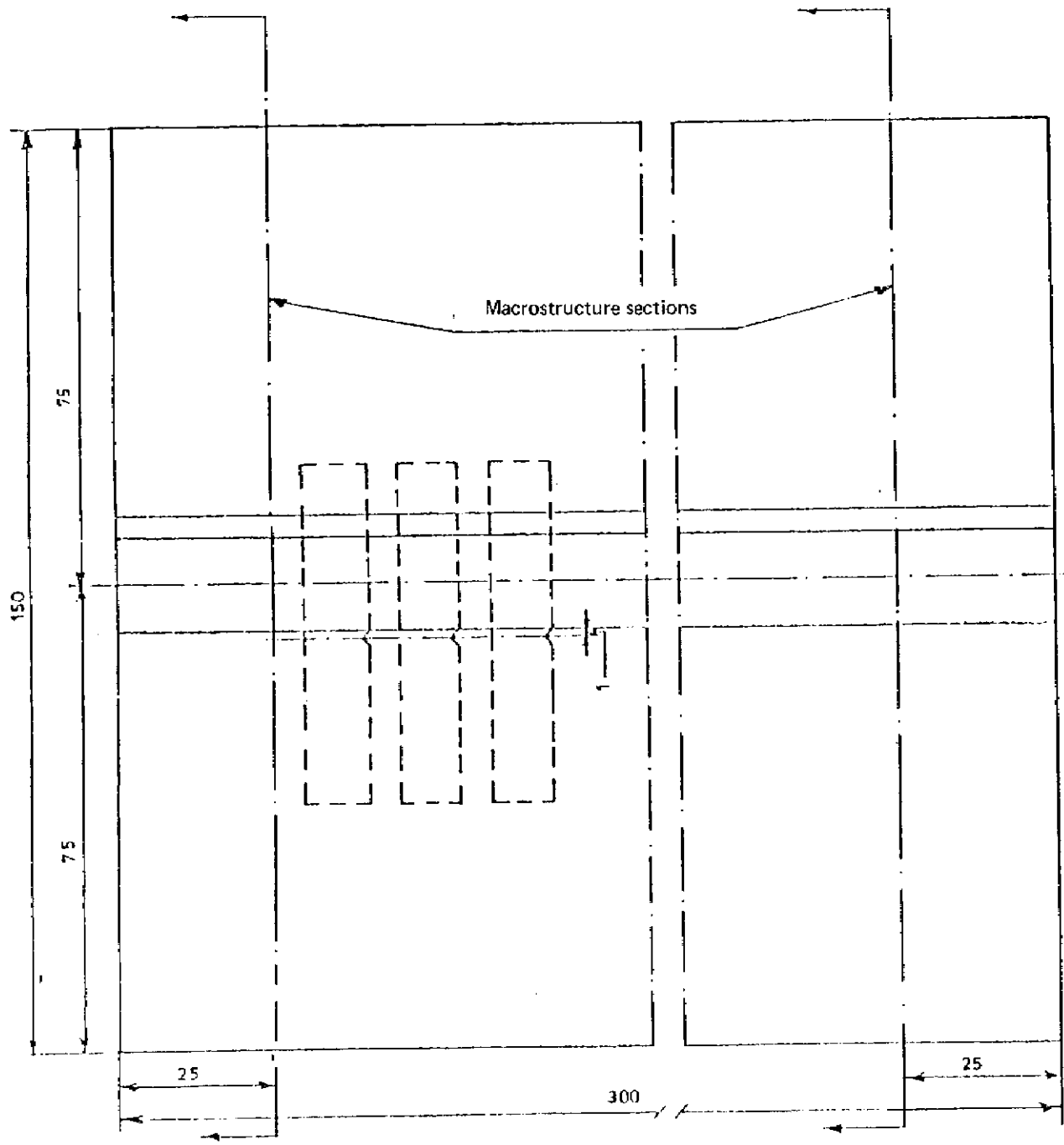
**3.1 - Notched bar impact test**

The position of the notch on the impact test pieces shall be determined by macro-etching (Fig.1).

The impact test-piece and the organisation of the test shall comply with the provisions of ISO Recommendation R 148.

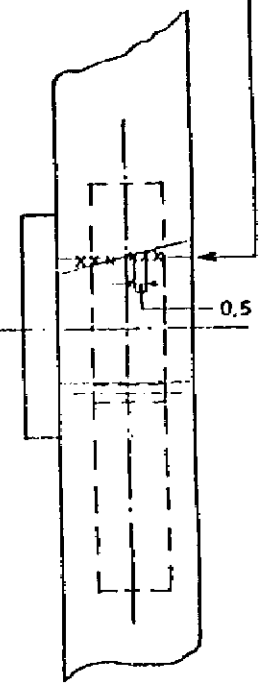
**3.2 - Vickers hardness test**

The HV 5 hardness test shall be carried out at intervals of 0.5 mm in straight line, as indicated in figure 1 for the test at high temperature, and as indicated in figure 2 for the test at low temperature. The test must be conducted in conformity with ISO Recommendation R 81.



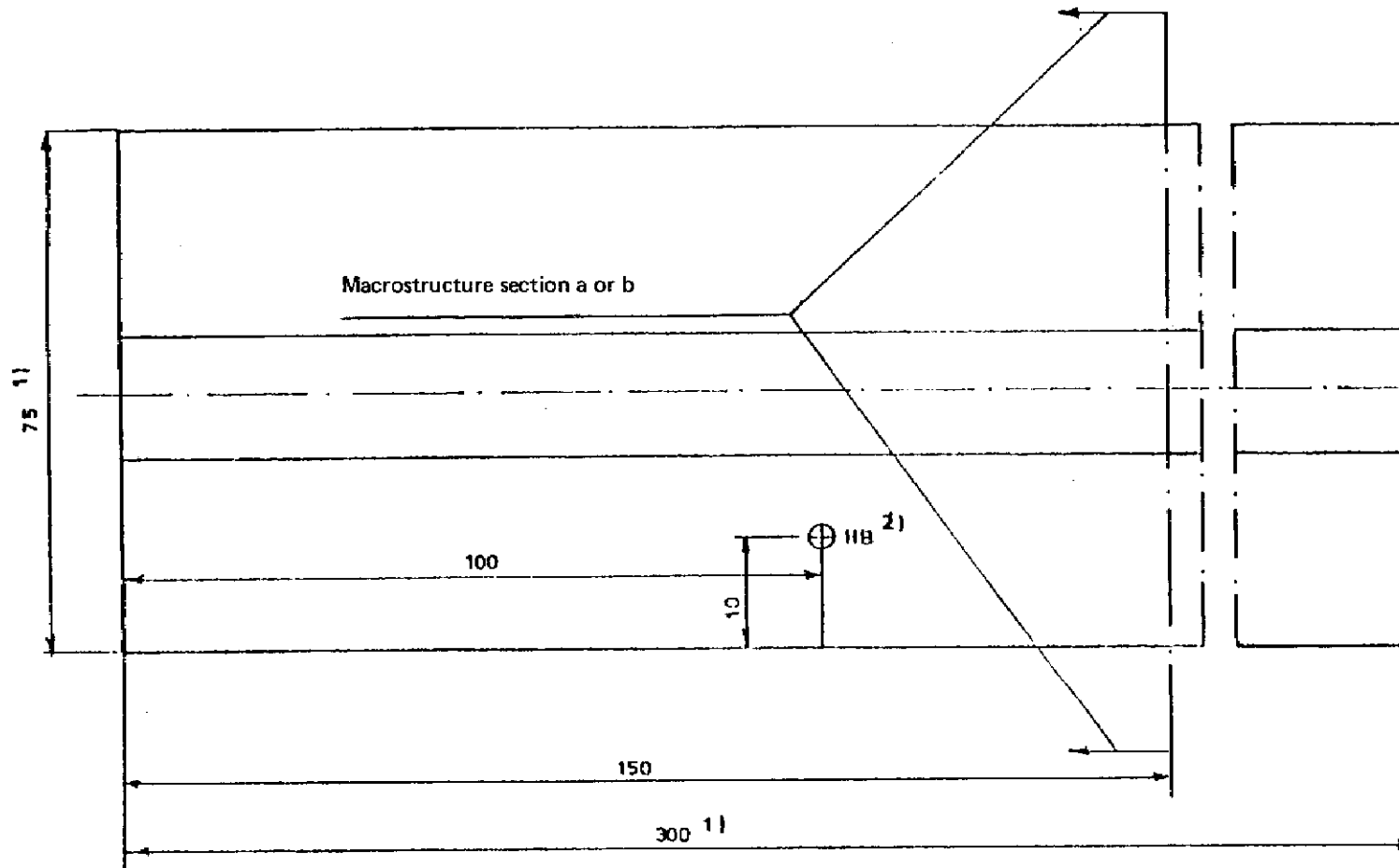
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Section 1  
Appendix 3

For Steel A  
Hardness relationship



1) e = side thickness

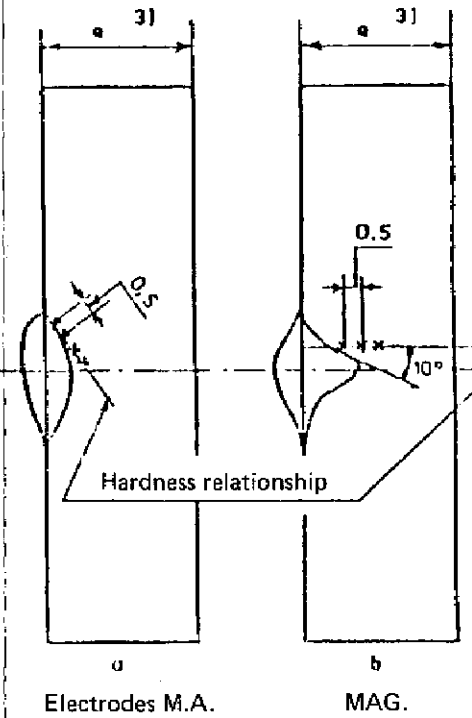
Fig. 1



1) For mass production :  
Length = 400 mm.  
Width = 100 mm.

2) HB = Brinell hardness measurement

Fig. 2



3) Prototype :  
e = side thickness  
Mass production :  
e = 25 mm

**- SECTION 2 -**

**AUTOMATIC COUPLER HEADS  
CONSISTING OF TWO WELD-ASSEMBLED  
CAST-STEEL PARTS**

---

*Section 2*

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- 4.2.1 - Presentation
- 4.2.2 - Nature and proportion of the checks and tests
- 4.2.3 - Removal and preparation of the samples and test-pieces
- 4.2.4 - Performance of the checks and tests

##### 4.3 - Conclusion of inspection

#### 5 - DELIVERY

- 5.1 - Protection against oxidation
- 5.2 - Guarantee

#### 1 - PURPOSE

1.1 - This specification governs the supply of heads for UIC type automatic couplers with centre buffer, for tractive and trailing stock.

The provisions set out below apply to automatic-coupler heads made of two cast-steel parts, weld-assembled along a horizontal plane located outside the impact zone. These parts shall be in cast steel from grades A, B or C.

All relevant instructions for implementing the contract, especially those concerning the application of the following paragraphs in this specification :

- 2.2.1.2
- 2.2.2 ; 2.2.3
- 3.2.5
- 4.2 ; 4.2.3.3

must be indicated in the order and its appended documents.

#### 1.2 - List of reference documents

Reference is made, in this specification, to the following documents :

- UIC leaflets 829-3, 897-13, 840-2 ;
- International Standard : ISO 82.



- ISO Recommendations : ISO/R 79, ISO/R 148,  
ISO/R 81,  
ISO/R 404, ISO/R 1027.

- ASTM E 71-64.

## 2 - CHARACTERISTICS

### 2.1 - Materials

#### 2.1.1 - Standard grades

The coupler heads shall be made of cast steel from Grades A,  
B or C.

#### 2.1.2 - Chemical properties (on products)

Grade A steel (1) : % C  $\leq 0.15$

Grade B steel (2) :  $0.15 < \% C \leq 0.24$  and  $C_{\text{eq}} \leq 0.50$  (3)

Grade C steel (4) :  $0.24 < \% C \leq 0.30$  or  $C < 0.24$  and  $C_{\text{eq}} > 0.50$

For these three grades  $S \leq 0.035\%$

$P \leq 0.035\%$

(1) This grade is weldable without any special precautions.

(2) This grade is weldable without preheating, on condition that the welding energy is higher than 1,5 kJ/mm, that it produces low hydrogen percentages and that the welding-induced constraints are limited, as is the case during re-loading.

(3)  $C_{\text{eq}} = C + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15}$

(4) This grade is weldable subject to certain special precautions being taken (preheating). The fact that the carbon content might not be so high as it could be shall not justify rejection of the steel grade.

The chemical composition shall be decided by the manufacturer who must specify, in the manufacturing programme, the standard grade used as well as the permissible limits for each of the chemical properties, including residual traces (see 3.2.1).

#### 2.1.3 - Mechanical properties

The mechanical properties of the filler metal and of zones adjacent to the welding must be at least equal to those imposed for the base metal of the parts to be assembled. These properties are listed below :

- Tensile strength  $\geq 600$  N/mm<sup>2</sup>

- 0.2 % proof stress  $\geq 450$  N/mm<sup>2</sup>

- Elongation percentage after fracture  $\geq 17\%$

- Notched bar impact test at - 50° C on V-shape notch test-pieces : the average value (of 3 tests) of the fracture energy must be higher than 20 Joules, each individual value not being less than 2/3 of the value laid down.

- Brinell hardness :

The hardnesses recorded on parts in the same batch, ball-tested in the same place, must not show any differences of more than 40 Brinell units.

The hardness recorded on the test bar (see 3.2.3) must fall within the range of values for hardnesses obtained with parts from the same batch.

**2.1.4 - Weldability properties**

The properties imposed for the weldability tests forming part of the acceptance of the different types of steel, are given in Appendix 3.

The values of Vickers hardnesses under bead (see 4.2.3.4) for steels from standard grades B and C must be less than or equal to 450.

**2.2 - Parts****2.2.1 - Physical properties****2.2.1.1 - Appearance**

The coupler-head parts must be thoroughly cleaned, fettled and free from loose oxide or scale. All risers, gates, feeder heads and vents must be carefully removed. These different operations must be carried out in a manner that ensures satisfactory appearance of the parts and does not impede their functioning.

The welds must be free of hollows, undercut, sudden irregularities or excessive extra thickness, restarts, differences in level and any other cause of stress concentration.

Penetration must be complete over the whole length of the weld.

No arc burns or arc spots must be made outside the boundaries of the weld preparation.

The centre-line of the weld beads must not deviate by more than 1 mm from that of the edges to be welded.

**2.2.1.2 - Soundness**

The coupler heads must be sound throughout and not show any defect detrimental to their use.

The magnetic particle crack test must not reveal any traces of defect in the heavily-stressed areas (1). Cracks of less than 20 mm in length shall be permitted elsewhere.

No residual magnetism, likely to bring about the persistent presence of magnetic dust detrimental to satisfactory performance in service, may exist in the parts after examination.

The films obtained from the radiographic examination of heavily-stressed areas (2) must not reveal any defects more serious than those shown on the films in class 3 of Standard ASTM E 71-64, to which the order or its appended documents must refer, for defects in types A, B and C; no defect in types D, E, F and G may be allowed.

The magnetoscopic examination of the weld beads and of areas adjacent to them must not reveal any trace of defect.

(1) See Appendix 1 (sheets 1 and 2)

(2) See Appendix 2

The films obtained from the radiographic examination of the welded zones must be consistent with the characteristics of class 2, UIC Leaflet 897-13.

**2.2.1.3 - Texture**

The texture must be fine, uniform and free of any shiny crystals.

**2.2.2 - Geometrical properties**

The shape, dimensions, and the tolerances allowed on the dimensions must be consistent with those fixed in the order or its appended documents. Failing any indication on these documents, the tolerances to be complied with shall be those given in UIC Leaflet 840-2.

**2.2.3 - Marks**

Each part leaving the foundry must bear, in the position and to the dimensions indicated on the order or its appended documents, the following embossed manufacturing marks :

- the mark of the supplier,
- the reference number of the part.
- the identification mark
- the date of manufacture (month and last two figures of the year of manufacture) ;
- the standard grade of the steel (A, B or C).

**3 - MANUFACTURE**

**3.1 - Preparation of the steel**

The steel used for manufacturing the parts of the coupler body shall be prepared by means of the electric or open-hearth process, by a top-blown oxygen process or by any other process recognised as equivalent by the purchasing Railway.

**3.2 - Preparation of the parts**

The manufacture of the coupler-body parts may only be entrusted to suppliers who have been approved by the purchasing Railway.

The manufacture of the welded parts may only be entrusted to approved suppliers using semi-automatic or automatic welding processes, which have received the prior approval of the purchasing Railway.

The welders carrying out the semi-automatic welding work must also have been approved by a representative of the purchasing Railway, after tests which must be repeated periodically.

### 3.2.1 - Manufacturing and inspection programme

Before the start of manufacture, the supplier must indicate which grade of steel he will be using, as well as the permitted limits, on products, for each of the parts including residual parts, together with the possible pre-heating thermal cycle to be provided for during the welding process.

The supplier must also submit to the purchasing Railway, for approval, a manufacturing programme specifying the methods employed, particularly as regards casting techniques (sizes of gates, risers, feeder heads, air vents, denseners, etc), and the type of heat treatment (maximum temperature, the period during which the temperature is maintained, cooling conditions) which he intends to use.

In addition, the manufacturing programme submitted to the purchasing Railway for approval must contain full particulars on the preparation of the edges to be welded, on welding conditions (preheating, process, adjustment, diameter of wire, nature of flux, etc) and the heat-treatment after welding.

It shall also specify that assembly is to be effected on a fixture permitting flat (downhand) welding as far as possible, and that no adjustment may take place after welding.

The supplier shall submit a programme of the envisaged inspections to the purchasing Railway for approval.

Any alteration to this programme must be submitted to the purchasing Railway for approval.

### 3.2.2 - Prototype

Before commencing mass production, the supplier must manufacture three prototype heads in strict conformity with the approved manufacturing programme.

This operation must be monitored and checked by the purchasing Railway's representative, who shall subsequently carry out, on the manufacturer's premises or in his laboratories, all the examinations (magnetic-particle crack testing, radiography, sectioning of certain areas, etc.) which he considers necessary to ensure that the manufacturing programme followed enables sound parts to be obtained.

He shall also check the obligatory chemical, mechanical and geometrical properties defined in Article 2, according to the process laid down for mass production.

In addition, he shall carry out all the weldability tests as stipulated in Appendix 3 for acceptance of the steel.

Only when all those examinations and tests have given satisfactory results may the purchasing Railway authorise mass production.

Before assembly of the prototype heads, the representative of the purchasing Railway shall examine the welding process(es) laid down in the plan of manufacture.

If the results of these tests are satisfactory, the representative of the purchasing Railway shall authorise the assembly of the prototypes, on which he shall then carry out all the sectioning and examinations which he considers necessary to satisfy himself regarding the quality of the workmanship and the soundness of the weld.

Only when all these tests and examinations have given satisfaction shall the Railway authorise mass production.

### 3.2.3 - Mass production

The mass production process must be strictly identical to that approved after tests on prototypes.

Any alteration to the welding conditions shall result in the procedure prescribed in 3.2.1 and 3.2.2 being set in motion.

Each coupler head leaving the foundry must have at least two cast-on test bars of about 15 mm x 20 mm in section still attached for the purposes of the texture test. One of these test bars must obligatorily be positioned on the thickest part of the coupler head, and remain attached to it until completion of the full heat cycle.

Each casting shall be represented by at least two test blocks measuring 400 x 100 x 25 mm, for the tensile, notched-bar-impact and hardness-under-bead tests, as well as the sample for chemical analysis:

These test blocks shall be marked and cast at the same time as the castings, with metal from the same cast, in a mould formed in the same way as that of the parts.

They shall undergo the same heat cycle as the parts, and shall be placed in the furnace adjacent to them.

The representative of the purchasing Railway shall have the possibility to check that the metal of the castings is identical to that of the test-blocks representing the cast, by comparing the analysis of these blocks with that effected on a test bar for the texture test taken from a casting chosen at random in the batch.

The mass-welding operation must be identical, in all respects, to that specified in the manufacturing programme and approved after tests and examinations on models and prototypes.

Any modification in the welding conditions shall cause the procedure laid down in 3.2.1 and 3.2.2 to be set in motion again.

It shall be possible for the purchasing Railway's representative to obtain, from each cast, two further test blocks measuring 400 x 100 x 25mm, identical to the test blocks for mechanical and chemical tests.

If he considers it necessary, the representative of the purchasing Railway may, at any time, use two test blocks for manufacturing a model enabling the mechanical tests prescribed in 4.2.2 to be carried out.

The shape and surface condition of the chamfers must be identical to that prescribed for the parts.

The welding must be carried out in accordance with the instructions in the manufacturing programme, both parts for assembly being rigidly held in position by a suitable device while the welding is being carried out. No rectification may be carried out after welding.

The model shall then be subjected to heat treatment under the conditions laid down in the manufacturing programme.

The manufacture of the model must be monitored and checked by the representative of the purchasing Railway, who shall subsequently check, on the manufacturer's premises, that the weld metal and the areas adjacent to the weld possess the mechanical properties laid down in 2.1.3.

### 3.2.4 - Heat treatment

The coupler heads shall undergo heat treatment in accordance with the conditions prescribed in the manufacturing programme.

Heat treatment must be carried out after welding.

### 3.2.5 - Machining

Machining shall be carried out in accordance with the indications given in the order or its appended documents.

### 3.2.6 - Repairs

Minor defects may be repaired by welding, after approval of the process by the representative of the purchasing Railway.

Any repair intended to hide a defect is strictly forbidden, and shall result in rejection of the entire batch.

## 4 - INSPECTION

### 4.1 - Inspection of manufacture

The representative of the purchasing Railway must be able to carry out random checks on any phase in the manufacture. He shall examine the prototype after stripping from the mould, before removal of the gates, risers and feeder heads, in order to check that the manufacturing programme has been strictly observed.

He may carry out the same checks on mass-produced coupler heads, as he thinks fit.

He must have access to all documents prescribed by the inspection programme, in particular to the charts plotted by correctly-calibrated recording pyrometers, in order to check the characteristics of the heat treatments.

Before presentation, the supplier shall carry out, under his own responsibility, a magnetic particle crack test on each coupler head part.

The representative of the purchasing Railway must be able to carry out this examination before welding.

The supplier must also carry out, under his own responsibility, a Brinell hardness test on at least 10 % of coupler-head parts from each batch.

The representative of the purchasing Railway must be able to check the preparation of the chamfers and the execution of the welds by random checks in order to ensure that the manufacturing programme has been strictly complied with.

If he considers it necessary, he may ask for a model to be manufactured, at any time, under the conditions prescribed in 3.2.3 in order to check that the mechanical properties in the weld metal and in the heat affected zones are in accordance with those laid down in 2.1.3.

Before presentation, all weld beads and adjacent zones must also be subjected, by the supplier, to the magnetic particle crack test.

#### 4.2 - Inspection of the parts

Inspection of the parts shall be carried out by the representative appointed by the purchasing Railway. However, if the order or its appended documents so stipulate, delivery of coupler heads may, simply, be accompanied by an inspection certificate for the products, issued by the factory, as defined in paragraph 4.1.3 of ISO Recommendation R 404.

##### 4.2.1 - Presentation

###### 4.2.1.1 - Condition of the parts on presentation

The coupler heads shall be presented in delivery condition, before protective treatment.

##### 4.2.1.2 - Grouping into batches

The coupler heads shall be presented grouped into batches ; each batch shall consist exclusively of parts from the same cast, which have undergone the same heat treatment.

In the event of a second annealing requiring to be carried out, the batch shall consist of parts from the same cast and emanating from a charge having undergone the same heat treatment. The size of the batch may not exceed 20 tonnes.

##### 4.2.1.3 - Advice of presentation

The date of presentation shall be advised to the representative of the purchasing Railway by written note, signed by the director of the producing factory or his authorised representative. This note must indicate the number of parts presented in each cast, also the references of the order covering them. At the time of presentation, the supplier shall hand to the representative of the purchasing Railway, a certificate stating that the prescribed conditions of manufacture have been complied with and that the magnetic particle crack test and the Brinell hardness test as prescribed above, have been satisfactorily carried out.

The certificate issued to the representative of the purchasing Railway must also state that the individual magnetic-particle crack test on the component parts as well as on the weld beads and their surrounds have been effectively and satisfactorily carried out.

4.2.2 - Nature and proportion of the checks and tests

4.2.2.1 - The coupler heads shall be subjected to the following checks and tests :

Nature of the checks and tests	Number of the checks or tests per batch
Chemical composition check (1)	1
Tensile test	1
KV impact test at -50° C	1 (2)
Brinell hardness test	- on 10 % of the parts (3) - on the test block
Texture test	on each part
Magnetic particle crack test	on 10 % of the parts (3)
Radiographic examination	1 per 4 batches
Vickers hardness test under bead (4)	1
Appearance and dimensional checks	as the purchasing Railway thinks fit

- (1) The chemical analysis, including residual traces, must be consistent with the chemical analysis presented during acceptance.
- (2) Each test includes a series of 3 test pieces.
- (3) Before presentation, at least 10 % of the parts must have undergone, under the responsibility of the supplier, the Brinell hardness test, and all parts the magnetic particle crack test.
- (4) The test shall be carried out on steel from standard grades B and C only.

4.2.2.2 - The models and parts shall be subjected to the following checks and tests :

Nature of the checks and tests	Number of tests or checks	
	on model manufactured as decided by the representative of the purchasing Railway	on a batch of parts
Tensile test on weld metal, base metal and heat-affected zone	1	1 per 4 batches
V-notch impact test at -50° C on weld metal (1)	1	10 % (2)
Radiographic examination of welded zones		5 % (3)
Magnetic particle crack test		
a) on the component parts before welding		
b) on the weld beads and adjacent zones		

- (1) See figure 1. § 4.2.3.2. Each test comprises a series of three test pieces.
- (2) All parts must have been subjected, before welding, under the responsibility of the supplier, to the magnetic particle crack test.
- (3) Before presentation, all the weld beads and adjacent zones must have been subjected, under the responsibility of the supplier, to the magnetic particle crack test.



**4.2.3 - Removal and preparation of the samples and test-pieces**

The representative of the purchasing Railway shall remove at random, from each batch presented, the test blocks and castings which he intends for the tests, and shall mark them indelibly.

The cutting up of the samples and the machining of the test pieces must be carried out in the cold condition, and conducted with care, so that no appreciable heating of the metal should occur.

The samples shall be removed in such a way that additional tests can be carried out with the metal left over.

The samples and test-pieces must retain the stamps of the representative of the purchasing Railway; any transfer of marks may only be effected by him.

**4.2.3.1 - Chemical analysis**

The sample for chemical analysis shall consist of a section about 10 mm in thickness from a test block.

**4.2.3.2 - Tensile and impact tests**

On the coupler-head parts, the test pieces for the tensile and impact tests shall be taken from the axis of the test block.

The test-piece for the tensile test, 15 mm in thickness, and the test-pieces for the impact tests, shall be removed, in accordance with paragraph 3.2.3, in the axis of the model, as per figure 1 opposite.

**4.2.3.3 - Brinell hardness test**

The Brinell hardness test shall be carried out on the parts in the position indicated in the order or its appended documents, and on a test block as indicated in figure 2.

**4.2.3.4 - Vickers hardness test under bead**

A weld bead shall be deposited in a single run on one of the test blocks measuring 400 x 100 x 25 mm, as indicated in figure 2 opposite.

The net welding energy to be used shall be  $E = 1.5 \text{ kJ/mm} \pm 15\%$  where

$$E = 0.85 \times \frac{\text{arc voltage (Volt)} \times \text{welding current (Amp)}}{1000 \times \text{welding speed (mm/sec)}}$$

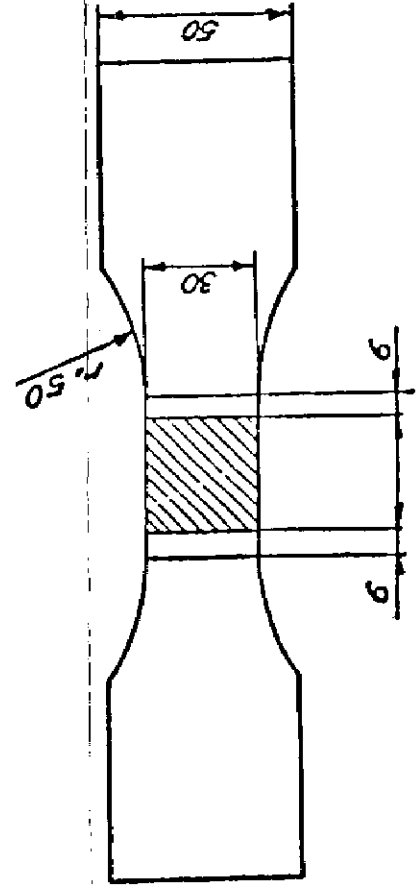
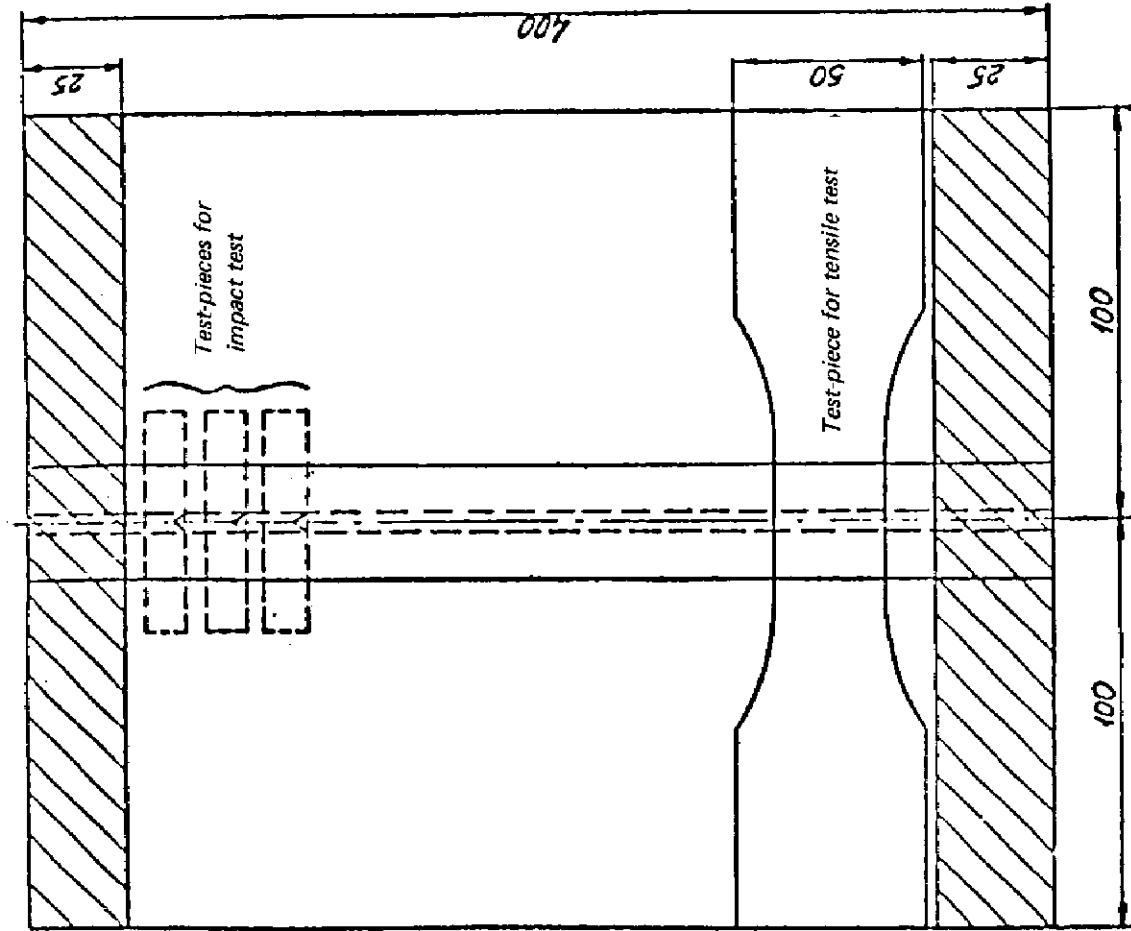


Fig. 1

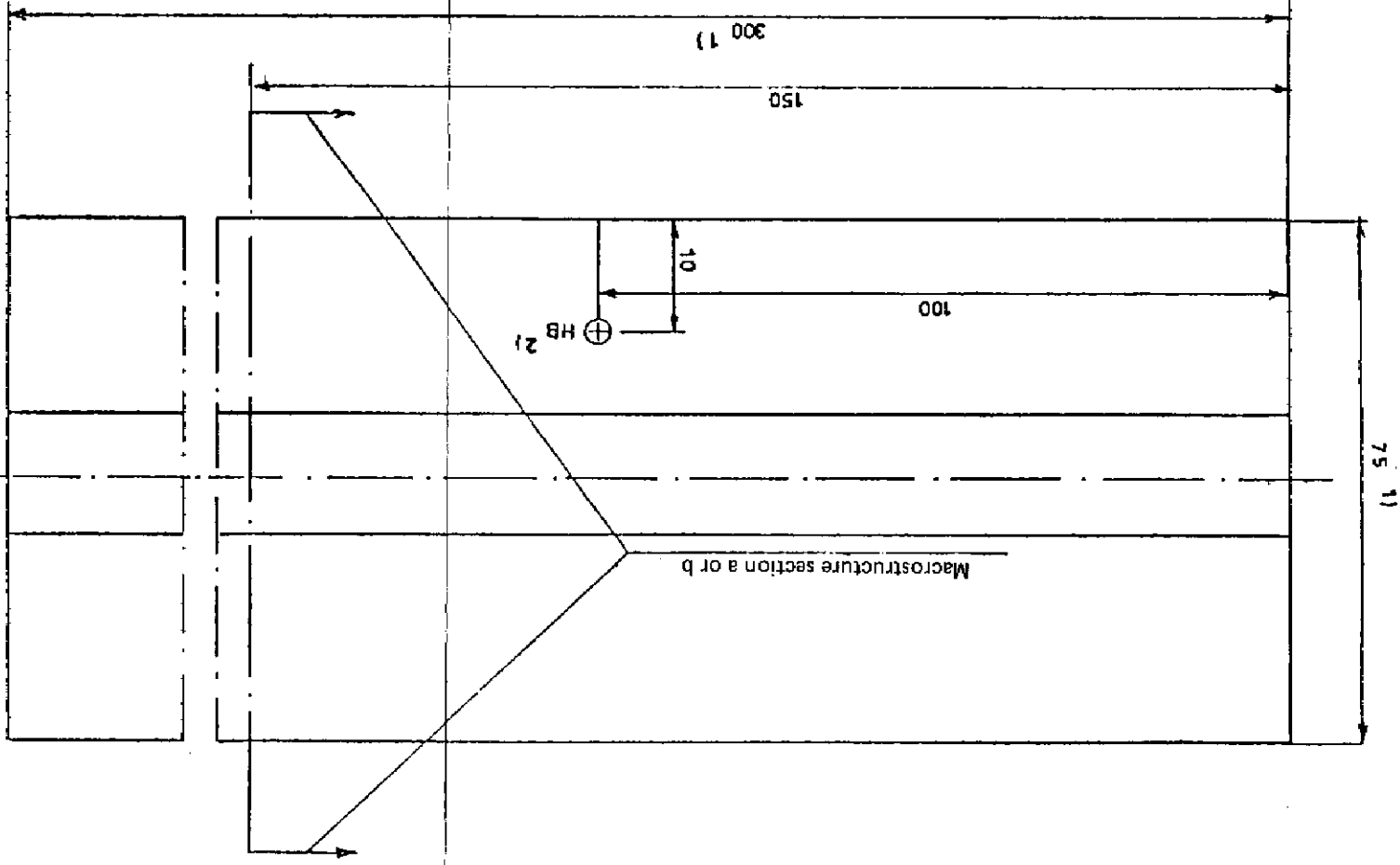
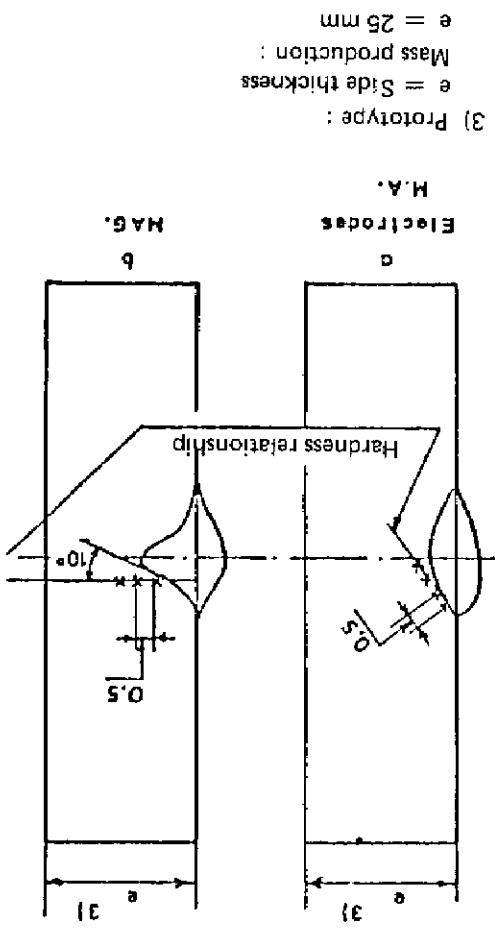


Fig. 2

- 1) For mass production :  
Length = 400 mm.  
Width = 100 mm.
- 2) HB = Brinell hardness test



**4.2.3.5 - Texture test**

The cast-on test bars for the texture test shall be notched on one face only and as near as possible to the points where they were attached to the casting.

The depth of this notch must be less than 1/2 of the thickness of the bar.

**4.2.3.6 - Magnetic particle crack test**

The magnetic particle crack test shall be carried out on the component parts before welding and on the welded zone of parts as ready for delivery.

The surfaces to be monitored must be clean, and clear of any oil, grease or other anomaly that may affect the formation of the spectrum.

**4.2.4 - Performance of the checks and tests**

**4.2.4.1 - Tensile test**

The tensile test-piece and the actual test must conform to the provisions of ISO international standard ISO 82. The length between markers shall be calculated by the formula :

$$L_0 = 5.65 \sqrt{S_0}$$

**4.2.4.2 - Notched bar impact test**

The notched bar impact test-piece and the actual test must conform to the provisions of ISO Recommendation R 148.

**4.2.4.3 - Brinell hardness test**

The Brinell hardness test must be carried out in accordance with ISO Recommendation R 79.

**4.2.4.4 - Vickers hardness test under bead**

The HV 5 Vickers hardness tests shall be carried out at intervals of 0.5 mm, as indicated in figure 2.

The test must be performed in accordance with ISO Recommendation R 81.

**4.2.4.5 - Texture test**

The test bars for the texture test shall be broken with a hammer, the blow being applied on the notched side.

**4.2.4.6 - Magnetic particle crack test**

The magnetic particle crack test, effected on parts previously cleaned and either shot-blasted or sand-blasted correctly shall be carried out in accordance with Appendix 1 (sheets 1 and 2) which gives the heavily stressed areas where no defect can be allowed, and stressed areas where the presence of lines not exceeding 20 mm can be tolerated. The detection process based on magnetic ink shall be used.

The test shall be carried out in such a way that all the weld beads and their surrounds are checked.

Procedures for the magnetisation and demagnetisation test must first have been approved by the purchasing Railway.

Magnetization by current flow through the casting is not authorised ; its use shall result in rejection.

**4.2.4.7 - Radiographic examination**

The radiographic examination shall be carried out in the heavily stressed areas indicated in Appendix 2 and over the whole length of the welded areas. The image quality index shall be assessed by means of one of the wire or step indicators defined in ISO Recommendation R 1027.

All the parts on which a radiographic test is performed must carry a mark clearly visible on the film.

Parts where this examination reveals defects that are not permitted in Paragraph 2.2.1.2, can be cut up, at the manufacturer's request, to determine the seriousness of the defects with accuracy.

**4.2.4.8 - Dimensional check**

Checking of the dimensions shall be carried out by any suitable means, especially by means of gauges supplied by the manufacturer and conforming to those defined by the UIC.

The gauges must be periodically checked by an approved laboratory.

**4.3. - Conclusion of the inspection**

Any result of a texture test which is not satisfactory, also any appearance or dimensional defects shall lead to rejection of the part.

Any result of chemical analysis, tensile, impact, Brinell hardness or Vickers hardness test under bead which is not satisfactory, shall lead to rejection of the corresponding batch.

Further tests may only be carried out, at the request of the manufacturer, with or without improvement treatment, with the prior agreement of the purchasing Railway.

Any result of a magnetic particle crack test which is not satisfactory, shall lead to rejection of the part or of the casting itself if the anomaly involves the welded area.

A systematic examination of the area in which the anomaly occurred shall then be carried out on all component parts or castings forming the batch. Any result which is not satisfactory shall lead to rejection of the corresponding casting.

Any radiographic examination result which is not satisfactory shall lead to rejection of the corresponding casting, followed by a systematic examination of the area involved on all the castings of the four batches concerned.

Any result of mechanical tests on models which is not satisfactory shall lead to the immediate interruption of manufacture. Once his welding procedure has been put right, the supplier must submit afresh to the process set out in 3.2.1 and 3.2.2.

## 5 - DELIVERY

### 5.1 - Protection against oxidation

After checking and stamping by the representative of the purchasing Railway, the parts shall receive, before storage or despatch, a coating approved by this Railway.

### 5.2 - Guarantee

The coupler heads shall be guaranteed for a period of 5 (five) years against any manufacturing defect. This period shall run with effect from the end of the month marked on the parts.

If the coupler heads are fitted to new stock, the delivery date of the vehicles equipped with them shall be considered as the starting period of the guarantee. If the coupler heads are fitted to stock in use at the time of reconversion to automatic coupling, the fitting-out date, which shall be notified to the supplier, shall be considered as the starting period of the guarantee.

Coupler heads which, during the guarantee period, show defects rendering them unsuitable for service or reducing their service life, shall be rejected.

Before being finally rejected, however, the defective coupler heads may be subjected to a check examination between the purchasing Railway and the supplier, if the latter so requests.

When the check examination confirms that the defects are truly imputable to manufacture, the defective coupler heads shall be finally rejected.

In cases where the results of the check examination do not enable an agreement to be reached between the purchasing Railway and the supplier, recourse shall be had to experts approved by both parties to settle the dispute. The costs shall then be borne by the party finally held responsible.

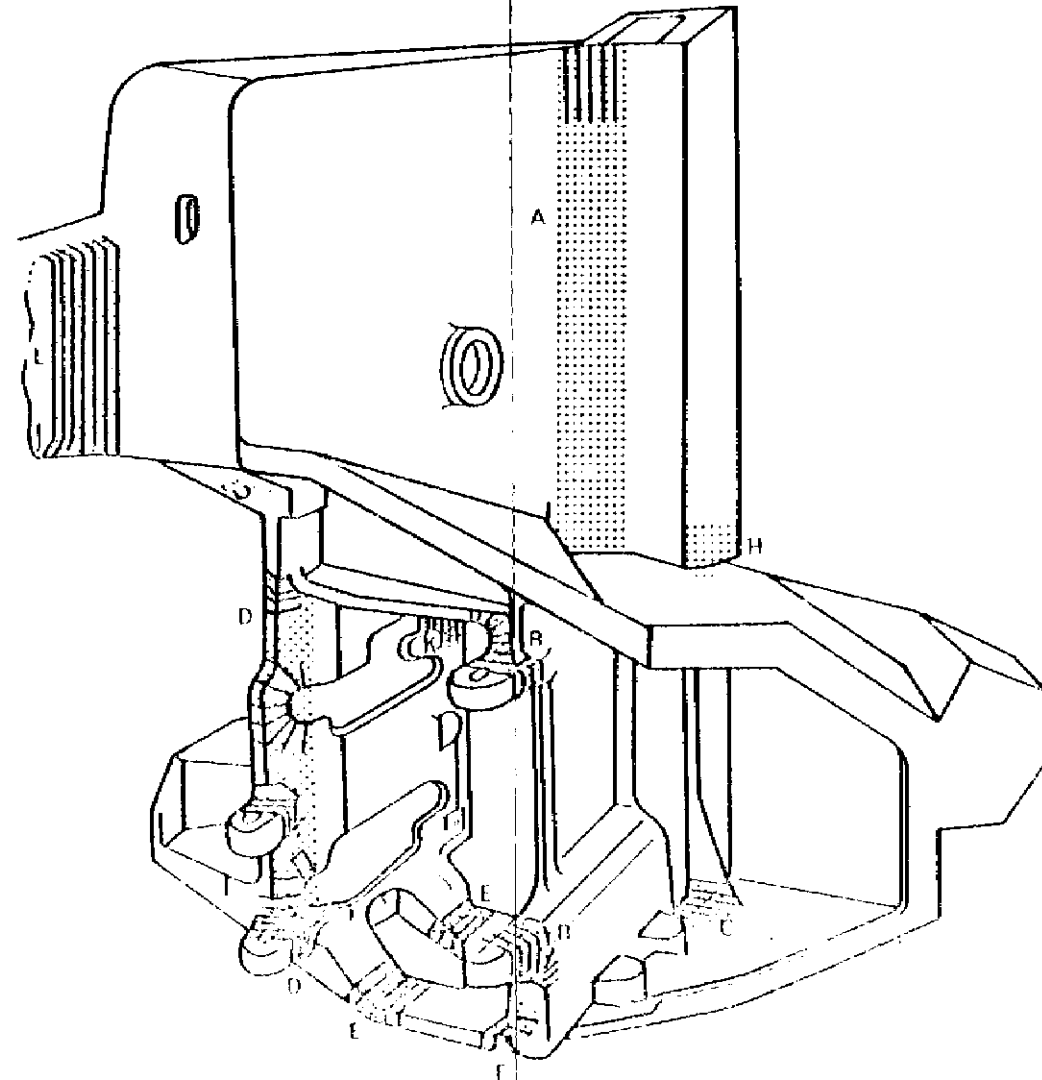
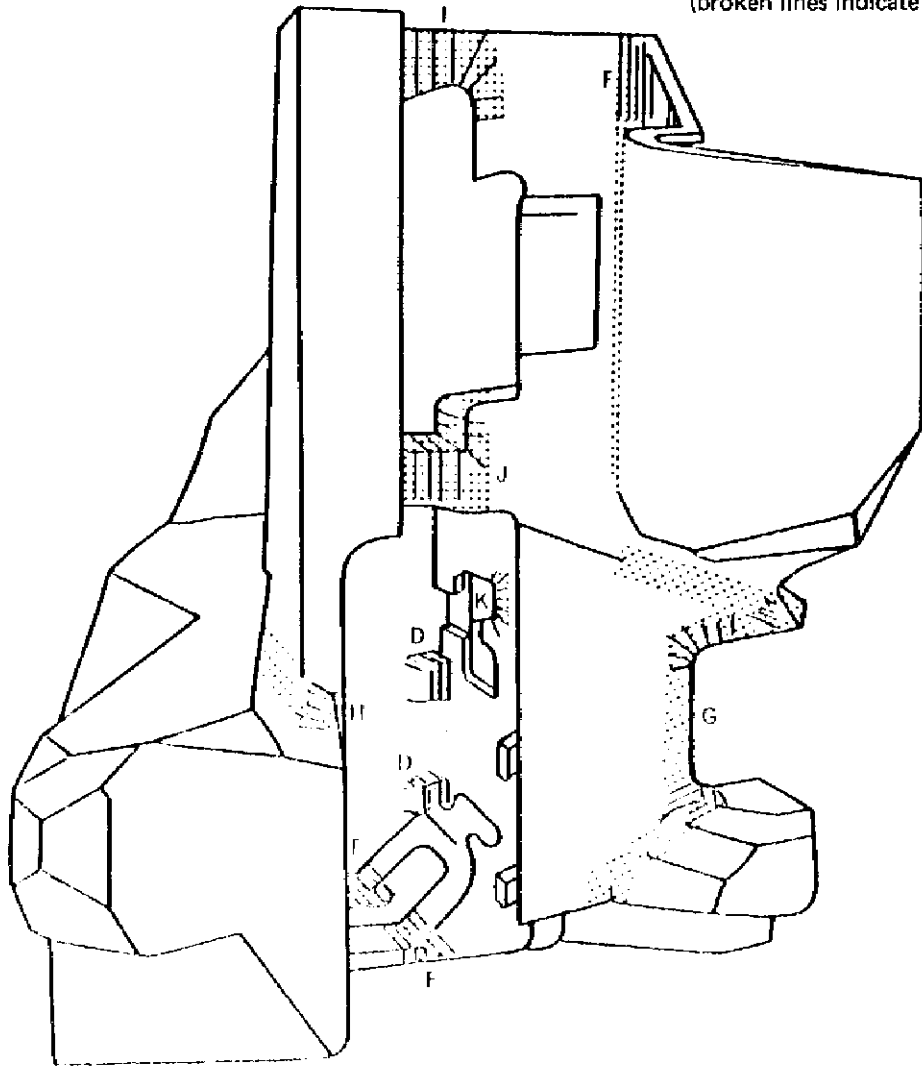
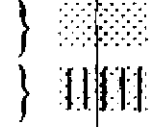
When more than 5% of parts from the same cast show defects resulting in rejection, the purchasing Railway may reject the whole of the cast.

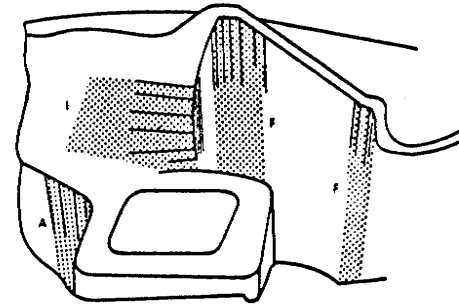
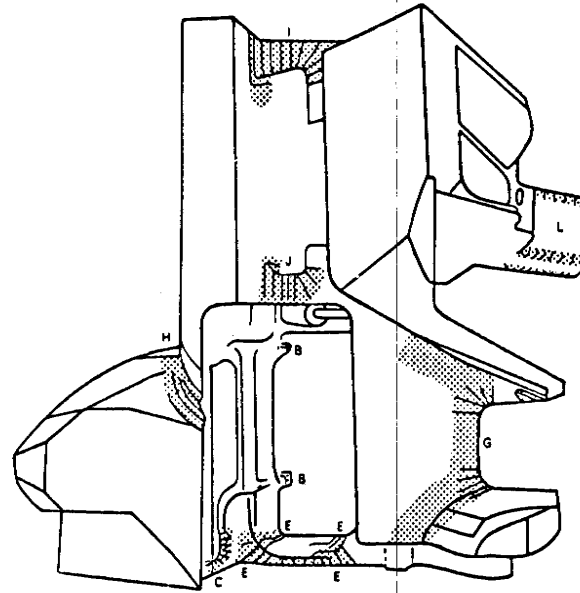
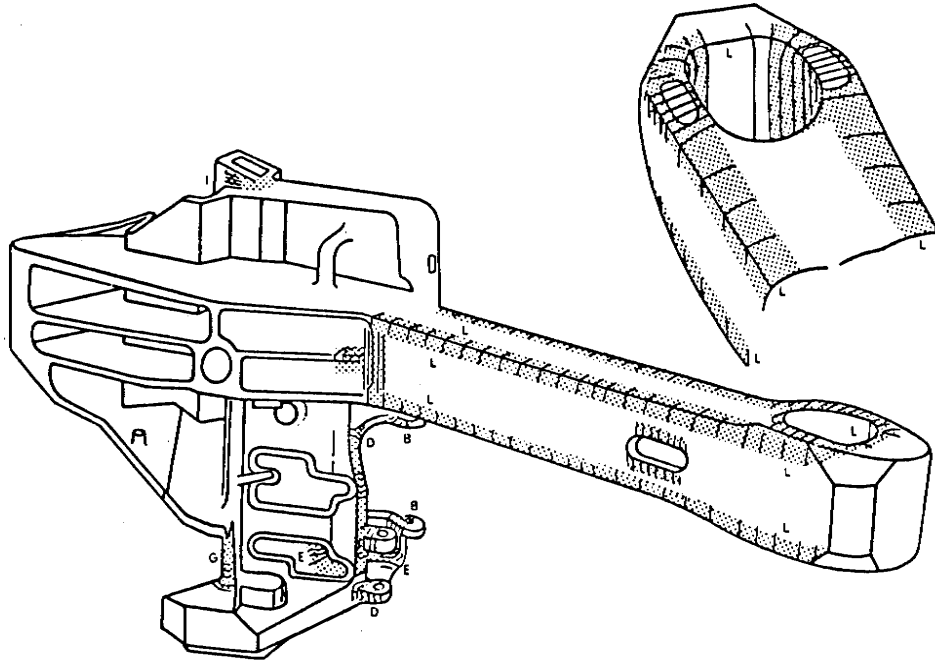
Rejected coupler heads shall be made available to the supplier, with a view to their replacement or their reimbursement at their value, in new condition, at the time of withdrawal.

### AUTOMATIC COUPLER HEAD

#### Magnetic particle crack test

- on «stressed» areas where the presence of lines not exceeding 20 mm may be tolerated
- on «heavily-stressed» edges where no defect can be permitted (broken lines indicate the unfavourable direction)



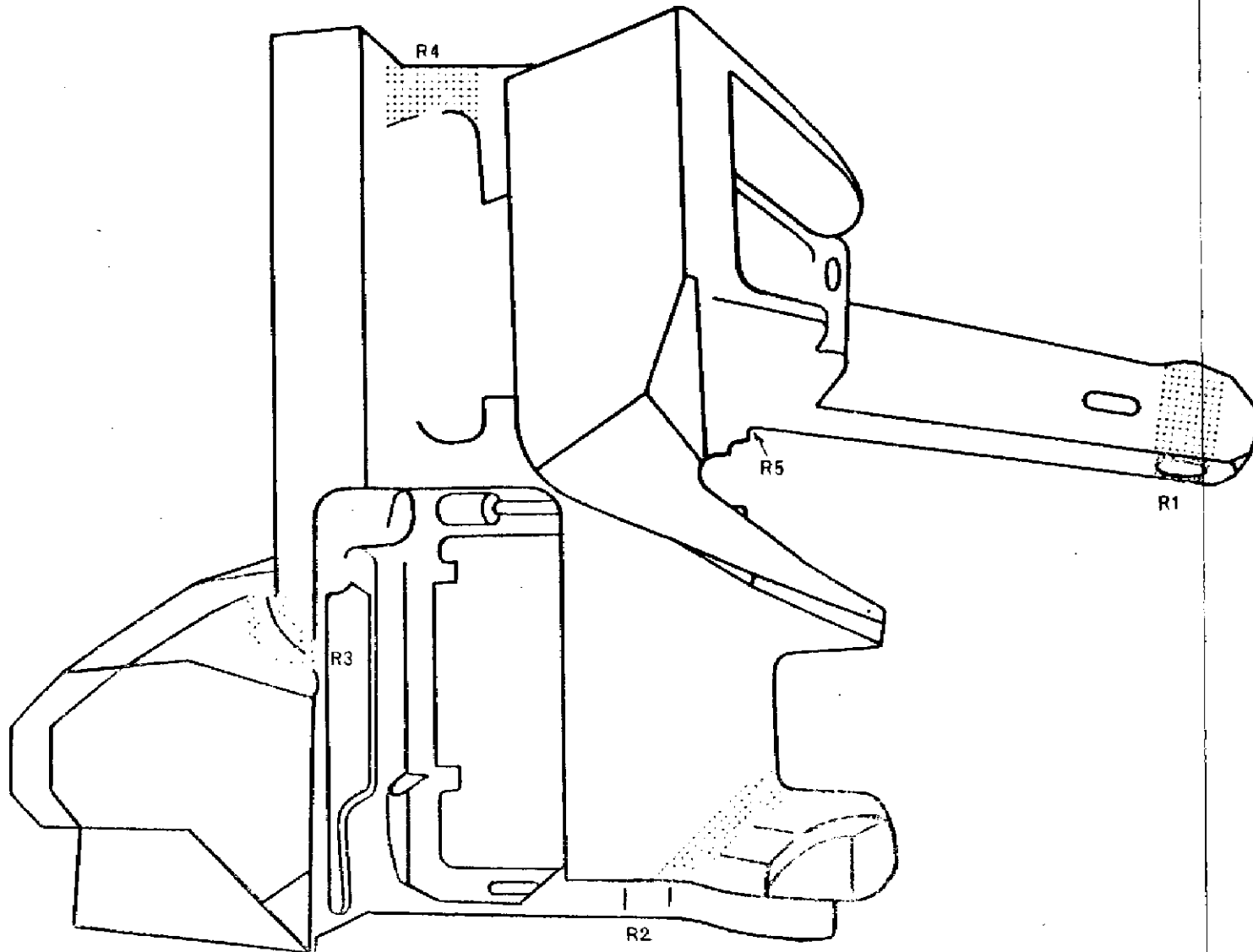




### AUTOMATIC COUPLER HEADS

#### Radiographic examination

Heavily-stressed areas :



R5 : Head-arm connection

## WELDABILITY TESTS FOR ACCEPTANCE OF THE STANDARD-GRADE STEELS

The standard grade of steel proposed must be subjected to the following weldability tests before acceptance.

### 1 - CHARACTERISTICS TO BE OBTAINED

Grade	Type of test	Tests	Results to be obtained	Fig.
Steel A	Weldability test at high temperature	HV 5 hardness test in the ZAT (1) KV impact test at -30° C in the ZAT (2) (KV-shape notch)	≥ 90% HV 5 of base metal KV ≥ 27 J	1 1
Steels B and C (3)	Test at low temperature	KV impact test at -30° C in the ZAT (2) (KV-shape notch) HV 5 hardness test under bead	KV ≥ 27 J HV 5 ≤ 450	1 2

(1) ZAT = Heat-affected zone.

(2) Average for the 3 samples : no individual value must be less than 20 J.

(3) Tests with steel C are carried out under the conditions of preheating as provided for during acceptance.

## 2 - REMOVAL AND PREPARATION OF THE SAMPLES AND TEST PIECES

### 2.1 - Removal

The representative of the purchasing Railway shall arrange for samples measuring 75 x 300 mm to be removed from the arm of the prototype coupler bodies.

The thickness of these samples shall be the same as that of the side of the coupler head arm.

### 2.2 - Preparation of the samples

#### 2.2.1 - Weldability test at high temperature (Steel A)

HV 5 hardness and notched-bar impact tests.

Two samples shall be prepared and welded as indicated in figure 1.

All the weld-bead runs shall be deposited with the same net welding energy of  $E = 3 \pm 10 \% \text{ kJ/mm}$  where

$$E = 0.85 \times \frac{\text{arc voltage (Volt)} \times \text{welding current (Amp)}}{100 \times \text{welding speed (mm/sec)}}$$

**2.2.2 - Weldability test at low temperature (Steels B and C)**

**2.2.2.1 - Notched-bar impact test**

Two samples shall be prepared and welded as indicated in figure 1.

All the weld-bead runs shall be deposited with the same net welding energy of  $E = 1.5 \pm 15\%$  kJ/mm.

The temperature between runs shall not exceed  $150^{\circ}\text{C}$ .

**2.2.2.2 - Vickers hardness test under bead**

A weld bead shall be deposited on a sample in a single run (figure 2).

The net welding energy to be used shall be  $E = 1.5 \pm 15\%$  kJ/mm.

**3 - PERFORMANCE OF THE TESTS**

**3.1 - Notched bar impact test**

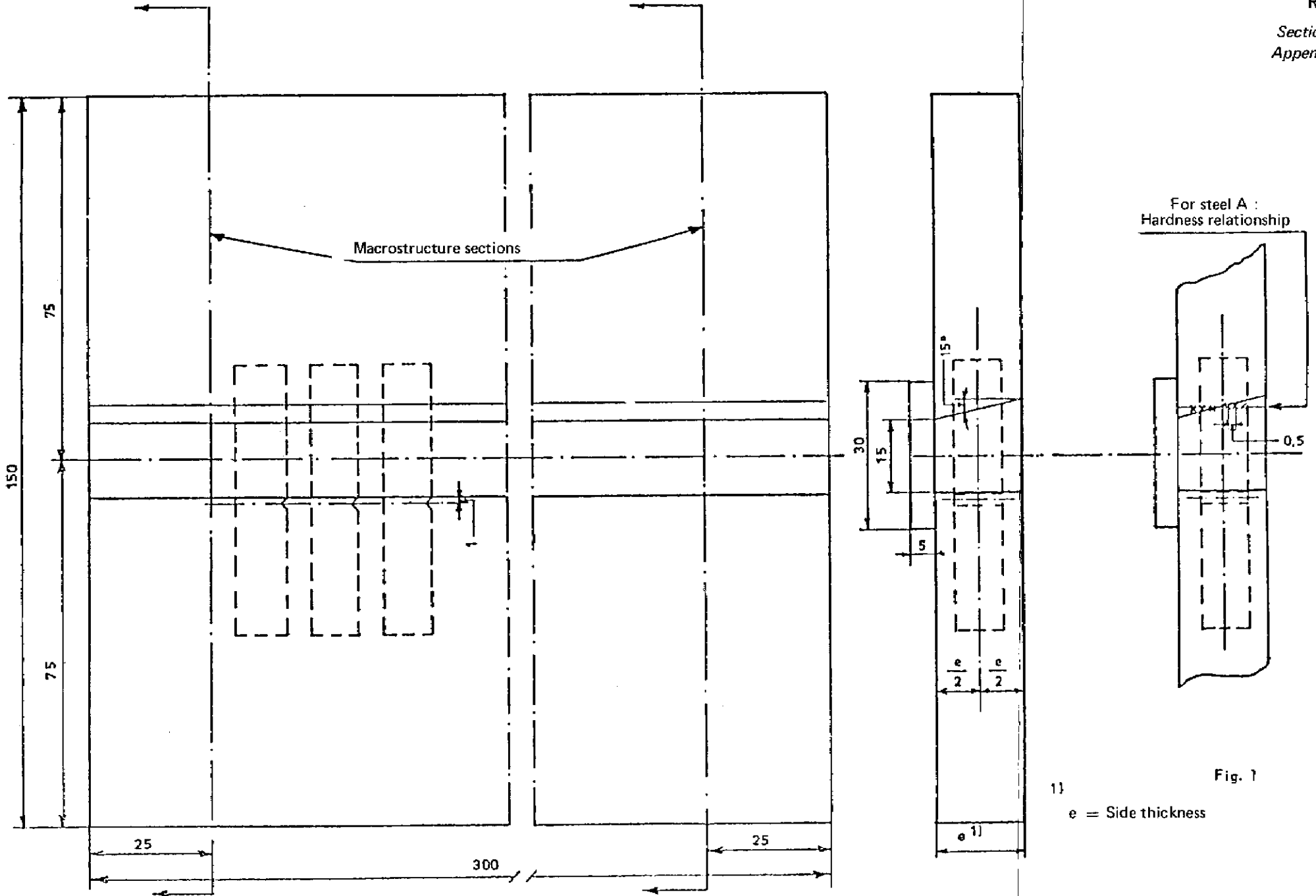
The position of the notch on the impact test pieces shall be determined by macro-etching (Fig. 1).

The impact test-piece and the organisation of the test shall comply with the provisions of ISO Recommendation R 148.

**3.2 - Vickers hardness test**

The HV 5 hardness test shall be carried out at intervals of 0.5 mm in straight line, as indicated in figure 1 for the test at high temperature and as indicated in figure 2 for the test at low temperature.

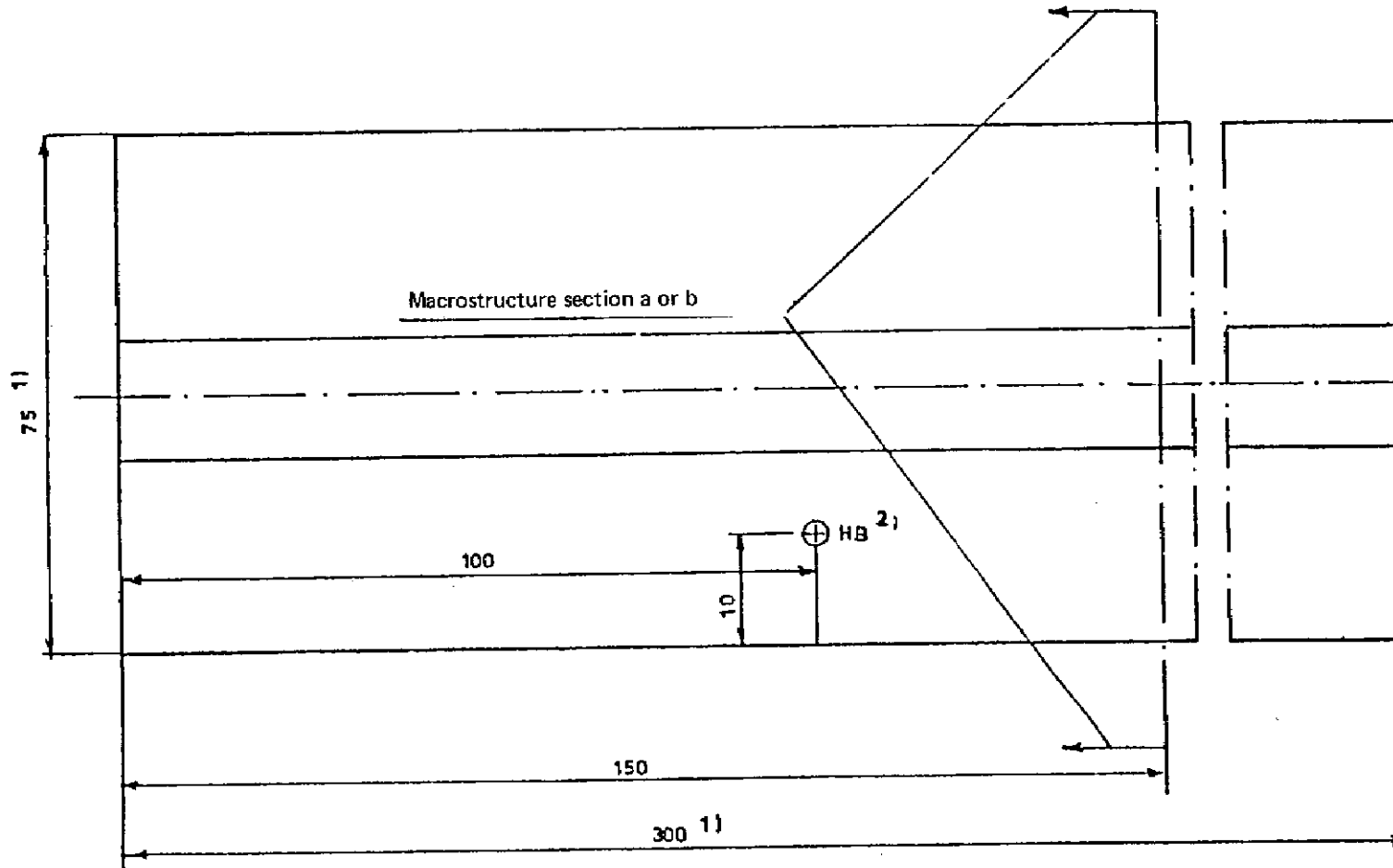
The test must be conducted in conformity with ISO Recommendation R 81.



1)

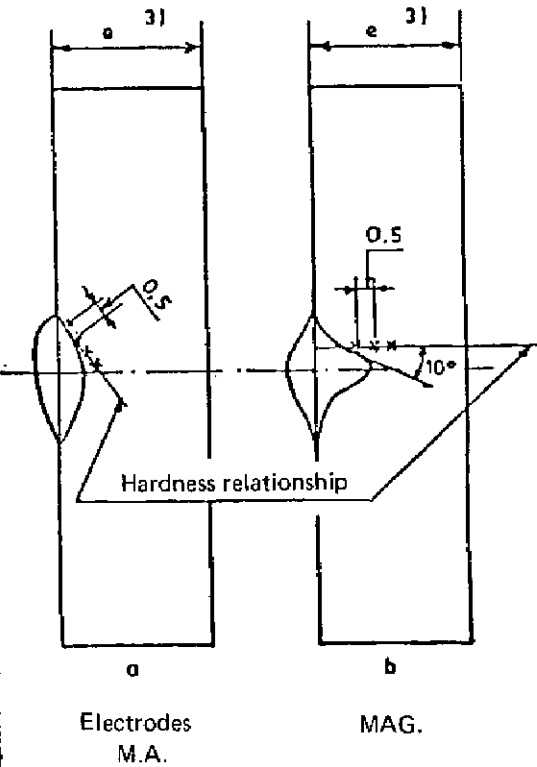
e = Side thickness

Fig. 1



- 1) For mass production  
Length = 400 mm  
Width = 100 mm
- 2) HB = Brinell hardness measurement

Fig. 2



- 3) Prototype :  
e = Side thickness  
Mass production :  
e = 25 mm

- SECTION 3 -

SPHEROIDAL GRAPHITE

CAST-IRON COUPLER HEADS

---

*Section 3*

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#### 1 - PURPOSE

1.1 This specification governs the supply of heads for UIC-type automatic couplers with centre buffer, for tractive and trailing stock.

The provisions set out below apply to spheroidal-graphite cast-iron automatic-coupler heads.

All relevant instructions for implementing the contract, especially those concerning the application of the following paragraphs in this specification :

- 2.2.1.2
- 2.2.2 ; 2.2.3
- 3.2.5
- 4.2 ; 4.2.3.3

must be indicated in the order and its appended documents.

#### 1.2 - List of reference documents

Reference is made, in this specification, to the following documents :

- UIC leaflets : 829-3, 840-2
- international standards : ISO 82, ISO 1083
- ISO recommendations : ISO/R 79, ISO/R 148,  
ISO/R 81,

- ISO Recommendation : ISO/R 404, ISO/R 1027
- ASTM E 71-64.

## 2 - CHARACTERISTICS

### 2.1 - Materials

#### 2.1.1 - Standard grade

The coupler heads shall be made of spheroidal graphite cast iron.

#### 2.1.2 - Chemical properties

The chemical composition is left to the choice of the supplier, but must be indicated in the manufacturing programme. It must enable the mechanical properties stipulated in 2.1.3 to be complied with and guarantee the building-up of parts by welding.

#### 2.1.3 - Mechanical properties

- Tensile strength  $\geq 600$  N/mm<sup>2</sup>
- 0.2 % proof stress  $\geq 450$  N/mm<sup>2</sup>
- Elongation percentage after fracture  $\geq 17$  %

### Section 3

Notched bar impact at - 50° C on V-shape notch test pieces : the average value (of three tests) of the fracture energy must be higher than 20 Joules, each individual value not being less than 2/3 of the value laid down.

#### Brinell hardness :

The hardnesses recorded on parts in the same batch, ball-tested in the same place, must not show any differences of more than 40 Brinell units.

The hardness recorded on the sample bar (see § 3.2.3) must fall within the range of values for hardnesses obtained with parts from the same batch.

### 2.2. - Parts

#### 2.2.1 - Physical properties

##### 2.2.1.1 - Appearance

The coupler heads must be carefully cleaned, fettled and free from loose oxide or scale. All risers, gates, feeder heads and vents must be carefully removed. These different operations must be carried out in a way that ensures a satisfactory appearance of the parts and does not impede their functioning.

##### 2.2.1.2 - Soundness

The coupler heads must be sound throughout and not show any defect that may be detrimental to their use.



The magnetic particle crack test must not reveal any trace of defect in the heavily-stressed areas (1). Cracks of less than 20 mm shall be permitted in the other areas examined.

No residual magnetism, likely to bring about the persistent presence of magnetic dust detrimental to satisfactory behaviour in service may exist in the parts after examination.

The films obtained from the radiographic examination of heavily stressed areas (2) must not show any defects more serious than those shown on the films in class 3 of standard ASTM E 71-64 to which the order or its appended documents must refer, for defects in types A, B and C; no defect in types D, E, F and G may be allowed.

**2.2.1.3 - Structure**

The micro-structure examination must reveal the graphite in its spheroidal state.

**2.2.2 - Geometrical properties**

The shape, dimensions and tolerances allowed on the dimensions must be consistent with those laid down in the order or its appended documents; failing any indications on these documents, the tolerances to be complied with are those given in UIC Leaflet 840-2.

(1) See Appendix 1 (Sheets 1 and 2)

(2) See Appendix 2.

**2.2.3 - Marks**

Each part leaving the foundry must bear, in the position indicated in the order or its appended documents, the following embossed manufacturing marks :

- the mark of the supplier,
- the letter S,
- the reference number of the part,
- the identification mark,
- the date of manufacture (month and last two figures of the year of manufacture).

**3 - MANUFACTURE**

**3.1 - Preparation of the cast iron**

The supplier shall be free to select the method of preparation, and the various possible treatments, using his own technique.

**3.2 - Manufacture of the parts**

The manufacture of the coupler heads may only be entrusted to suppliers having received the prior approval of the purchasing Railway.

### 3.2.1 - Manufacturing and inspection programme

Before the start of manufacture, the supplier must indicate the chemical composition of the cast iron he will be using as well as the permitted limits, on product, for each of the parts, including residuals, together with the preheating thermal cycle for which provision may have to be made during the welding phase.

The Supplier must also submit to the purchasing Railway, for approval, a manufacturing programme specifying the methods employed particularly as regards casting techniques (sizes of gates, risers, feeder heads, air vents, denseners, etc.) and the type of heat treatment (maximum temperature, the period during which the temperature is maintained, cooling conditions) which he intends to use.

In addition, the supplier must submit a programme of the inspections envisaged to the purchasing Railway for approval.

Any alteration to this programme must be submitted to the purchasing Railway for approval.

### 3.2.2 - Prototypes

Before commencing mass production, the supplier must manufacture three prototype heads in strict conformity with the approved manufacturing programme.

This operation must be monitored and checked by the purchasing Railway's representative, who shall subsequently carry out, on the manufacturer's premises or in his laboratories (magnetic-particle crack testing, radiography, sectioning of certain areas, etc.) which he considers necessary to ensure that the manufacturing programme followed enables sound parts to be obtained.

He shall also check the obligatory chemical, mechanical and geometrical properties defined in paragraph 2, according to the process laid down for mass production.

Only when all the examinations and tests have given satisfactory results shall the purchasing Railway authorise mass production.

### 3.2.3 - Mass production

The mass production process must be strictly identical to that approved after tests on prototypes.

Any alteration to the process shall result in the procedure described in 3.2.1 and 3.2.2 being set in motion.

Each coupler head leaving the foundry must have at least two cast-on test bars of about 15 mm x 20 mm in section, still attached for purposes of the texture test.

Each casting shall be represented by at least three test blocks, of type II b as defined in article 5 of International Standard ISO/1083 for the tensile and notched-bar impact tests.

These test blocks shall be marked and cast at the same time as the castings, with metal from the same cast, in a mould formed in the same way as that of the parts. They shall undergo the same heat cycle as the parts and shall be placed in the furnace adjacent to them.

The representative of the purchasing Railway shall have the possibility to check that the metal of the castings is identical to that of the test blocks representing the cast, by comparing the analysis of these blocks with that effected on a test bar for the texture test, taken from a casting chosen at random in the batch.

#### 3.2.4 - Heat treatment

The coupler heads shall undergo heat treatment in accordance with the conditions prescribed in the manufacturing programme.

#### 3.2.5 - Machining

Machining shall be carried out in accordance with the indications given in order or its appended documents.

#### 3.2.6 - Repairs

Minor defects may be repaired by welding, after approval of the process by the representative of the purchasing Railway.

Any repair intended to hide a defect is strictly forbidden, and shall result in rejection of the entire batch.

## 4 - INSPECTION

### 4.1. - Inspection of manufacture

The representative of the purchasing Railway must be able to carry out random checks on any phase in the manufacture. He shall examine the prototypes after stripping from the mould, before removal of the gates, risers and feeder heads, to check that the manufacturing programme has been strictly observed.

He may carry out the same checks on mass-produced coupler heads, as he thinks fit.

He must have access to all the documents prescribed by the inspection programme, in particular to the charts plotted by correctly-calibrated recording pyrometers, in order to check the characteristics of the heat treatments.

Before presentation, the supplier shall carry out, under his own responsibility, a magnetic-particle crack test on each coupler head and a Brinell hardness test on at least 10 % of the heads in each batch.

4.2 - Inspection of the parts

Inspection of the parts shall be carried out by the representative appointed by the purchasing Railway. However, if the order or its appended documents so stipulate, delivery of the coupler heads may simply be accompanied by an inspection certificate for the products, issued by the factory, as defined in paragraph 4.1.3 of ISO Recommendation R 404.

4.2.1 - Presentation

4.2.1.1 - Condition of the parts on presentation

The coupler heads shall be presented in delivery condition, before protective treatment.

4.2.1.2 - Grouping into batches

The coupler heads shall be presented grouped into batches.

Each batch shall consist exclusively of parts from the same cast, which have undergone the same heat treatment if necessary.

In the event of a second annealing requiring to be carried out, the batch shall consist of parts from the same cast and emanating from a charge having undergone the same heat treatment. The size of the batch may not exceed 20 tonnes.

4.2.1.3 - Advice of presentation

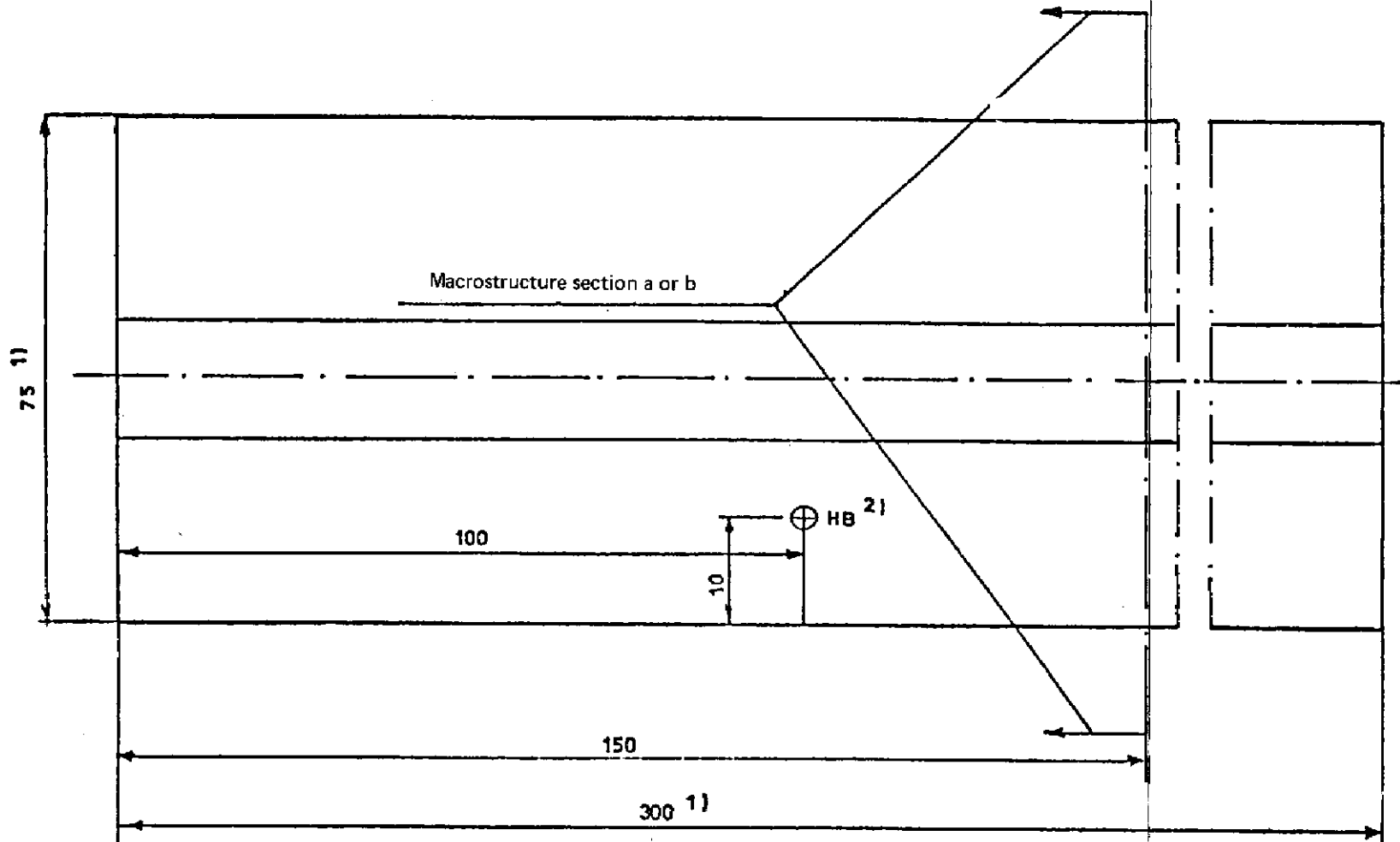
The date of presentation must be advised to the representative of the purchasing Railway by written note, signed by the manager of the producing factory or his authorised representative. This note must indicate the number of parts presented in each cast, also the references of the order covering them. At the time of presentation, a certificate giving the complete analysis of the casting, including residual traces, and stating that the prescribed conditions of manufacture have been complied with, and that the magnetic crack particle test and the Brinell hardness test have been carried out and given satisfactory results, shall be handed to the representative of the purchasing Railway.

4.2.2 - Nature and proportion of the checks and tests

The coupler heads shall be subjected to the following checks and tests :

Nature of the checks and tests	Number of checks or tests per batch
- Chemical composition check (1)	1
- Tensile test	1
- KV impact test at -50° C	1 (2)
- Brinell hardness test	- on 10 % of the parts (3) - on the test block
- Structure test	on 10 % of the parts
- Magnetic particle crack test	on 10 % of the parts (3)
- Radiographic test	1 per 4 batches
- Appearance and dimensional checks	as the purchasing Railway thinks fit.

- (1) The chemical analysis, including residual traces, must be consistent with the chemical analysis presented during acceptance.
- (2) Each test includes a series of 3 test-pieces.
- (3) Before presentation, at least 10 % of the parts must have undergone, under the responsibility of the supplier, the Brinell hardness test, and all parts the magnetic-particle crack test.



1) For mass production  
Length = 400 mm.  
Width = 100 mm.

Fig: 1

2) HB = Brinell hardness measurement

**4.2.3 - Removal and preparation of the samples and test-pieces**

The representative of the purchasing Railway shall remove, from each batch presented, the test blocks and castings which he intends for the tests, and shall mark them indelibly.

The cutting-up of the samples and the machining of the test pieces must be carried out in the cold condition, and conducted with care, so that no appreciable heating of the metal should occur.

The samples shall be cut up in such a way that the metal left over can be used for additional tests.

The samples and test-pieces must retain the stamps of the representative of the purchasing Railway ; any transfer of marks may only be effected by him.

**4.2.3.1 - Chemical analysis**

The sample for chemical analysis shall consist of a section of about 10 mm in thickness from the test block.

**4.2.3.2 - Tensile and impact tests**

The test pieces for the tensile and impact tests shall be removed from the axis of the test block.

**4.2.3.3 - Brinell hardness test**

The Brinell hardness test shall be carried out on the parts in the position indicated in the order or its appended documents, and on a test block as indicated in figure 1.

**4.2.3.4 - Structure test**

The samples for examination of the structure shall be removed from the cast-iron bars attached to the parts.

**4.2.3.5 - Radiographic examination**

The radiographic examination shall be carried out on a part chosen by the representative of the purchasing Railway.

**4.2.4 - Performance of the checks and tests**

**4.2.4.1 - Tensile test**

The tensile test-piece and the actual test must conform to the provisions of international Standard ISO 82. The length between markers shall be calculated by the formula :

$$L_0 = 5.65 \sqrt{S_0}$$

**4.2.4.2 - Notched-bar impact test**

The notched bar impact test-piece and the actual test must conform to the provisions of ISO Recommendation R 148.

**4.2.4.3 - Brinell hardness test**

The Brinell hardness test must be carried out in accordance with ISO Recommendation R 79.

**4.2.4.4 - Structure**

The micro-structure test shall be carried out at a magnification of 100.

**4.2.4.5 - Magnetic-particle crack test**

The magnetic particle crack test, effected on parts previously cleaned and either shot-blasted or sand-blasted correctly, shall be carried out in accordance with Appendix 1 (Sheets 1 and 2), which gives the heavily-stressed areas where no defects can be allowed, and stressed areas where the presence of lines not exceeding 20 mm can be tolerated. The detection process based on magnetic ink shall be used.

Procedures for the magnetization and demagnetization test must first have been approved by the purchasing Railway.

Magnetization by current flow through the casting is not authorized ; its use shall result in rejection.

**4.2.4.6 - Radiographic examination**

The radiographic examination shall be carried out in the heavily-stressed areas indicated in Appendix 2 ; the image quality index shall be assessed by means of one of the wire or step indicators defined by the ISO Recommendation R 1027.

All the parts on which a radiographic test is carried out must carry a mark clearly visible on the film.

Parts where this examination shows defects that are not allowed in 2.2.1.2 can be cut up, at the manufacturer's request, in order to determine the seriousness of the defects with accuracy.

**4.2.4.7 - Checking of the dimensions**

Checking of the dimensions shall be carried out by any suitable means, especially by means of gauges supplied by the manufacturer and consistent with those defined by the UIC.

The gauges must be periodically checked by an approved laboratory.

**4.3 - Conclusion of the inspections**

Any result of structure test that is not satisfactory, and any appearance or dimensional defects shall lead to rejection of the corresponding part.

Any result of chemical analysis as defined in the manufacturing programme and any tensile, notched-bar impact or hardness test which is not satisfactory, shall lead to rejection of the corresponding batch.

Further tests may only be carried out, at the request of the manufacturer, with or without improvement treatment, with the prior agreement of the purchasing Railway.

Any result of a magnetic particle crack test, which is not satisfactory, shall lead to rejection of the part, followed by a systematic examination of the area involved on all the parts of the batch ; any result which is not satisfactory shall lead to rejection of the corresponding part.

Any result of a radiographic examination which is not satisfactory shall lead to rejection of the part, followed by a systematic examination of the area involved on all the parts of the four batches concerned.

## 5 - DELIVERY

### 5.1 - Protection against oxidation

After checking and stamping of the representative of the purchasing Railway, the parts shall receive, before storage or despatch, a coating approved by this Railway.

### 5.2 - Guarantee

The coupler heads shall be guaranteed for a period of 5 (five) years against any manufacturing defect. This period shall run with effect from the end of the month marked on the parts.

If the coupler heads are fitted to new stock, the delivery date for the vehicles equipped with them shall be considered as the starting period of the guarantee. If the coupler heads are fitted to stock in use at the time of re-conversion to automatic coupling, the fitting-out date, which shall be notified to the supplier, shall be considered as the starting period of the guarantee.

Coupler heads which, during the guarantee period, show defects rendering them unsuitable for service or reducing their service life, shall be rejected.

Before being finally rejected, however, the defective coupler heads may be subjected to a check examination between the purchasing Railway and the supplier, if the latter so requests.

When the check examination does confirm that the defects are imputable to manufacture, the defective coupler heads shall be definitely rejected.

In cases where the results of the check examination do not enable an agreement to be reached between the purchasing Railway and the supplier, recourse shall be had to experts approved by both parties to settle the dispute. The costs shall then be borne by the party finally held responsible.

When more than 5 % of parts from the same cast show defects resulting in rejection, the purchasing Railway may reject the whole of the cast.

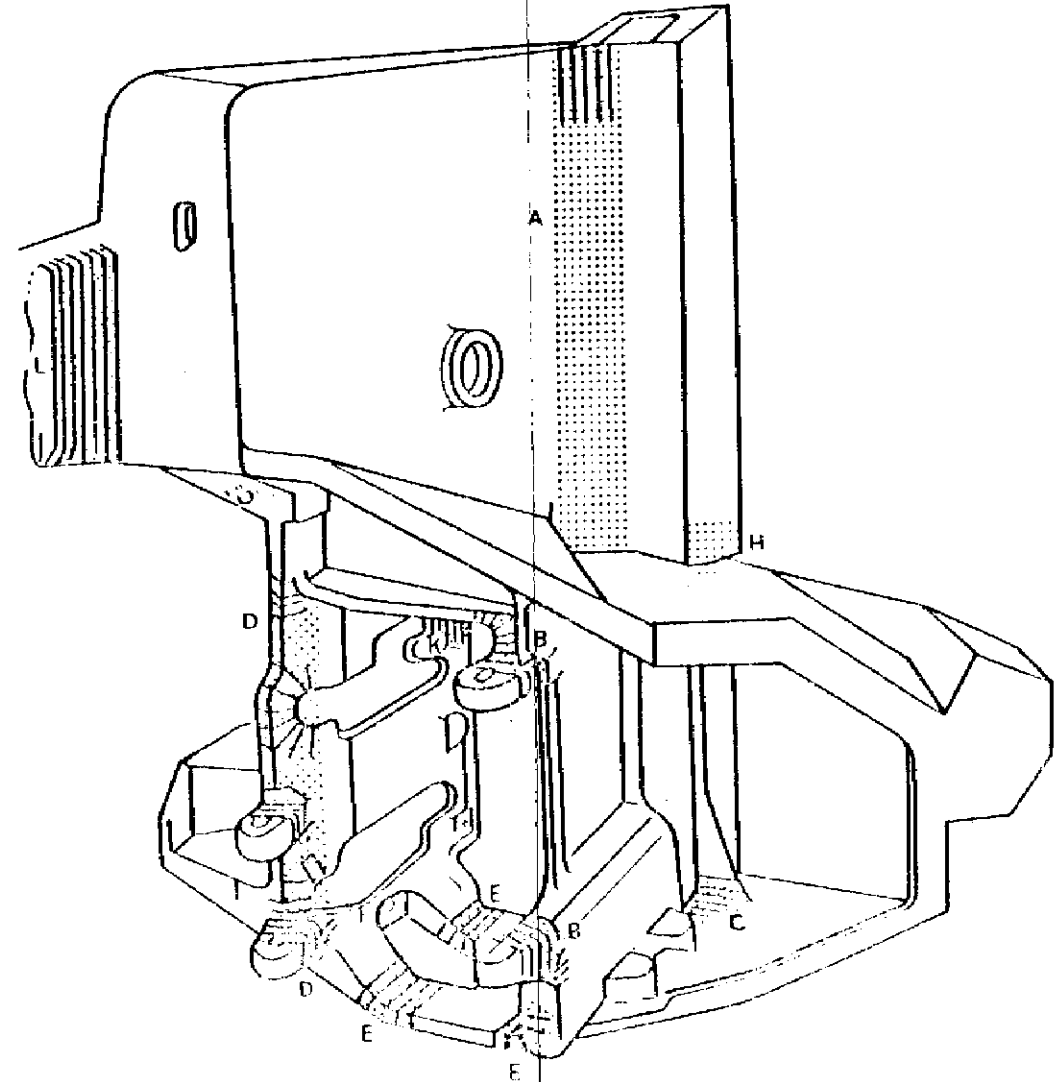
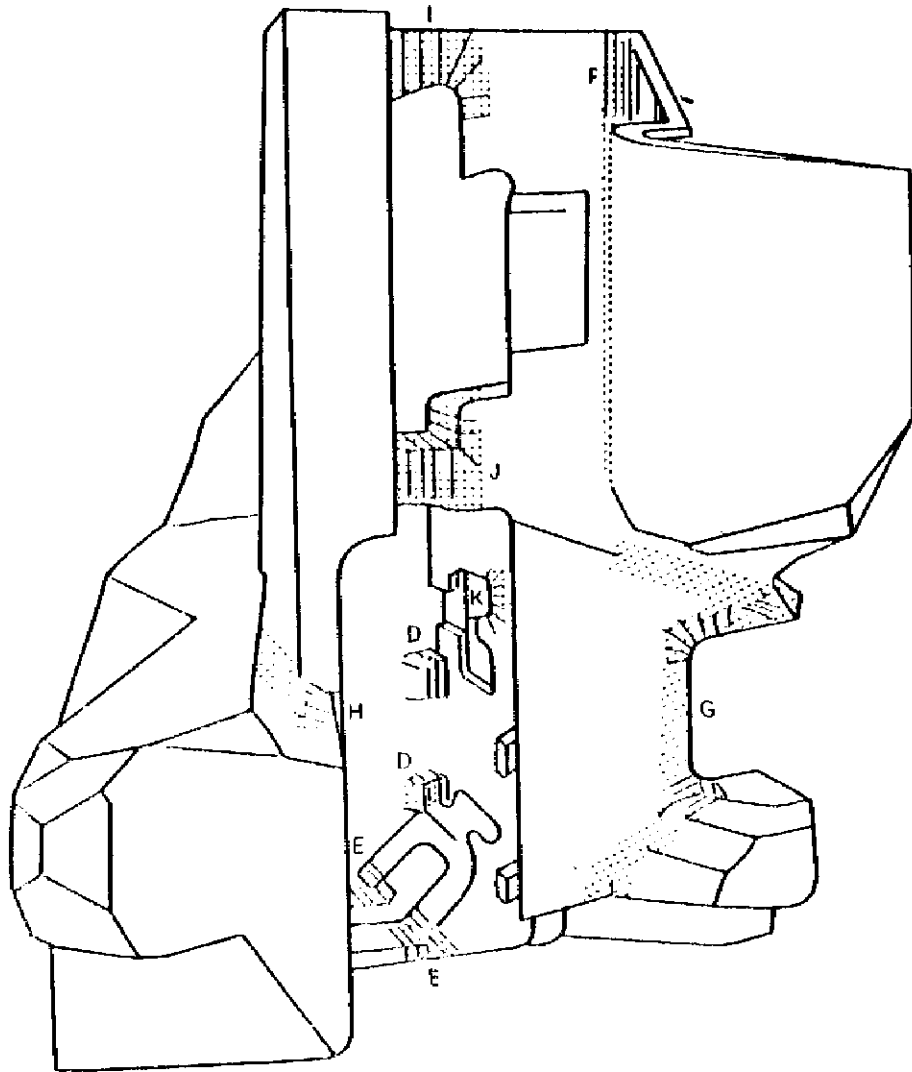
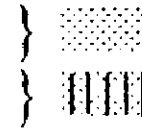
Rejected coupler heads shall be made available to the supplier, with a view to their replacement on their reimbursement at their value, in new condition, at the time of withdrawal.

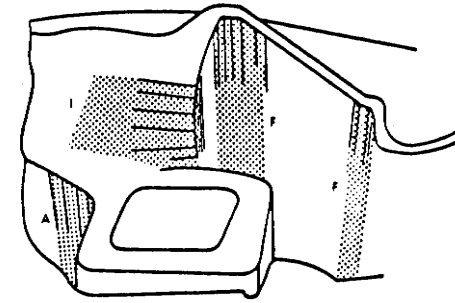
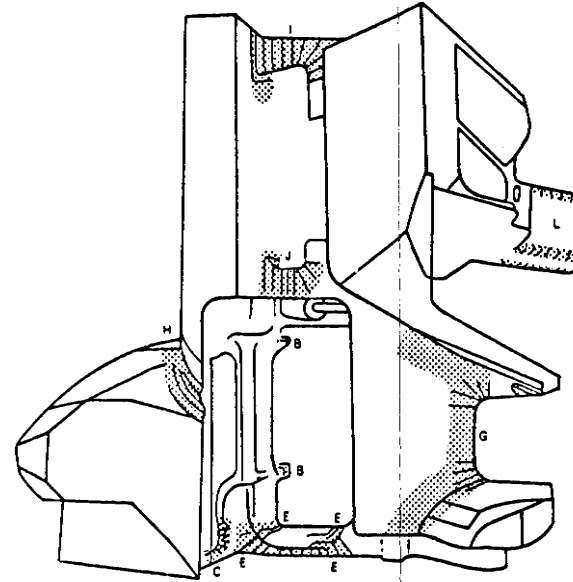
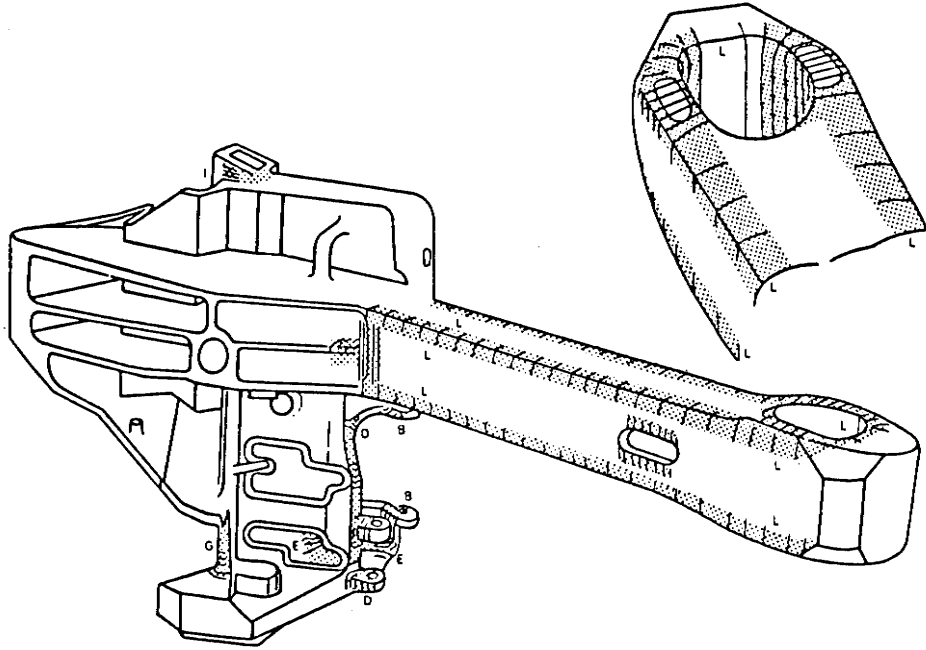


### AUTOMATIC COUPLER HEAD

#### Magnetic particle crack test

- on the «stressed» areas where the presence of lines not exceeding 20 mm can be tolerated.
- on «heavily-stressed» angles where no defect can be accepted (broken lines indicate the unfavourable direction)

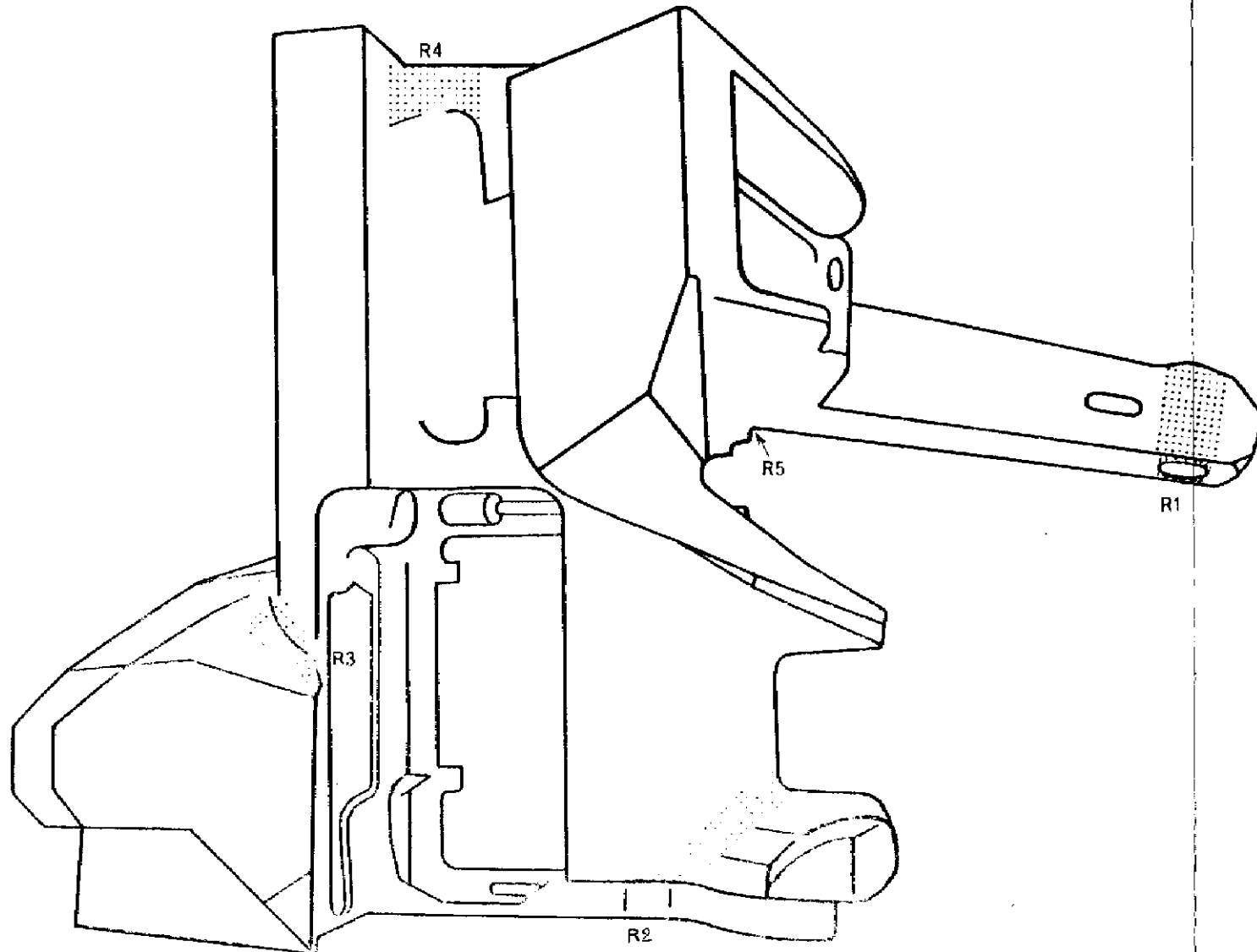
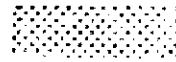




### AUTOMATIC COUPLER HEAD

#### Radiographic examination

Heavily-stressed areas :



R5 : Head-arm connection

- SECTION 4 -

**MECHANICALLY-WELDED  
AUTOMATIC COUPLER HEADS**

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5 - DELIVERY

- 5-1 - Protection against oxidation
- 5-2 - Guarantee

1 - PURPOSE

1.1 - This specification governs the supply of heads for UIC type automatic couplers with centre buffer, for tractive and trailing stock.

The provisions set out below apply to mechanically-welded coupler heads.

All relevant instructions for implementing the contract, especially those concerning the application of the following paragraphs in this specification :

- 2.1.4
- 2.2.3 ; 2.2.4
- 3.2.5
- 4 ; 4.2.3.3

must be indicated in the order and its appended documents .

1.2 - List of reference documents

Reference is made, in this specification, to the following documents :

- UIC Leaflets 829-3, 840-2 and 897-13 ;
- International Standard ISO/82

- Draft international Standard : ISO/DIS 4950

- ISO Recommendations : ISO/R 148 ;  
ISO/R 81 ;  
ISO/R 404 ;  
ISO/R 1027

- Euronorms 29-69  
30-69  
31-69

## 2 - CHARACTERISTICS

### 2.1 - Materials

#### 2.1.1 - Standard grades

The coupler-head component parts shall be made from semi-products for casting and rolled products of grades A or B.

#### 2.1.2 - Chemical properties (on products)

Grade A steel (1) : % C  $\leq$  0.15

Grade B steel (2) : 0.15 < % C  $\leq$  0.24 and C<sub>éq</sub>  $\leq$  0.50 (3)

(1) This grade is weldable without any special precautions.

(2) This grade is weldable without preheating, on condition that the welding energy is higher than 1.5 kJ/mm, that it produces low hydrogen percentages and that the welding-induced constraints are limited, as is the case during re-loading.

(3) 
$$C_{éq} = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni}{15} + Cu$$

Grade C steel (1) : 0.15 < % C  $\leq$  0.24 and C<sub>éq</sub> > 0.50

For these three grades S  $\leq$  0.035 %  
S  $\leq$  0.035 %

The chemical composition is decided by the manufacturer who must specify, on the manufacturing programme, the standard grade used as well as the permissible limits for each of the parts, including residual stresses.

#### 2.1.3 - Mechanical properties (2)

- Tensile strength  $\geq$  600 N/mm<sup>2</sup>
- 0.2 % Proof stress  $\geq$  450 N/mm<sup>2</sup>
- Elongation percentage after fracture  $\geq$  17
- For products with a thickness of  $\geq$  5 mm and notched bar impact at - 50° C on V-shape test-pieces :
  - the average value (of three tests) of the fracture energy must be higher than 20 Joules, each individual value not being less than 2/3 of the value laid down.

#### 2.1.4 - Weldability properties

The properties imposed as regards the weldability tests forming part of the acceptance of the different grades of steel are given in Appendix 3.

(1) This grade is weldable subject to certain special precautions being taken (preheating).  
(2) Crosswise for rolled products with a width of  $\geq$  600 mm.

The values of Vickers hardness under bead (see 4.2.3.4) for steels from standard grades B and C must be less than or equal to 450.

### 2.1.5 - Geometrical properties

The geometrical properties of the component materials must be in conformity with those laid down in the order and its appended documents, or with the specifications (ISO/R - Euronorms) governing their supply.

## 2.2 - Parts

### 2.2.1 - Physical properties

#### 2.2.1.1 - Appearance

The coupler heads must be completely free of any burr and loose oxide liable to impede their functioning or affect their resistance to corrosion.

The welds must be free of hollows, undercut, sudden irregularities or excessive extra thickness, differences in level and any other cause of stress concentration.

Penetration must be complete over the whole length of the weld.

No arc burns or arc spots must be made outside the boundaries of the weld preparation.

The centre-line of the weld beads must not deviate by more than 1 mm from that of the edges to be welded.

#### 2.2.1.2 - Soundness

The coupler heads must be sound throughout and not show any crack, flaw, lack of material or any other defect which might be detrimental to their use.

The magnetic particle crack test must not reveal any traces of defect in the weld beads and adjacent zones.

No residual magnetism likely to bring about the persistent presence of magnetic dust detrimental to satisfactory performance in service, may exist in the parts after examination.

The films obtained from the radiographic examination of the welded areas must be consistent with the characteristics of class 2, UIC Leaflet 897-13.

### 2.2.2 - Mechanical properties

The mechanical properties of the filler metal and of zones adjacent to the welding must be at least equal to those imposed for the base metal of the parts to be assembled.

### 2.2.3 - Geometrical properties

The shape, dimensions and the tolerances allowed on the dimensions must be consistent with those laid down in the order and its appended documents ; failing any indication on these documents, the tolerances to be complied with are those given in 2.2.2, UIC Leaflet 829-3.

### 2.2.4 - Marks

Each part must bear, in the position indicated in the drawing, the following manufacturing marks :

- the mark of the supplier,
- the date of manufacture (month and last two figures of the year of manufacture),
- the identification mark,
- the standard grade of the steel (A, B or C).

The use of sharp-edged stamps for affixing the marks is prohibited.

## 3 - MANUFACTURE

### 3.1 - Materials

The semi-products for foundry and the rolled products used for manufacturing the coupler-head component parts must be melted by the

electric furnace, the open-hearth process, by a top-blown oxygen process or by any other process recognised as equivalent by the purchasing Railway.

They must be made from fully-killed steel.

Component parts emanating from semi-products for foundry, and rolled products must be delivered in the normalised or treated condition, in order to obtain the characteristics specified.

### 3.2 - Manufacture of the parts

The manufacture of the coupler heads may only be entrusted to suppliers who have received the prior approval of the purchasing Railway.

The component parts shall be manufactured, in accordance with the indications of the manufacturing programme, as defined in 3.2.1, either by stamping or cutting-up of the rolled products. They must be carefully cleared of any burr or loose oxide.

Component parts manufactured from rolled products must be cut up in such a way that the rolling direction is as far as possible parallel to the coupler-head centre-line.

The welds must be carried out in accordance with semi-automatic and automatic methods previously approved by the purchasing Railway.



Welders performing semi-automatic weldings must also have been approved by a representative of the purchasing Railway, following tests repeated at intervals.

No residual stress prejudicial to utilisation of the parts must exist after welding.

### 3.2.1 - Manufacturing and inspection programmes

Before beginning manufacture, the supplier must present for approval to the representative of the purchasing Railway, a detailed manufacturing programme indicating, in particular, the shape, dimensions and preparation of the components, their order of assembly, the welding equipment (plant, machines, wires, flux), the welding conditions (frequencies, speeds, intensities, adjustment of the welding machines, positions), and the characteristics of the heat treatment effected after welding.

It must also specify that no rectification shall be carried out after welding.

In addition, the supplier must also submit for approval to the purchasing Railway a schedule of the inspections envisaged.

Any alteration to these schedules must be submitted to the purchasing Railway for approval.

### 3.2.2 - Prototypes

Before beginning mass production, the supplier must make three prototype heads in strict conformity with the approved manufacturing programme.

Manufacture of the prototypes must be monitored by the purchasing Railway's representative who shall check that the assembly is performed in accordance with the conditions laid down in the manufacturing programme, and that the chemical, mechanical and geometrical properties are consistent with the provisions of Paragraph 2.

He shall also effect, on the premises of the supplier or in his laboratories, all the examinations (magnetic particle crack testing, sectioning of certain areas, etc.) which he considers necessary to ensure that the assemblies have been properly carried out.

He shall also check the mechanical properties laid down, on test-pieces taken from the weld metal and the zones adjacent to the weld.

He shall also carry out all the weldability tests stipulated in Appendix 3 for acceptance of the steel.

He shall also carry out a radiographic examination of the welded zones.

All these test-pieces shall be taken from each of the prototypes by the representative of the purchasing Railway, in accordance with the process laid down for mass production.

Only when all these examinations and tests have given satisfactory results may the purchasing Railway authorise mass production.

**3.2.3 - Mass production**

The method used in mass production must be strictly identical to that approved after tests on prototypes.

Any modification to the manufacturing process shall invoke afresh the procedure laid down in 3.2.1 and 3.2.2.

**3.2.4 - Heat treatment**

The coupler heads shall undergo the heat treatment prescribed in the manufacturing plan, after welding.

**3.2.5 - Machining**

Machining shall be carried out in accordance with the indications in the order or its appended documents.

**3.2.6 - Repairs**

No repair may be carried out without the prior authority of the representative of the purchasing Railway, and his agreement on the method of repair.

Any repair intended to hide a defect is strictly forbidden and shall result in rejection of the entire batch.

**4 - INSPECTION**

The preliminary inspection, in the factory, of the materials (semi-products for forging and rolled products) used for the manufacture of the components of the coupler head, also the inspection of the coupler heads, shall be carried out by the representative appointed by the purchasing Railway.

However, if the order and its appended documents so stipulate, delivery of the component materials and of the coupler heads may merely be accompanied by an inspection certificate for the products, issued by the factory, as defined in Paragraph 4.1.3 of ISO Recommendation R 404.

**4.1 - Inspection of the materials**

The inspection of the materials shall consist of checking the chemical, mechanical and geometrical properties and the hardness under bead stipulated in Paragraph 2.

It shall be carried out in accordance with the provisions of the following documents:

**4.1.1 - Chemical and mechanical properties**

- of the rolled products : ISO/DIS 4950/1.
- of the semi-products for forging : Euronorms 30-69.

**4.1.2 - Geometrical characteristics**

- rolled products :  
hot-rolled steel sheets with a thickness  $\geq 3$  mm : Euronorm 29-69.
- other products :  
specifications (ISO/R - Euronorms) governing their supply.
- semi-products for forging : Euronorm 31-69.

**4.1.3 - Weldability properties - Vickers hardness test under bead**

A welding bead with a net welding energy of  $1.5 \pm 15$  % kJ/mm shall be laid, in one run, on a 75 mm x 300 mm test block with the same thickness as the side of the arm of the coupler head.

The position of the heat-affected zone shall be determined after macrostructure etching on a section perpendicular to the welding bead.

HV 5 hardness tests shall be carried out at 0.5 mm intervals, as indicated in fig. 1.

The test must be carried out in accordance with ISO Recommendation R 81.

**4.1.4 - Grouping into batches**

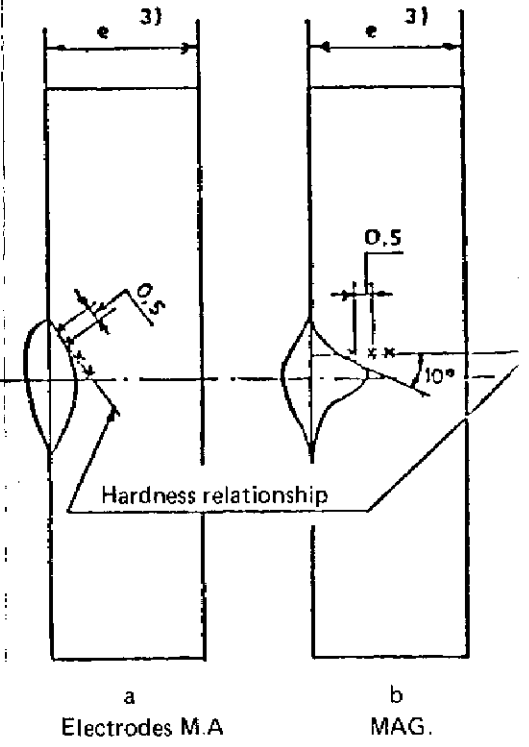
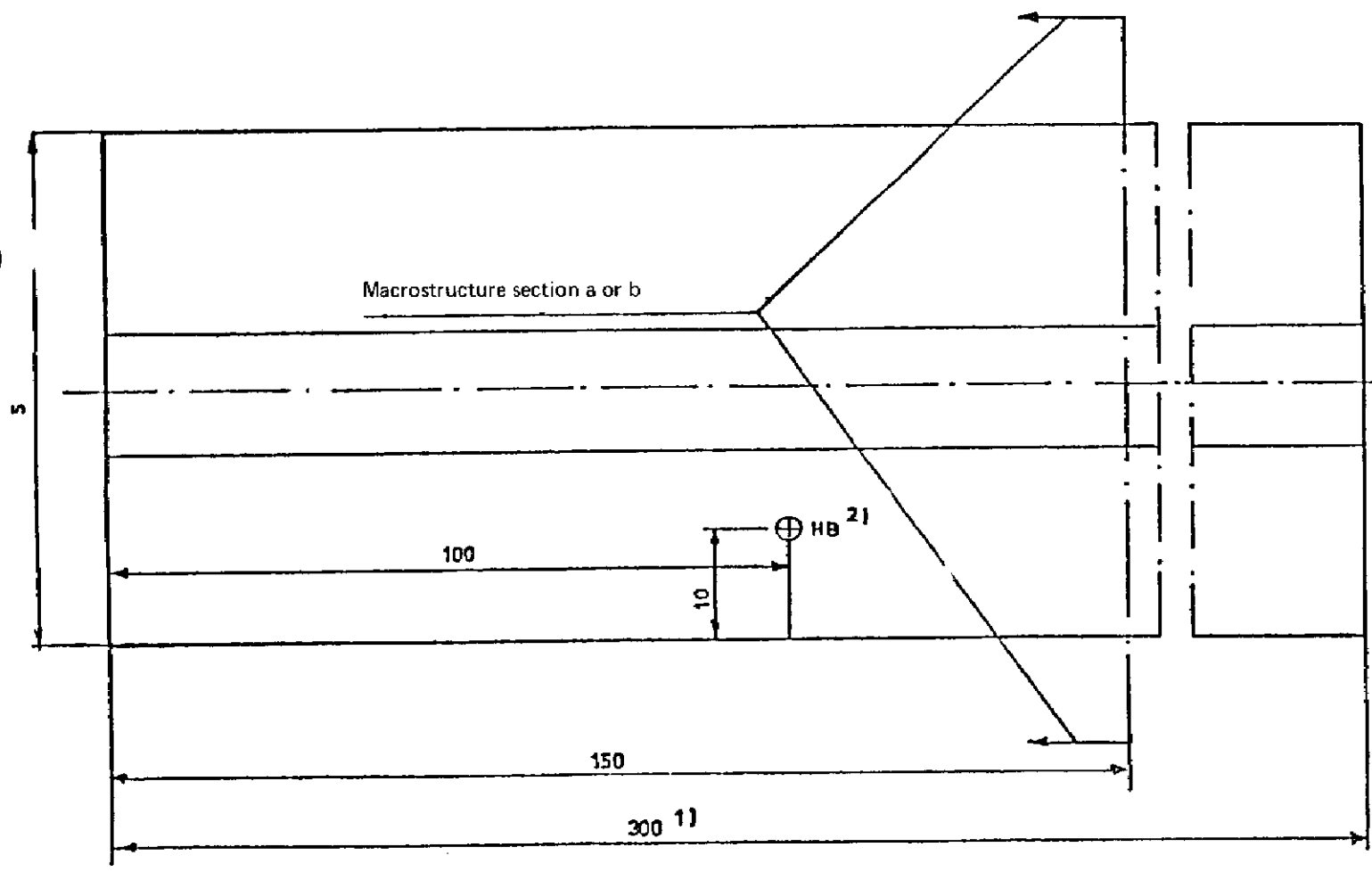
The batches shall consist of parts of identical dimensions and from the same cast. The size of each batch may not exceed 20 tonnes.

**4.1.5 - Nature and proportion of the checks and tests**

Each batch shall undergo the following tests :

Nature of the checks and tests	Number of checks per batch
Chemical analysis	1
Tensile test (2)	1
KV impact test at - 50° C (2)	1 (3)
Vickers hardness under bead (4)	1

- (1) The complete chemical analysis, including residual traces, must be consistent with the chemical analysis presented during acceptance.
- (2) Laterally for rolled products  $\geq 600$  mm in width.
- (3) Each test shall comprise a set of three test-pieces.
- (4) The test shall be carried out on steel from standard grades B and C only.



1) For mass production :  
 Length = 400 mm  
 Width = 100 mm

2) HB = Brinell hardness measurement (except Part 4)

Fig. 1

3) Prototype :  
 e = Side thickness  
 Mass production :  
 Parts 1 and 2 : e = 25 mm  
 Part 4 e = side thickness

The representative of the purchasing Railway also carry out, on the component parts, before assembly, a check on the chemical and mechanical properties stipulated in paragraph 2.

#### 4.2 - Manufacturing inspection

The representative of the purchasing Railway must be able to check any phase in the manufacture by random checks to ensure that the manufacturing programme has been strictly observed.

He shall monitor more particularly the preparation of the edges to be welded, and the welding operation.

If this examination reveals serious appearance defects such as craters, grooves, incipient cracks, serious irregularities in the beads or differences in level, the manufacture shall be stopped, and the supplier must then manufacture fresh prototypes after rectifying his welding process.

The representative of the purchasing Railway must have access to all documents prescribed by the inspection plan, in particular to the charts plotted by correctly-calibrated recording pyrometers, in order to check the characteristics of the heat treatments.

Before presentation, the supplier must carry out, under its own responsibility, a magnetic particle crack test on the welded zones of the coupler heads.

#### 4.3 - Inspection of the parts

##### 4.3.1 - Presentation

###### 4.3.1.1 - Condition of the parts on presentation

The coupler heads shall be presented in delivery condition before protective treatment.

###### 4.3.1.2 - Grouping into batches

The coupler heads shall be presented grouped into batches of not more than 200 parts.

###### 4.3.1.3 - Advice of presentation

The date of presentation must be advised to the representative of the purchasing Railway by written note, signed by the Manager of the producing factory or his authorised representative. This note must indicate the number of parts presented in each batch, also the references of the order covering them. At the time of presentation, a certificate certifying that the prescribed conditions of manufacture have been complied with, and that the magnetic particle crack test on the welded zones has been carried out and given satisfactory results, shall be handed to the representative of the purchasing Railway.

4.3.2 - Nature and proportion of the checks and tests

The coupler heads shall be subjected to the following checks and tests :

Nature of the checks and tests	Number of the checks or tests per batch
- Tensile test (weld metal, base metal and ZAT) (1)	1
- KV impact test at - 50° C (weld metal) (1)	1
- Radiographic examination of the welded zones	1
- Magnetic particle crack test on the welded zones	5 % (2)
- Appearance and dimensional checks	As the Railway thinks fit

4.3.3 - Selection and preparation of the samples and test-pieces

The representative of the purchasing Railway shall select at random, from each batch presented, the parts which he intends for the tests, and shall mark them indelibly.

The cutting up of the samples and the machining of the test-pieces must be carried out in the cold condition, and conducted with care so that no appreciable heating of the metal occurs.

(1) See Figure 2, § 4.3.3.1 - Each notched-bar impact test shall require a set of 3 test-pieces (see § 2.1.3).  
 (2) Before presentation, all the weld beads and their adjacent zones must have undergone the magnetic particle crack test, under the responsibility of the supplier.

The samples and test-pieces must retain the stamps of the representative of the purchasing Railway ; any transfer of marks may only be effected by him.

4.3.3.1 - Tensile and notched-bar impact tests

The test-pieces for the tensile and notched-bar impact tests shall be selected as indicated in Fig. 2 below ; the position of the notch of the test pieces for the notched-bar impact test shall be determined by macro-etching.

In cases where the design of the coupler head prevents the removal of test-pieces in this zone, other positions shall be defined in the approved manufacturing programme.

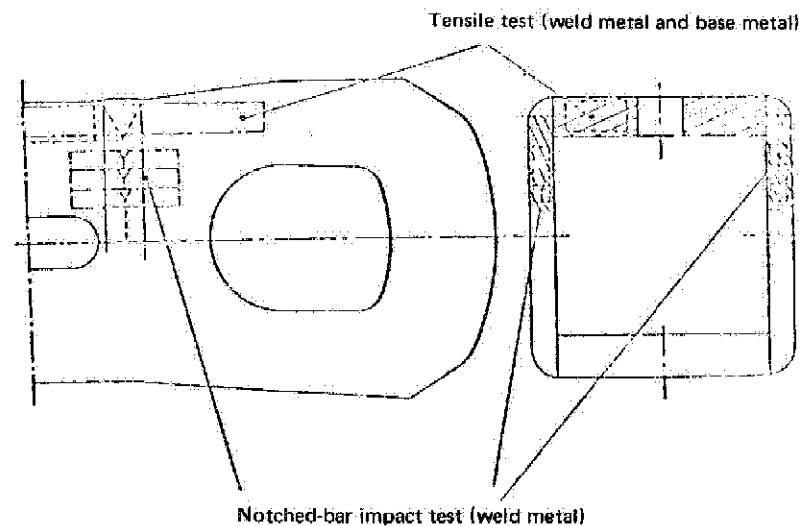


Fig. 2

**4.3.3.2 - Radiographic examination**

The radiographic examination shall be carried out on a part selected by the representative of the purchasing Railway.

**4.3.3.3 - Magnetic particle crack test**

The weld beads and their edges must be clean and free from oil, grease or any other anomaly likely to interfere with the accumulation of iron powder at leakage fields.

**4.3.4 - Performance of the checks and tests**

**4.3.4.1 - Tensile test**

The tensile test piece and the carrying out of the test must be in accordance with the provisions of the International Standard ISO 82. The length between markers shall be calculated by means of the following formula :

$$L_0 = 5.65 \sqrt{S_0}$$

**4.3.4.2 - Notched-bar impact test**

The notched-bar impact test-piece and the carrying out of the test must be in accordance with the provisions of ISO Recommendation R 148.

Section 4 **4.3.4.3 - Radiographic examination**

The radiographic examination shall be carried out on 10 % of the beads and on all the welded joints.

The image quality index shall be evaluated by means of one of the wire or step indicators defined in ISO Recommendation R 1027.

All the parts on which a radiographic test is performed must carry a mark clearly visible on the film.

Parts where this examination reveals defects can be cut up, at the manufacturer's request, to determine the seriousness of the defects with accuracy.

**4.3.4.4 - Magnetic-particle crack test**

The magnetic particle crack test, effected on parts previously cleaned and either shot-peened or sand-blasted correctly, shall be carried out in accordance with Appendix 1 (Sheets 1 and 2), which gives the heavily-stressed areas where no defects can be allowed, and stressed areas where the presence of lines not exceeding 20 mm can be tolerated. The detection process based on magnetic ink shall be used.

Procedures for the magnetization and demagnetization test must first have been approved by the purchasing Railway.

Magnetization by current flow through the casting shall not be authorised ; its use shall result in rejection.

#### 4.3.4.5 - Dimensional check

Checking of the dimensions shall be carried out by any suitable means, especially by means of gauges supplied by the manufacturer and approved by the purchasing Railway. The gauges must be periodically checked by an approved laboratory.

#### 4.4 - Conclusion of the inspections

Any chemical analysis, tensile, notched-bar impact or hardness under bead test result that is not satisfactory shall lead to rejection of the corresponding batch.

Any appearance or dimensional defect shall result in rejection of the part.

Further tests may be carried out, at the manufacturer's request, only if the purchasing Railway has given prior agreement.

Any result of a radiographic examination which is not satisfactory shall lead to rejection of the part, followed by a systematic examination of the area involved on all parts of the batch ; any unsatisfactory result shall lead to rejection of the corresponding part.

Any unsatisfactory result of a magnetic particle crack test shall lead to rejection of the part concerned, followed by a systematic examination of the area involved on all the parts forming the batch , each unsatisfactory result shall lead to rejection of the corresponding part.

## 5 - DELIVERY

### 5.1 - Protection against oxidation

After checking and stamping by the representative of the purchasing Railway, the parts shall receive, before storage or despatch, a coating approved by this Railway.

### 5.2 - Guarantee

The coupler heads shall be guaranteed for a period of 5 (five) years against any manufacturing defect. This period shall run with effect from the end of the month marked on the parts.

If the coupler heads are fitted to new stock, the delivery date for the vehicles equipped with them shall be considered as the starting period of the guarantee. If the coupler heads are fitted to stock in use at the time of reconversion to automatic coupling, the fitting-out date, which shall be notified to the supplier, shall be considered as the starting period of the guarantee.

Coupler heads which, during the guarantee period, show defects rendering them unsuitable for service or reducing their service life, shall be rejected.

Before being finally rejected, however, the defective coupler heads may be subjected to a check examination between the purchasing Railway and the supplier, if the latter so requests.



When the check examination does confirm that the defects are imputable to manufacture, the defective coupler heads shall be definitely rejected.

In cases where the results of the check examination do not enable an agreement to be reached between the purchasing Railway and the supplier, recourse shall be had to experts approved by both parties to settle the dispute. The costs shall then be borne by the party finally held responsible.

When more than 5% of parts from the same cast show defects resulting in rejection, the purchasing Railway may reject the whole of the cast.

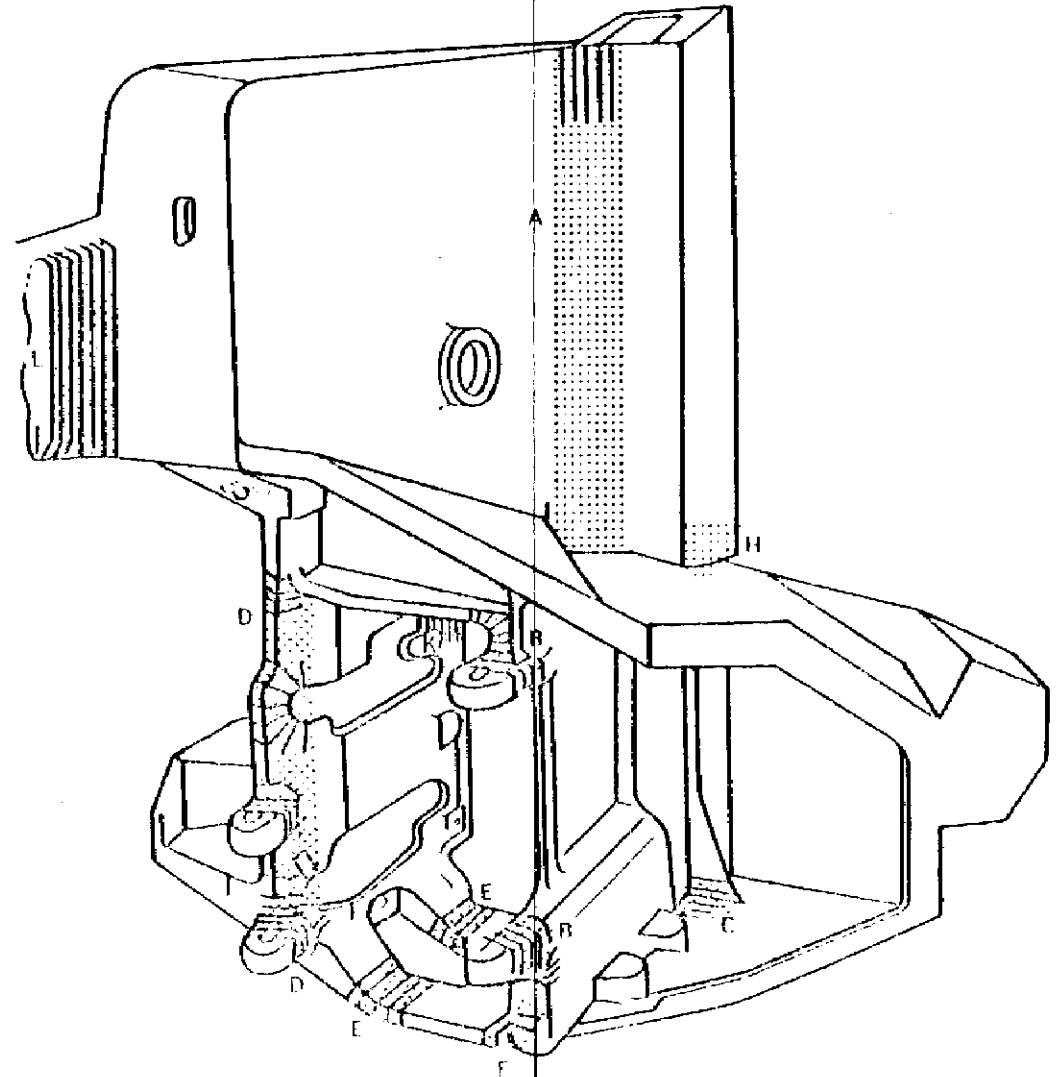
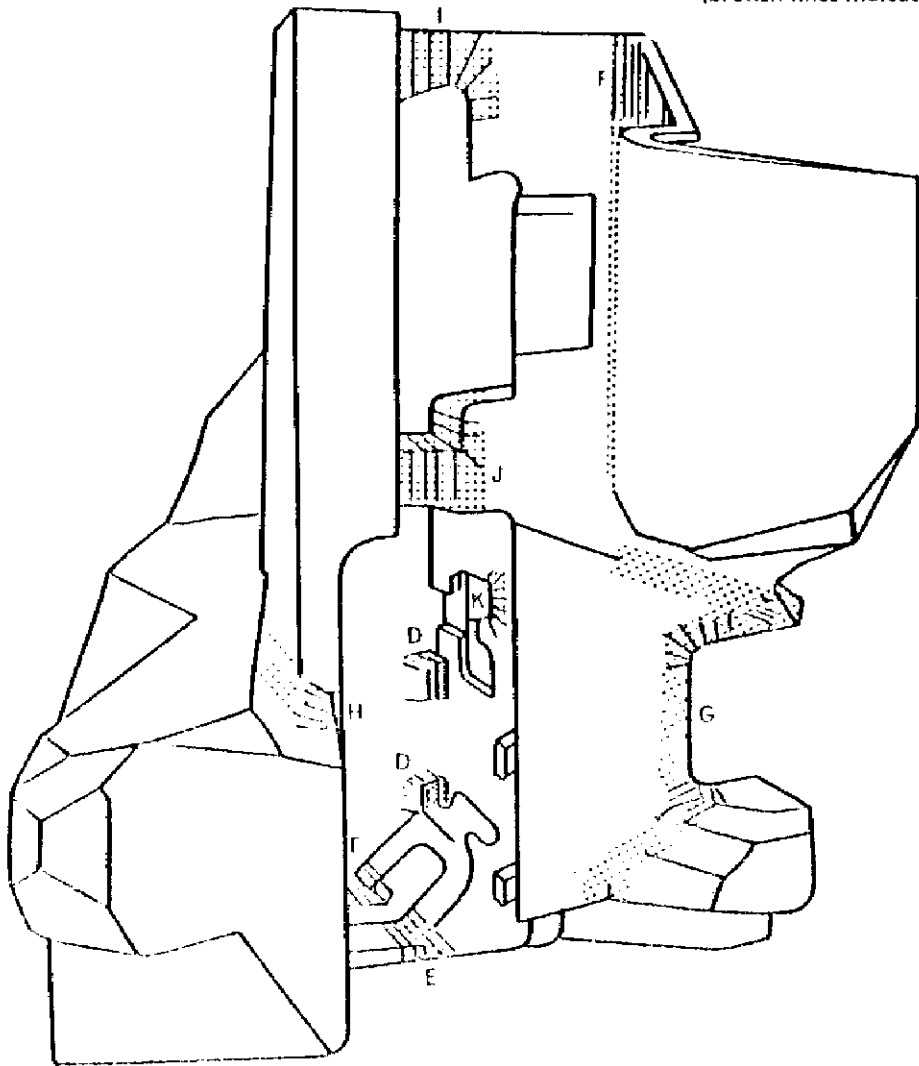
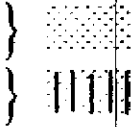
Rejected coupler heads shall be made available to the supplier, with a view to their replacement or their reimbursement at their value, in new condition, at the time of withdrawal.

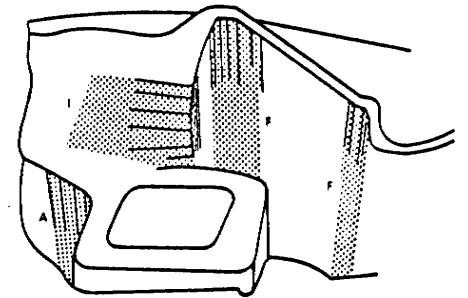
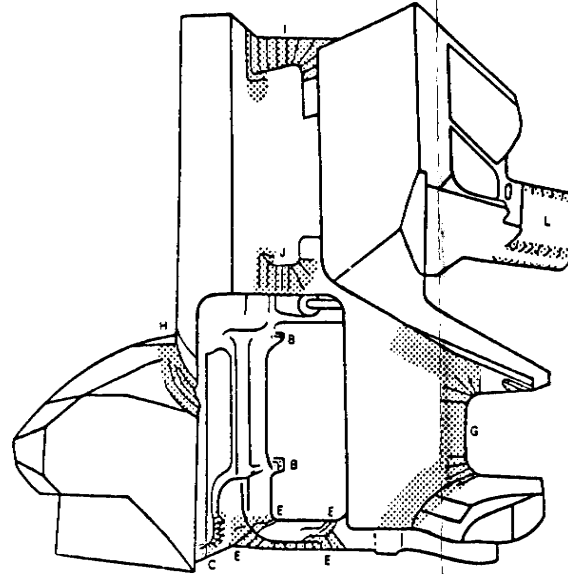
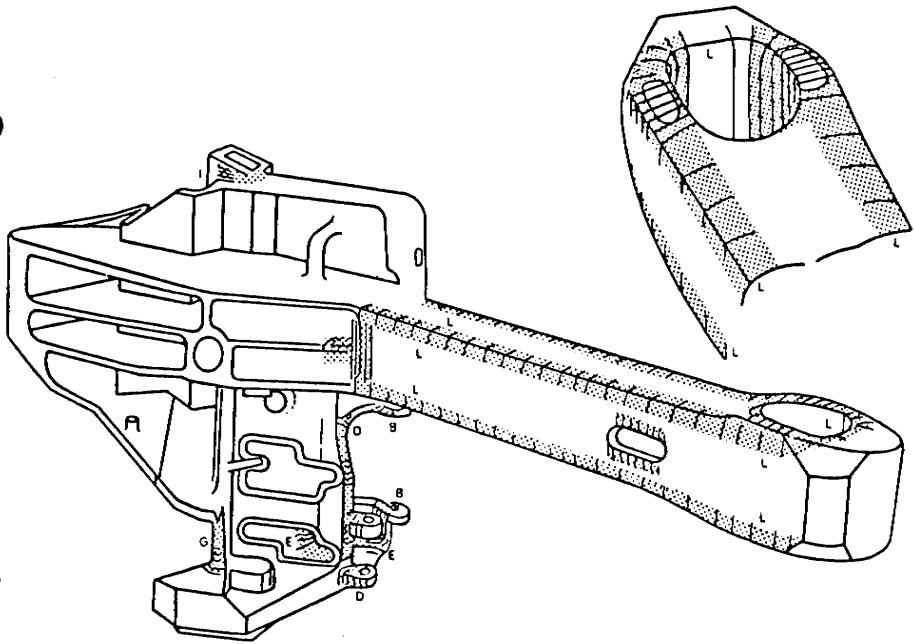
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### AUTOMATIC COUPLER HEAD

#### Magnetic particle crack test


- on «stressed» areas where the presence of lines not exceeding 20 mm may be tolerated
- on «heavily-stressed» edges where no defect can be permitted (broken lines indicate the unfavourable direction)





### AUTOMATIC COUPLER HEAD

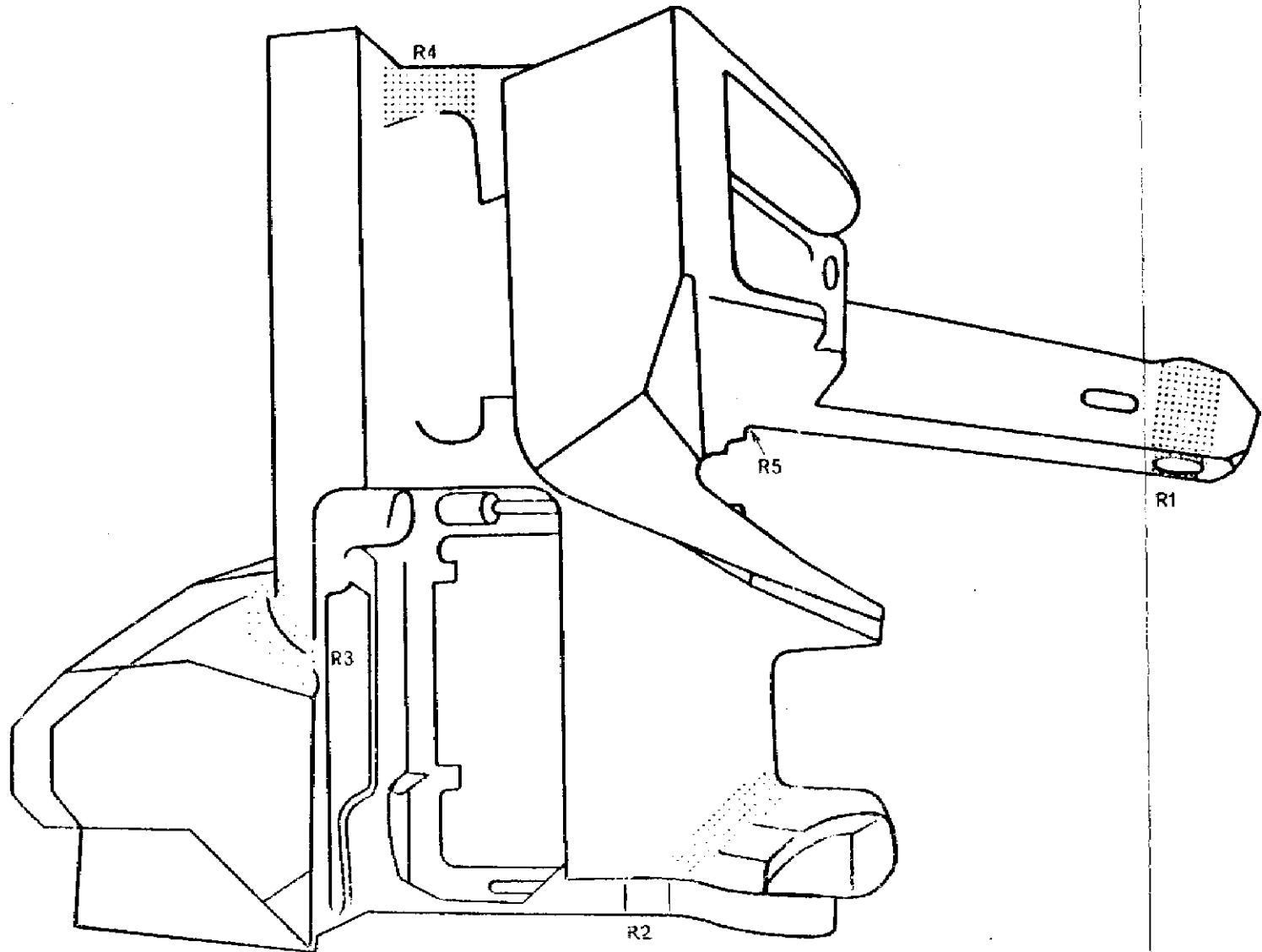
Radiographic examination

Heavily-stressed areas : 

829 - 1

R

Section 4  
Appendix 2



R5 : Head-arm connection

## WELDABILITY TESTS FOR ACCEPTANCE OF THE STANDARD-GRADE STEELS

The standard grade of steel proposed must be subjected to the following tests before acceptance.

### 1 - CHARACTERISTICS TO BE OBTAINED

Grade	Type of test	Tests	Results to be obtained	Fig.
Steel A	Weldability test at high temperature	HV 5 hardness test in the ZAT (1)	$\geq 90\%$ HV 5 of base metal	1
		KV impact test at $-30^{\circ}\text{C}$ in the ZAT (2) (KV-shape notch)	$\text{KV} \geq 27 \text{ J}$	1
Steels B and C (3)	Test at low temperature	KV impact test at $-30^{\circ}\text{C}$ in the ZAT (2) (KV-shape notch)	$\text{KV} \geq 27 \text{ J}$	1
		HV 5 hardness test under bead	$\text{HV } 5 \leq 450$	2

(1) ZAT = Heat-affected zone.  
 (2) Average for the 3 test-pieces; no individual value must be less than 20 J.  
 (3) Tests with steel C are carried out under the conditions of preheating as provided for during acceptance.

## 2 - REMOVAL AND PREPARATION OF THE SAMPLES AND TEST-PIECES

### 2.1 - Removal

The representative of the purchasing Railway shall arrange for samples measuring 75 x 300 mm to be removed from the arm of the prototype coupler bodies.

The thickness of these samples shall be the same as that of the side of the coupler head arm.

### 2.2 - Preparation of the samples

#### 2.2.1 - Weldability test at high temperature (Steel A)

HV 5 hardness and notched-bar impact tests.

Two samples shall be prepared and welded as indicated in figure 1.

All the weld-bead runs shall be deposited with the same net welding energy of  $E = 3 \pm 10\%$  of kJ/mm where

$$E = 0.85 \times \frac{\text{arc voltage (Volt)} \times \text{welding current (Amp)}}{1000 \times \text{welding speed (mm/sec)}}$$

### 2.2.2 - Weldability test at low temperature (Steels B and C)

#### 2.2.2.1 - Notched-bar impact test

Two samples shall be prepared and welded as indicated in figure 1.

All the weld-bead runs shall be deposited with the same net welding energy of  $E = 1.5 \pm 15\%$  kJ/mm.

The temperature between runs shall not exceed  $150^{\circ}\text{C}$ .

#### 2.2.2.2 - Vickers hardness test under bead

A weld bead shall be deposited on a sample in a single run (figure 2).

The net welding energy to be used shall be  $E = 1.5 \pm 15\%$  kJ/mm.

## 3 - PERFORMANCE OF THE TESTS

### 3.1 - Notched-bar impact test

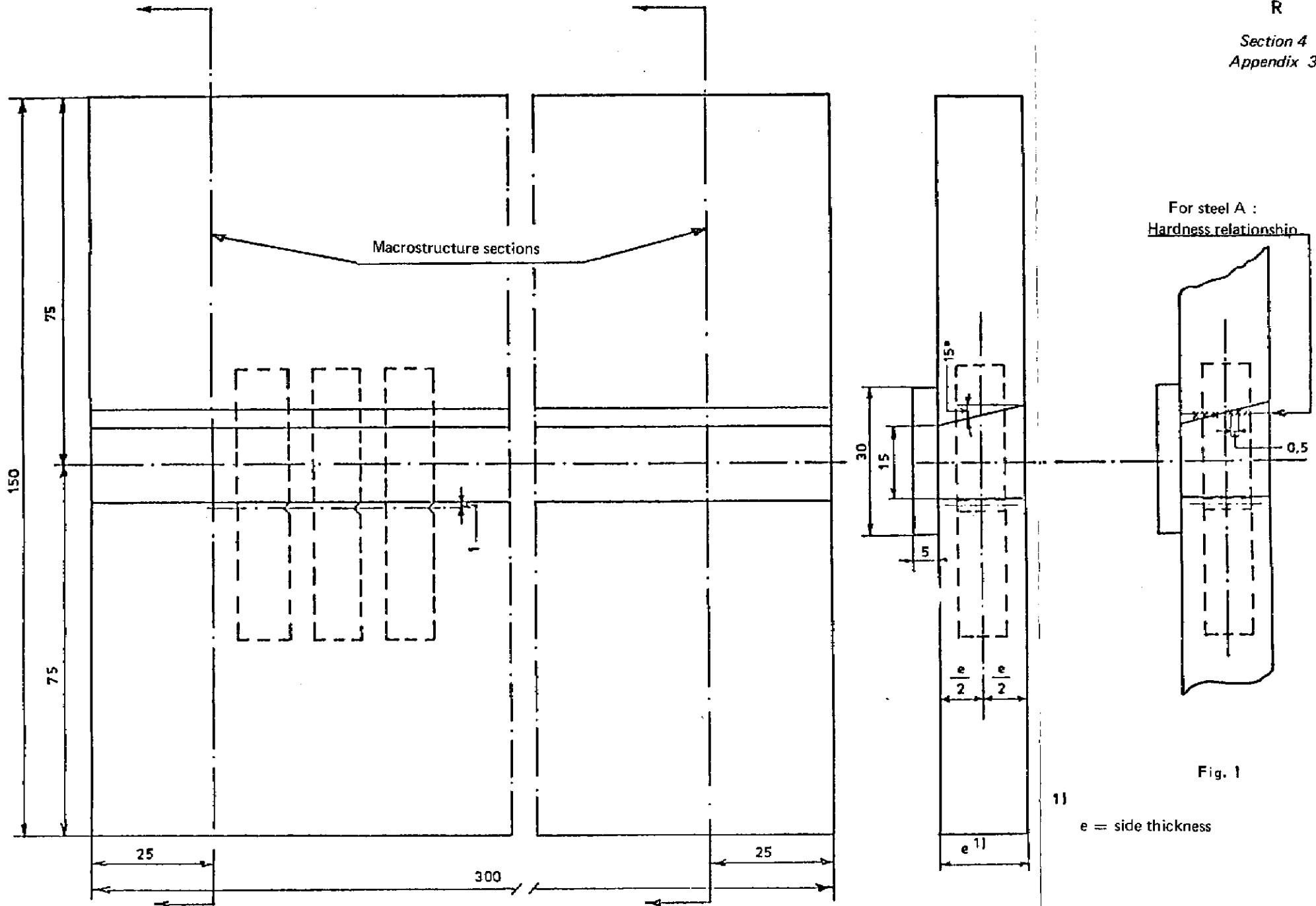
The position of the notch on the impact test-pieces shall be determined by macro-etching (Figure 1).

The impact test-piece and the organisation of the test shall comply with the provisions of ISO Recommendation R 148.

### 3.2 - Vickers hardness test

The HV 5 hardness tests shall be carried out at intervals of 0.5 mm in straight line, as indicated in figure 1 for the test at high temperature, and as indicated in figure 2 for the test at low temperature.

The test must be conducted in conformity with ISO Recommendation R 81.

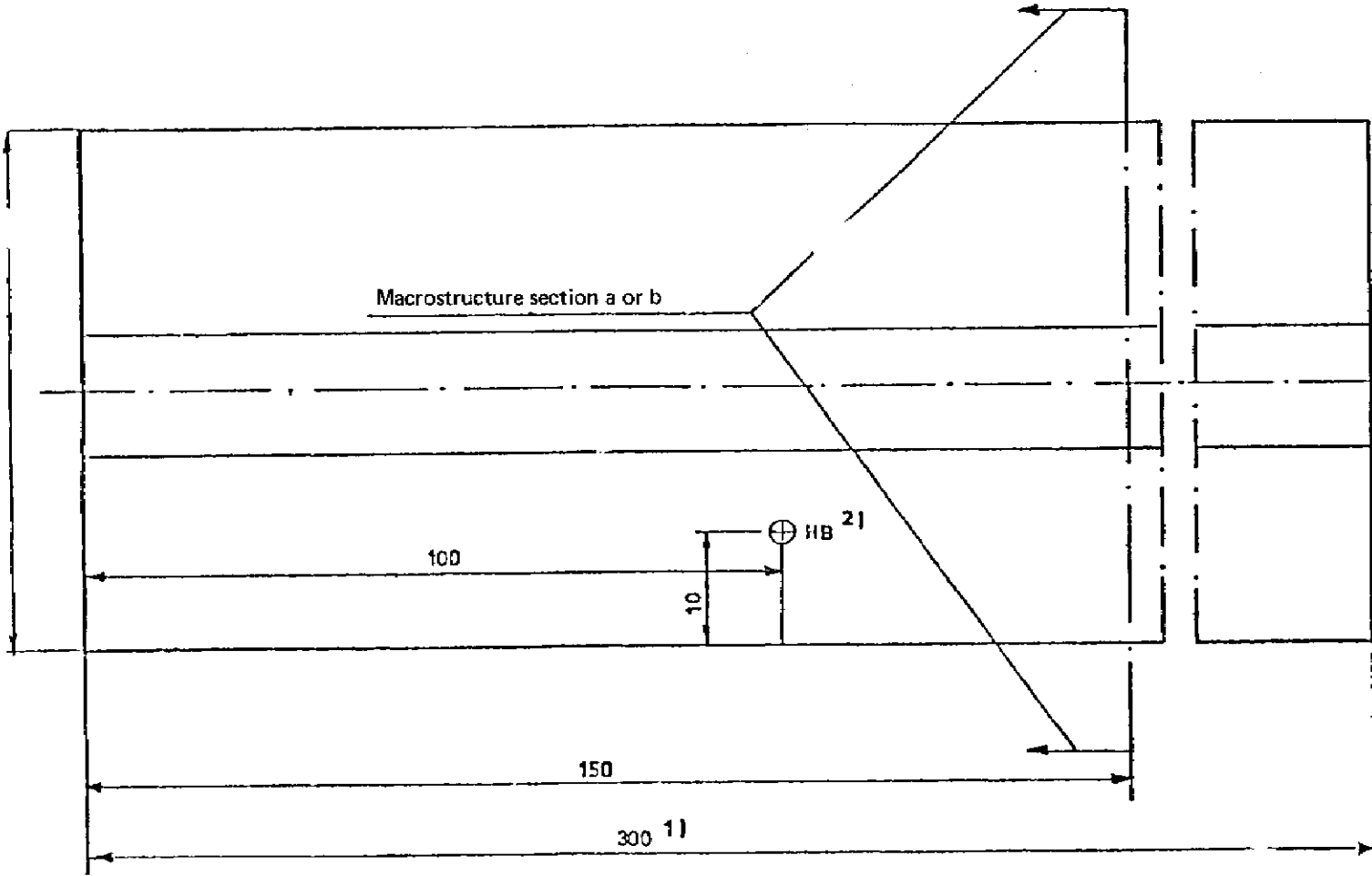


For steel A :  
Hardness relationship

Fig. 1

1)

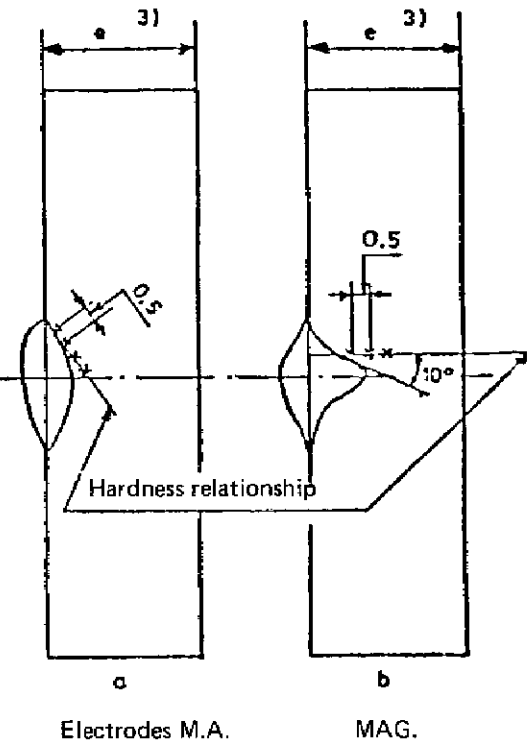
e = side thickness



1) For mass production :  
 Length = 400 mm  
 Width = 100 mm

2) HB = Brinell hardness measurement (except Part 4)

Fig. 2



3) Prototype :  
 e = Side thickness  
 Mass production :  
 Parts 1 and 2 : e = 25 mm  
 Part 4 : e = Side thickness



APPLICATION

All Railways in the Union.

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RECORD REFERENCES

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

- Preparation of specifications for the supply of automatic couplers.  
(Traction and Rolling Stock Committee : Graz, June 1972).
  
- Specification for the supply of automatic couplers.  
(Traction and Rolling Stock Committee : Trier, June 1974).
  
- *Question 5/sa/FIC* : Revision of Leaflet 829-1 « Heads for UIC type automatic coupler with centre-buffer for tractive and trailing stock ».  
(Sub-Committee for Specifications : Paris, January 1979).