

CONTENTS

1- SUBJECT

- 1.1- Working of purchase orders
- 1.2- List of reference documents

2- CHARACTERISTICS

2.1- Material

- 2.1.1 - Chemical characteristics (sample removed from casting)
- 2.1.2 - Mechanical characteristics
- 2.1.3 - Magnetic characteristics

2.2- Castings

- 2.2.1 - Physical characteristics
 - 2.2.1.1 - Appearance
 - 2.2.1.2 - Soundness
 - 2.2.1.3 - Texture
 - 2.2.1.4 - Leak and pressure tightness
 - 2.2.1.5 - Weight
- 2.2.2 - Geometrical characteristics
- 2.2.3 - Marking

3- MANUFACTURE

- 3.1- Steel-making process
- 3.2- Manufacture of the castings
 - 3.2.1 - Type of mould and casting
 - 3.2.2 - Heat treatment
 - 3.2.3 - Machining
 - 3.2.4 - Rectification of defects, if any

4- INSPECTION

- 4.1- Inspection during manufacture
- 4.2- Inspection of castings
 - 4.2.1 - Submission for acceptance
 - 4.2.1.1 - Condition of castings when submitted for acceptance

- 4.2.1.2 - Grouping into batches
- 4.2.1.3 - Presentation procedure

- 4.2.2 - Nature and proportion of inspections and tests
- 4.2.3 - Selection and preparation of samples and test pieces

- 4.2.3.1 - Chemical analysis
- 4.2.3.2 - Tensile and notched bar impact tests
- 4.2.3.3 - Hardness
- 4.2.3.4 - Texture
- 4.2.3.5 - Magnetic permeability

4.2.4 - Inspection and test procedure

- 4.2.4.1 - Tensile test
- 4.2.4.2 - Notched bar impact test
- 4.2.4.3 - Brinell hardness test
- 4.2.4.4 - Rockwell or Vickers hardness test
- 4.2.4.5 - Texture test
- 4.2.4.6 - Leak or pressure test
- 4.2.4.7 - Examination of magnetic permeability
- 4.2.4.8 - Dye penetrant test
- 4.2.4.9 - Magnetic particle test
- 4.2.4.10 - Ultrasonic examination
- 4.2.4.11 - Radiographic examination
- 4.2.4.12 - Checking of dimensions

4.3- Conclusion of inspections

5- DELIVERY

- 5.1- Protection against rust
 - 5.1.1 - Packing

6- GUARANTEE

APPENDIX 1 - Magnetic particle and dye penetrant testing of steel castings

APPENDIX 2 - Statistical texture inspection method

1 - SUBJECT

This specification governs the supply of rough or finished steel castings for tractive and trailing stock (1).

The castings are classified in two categories :

- category 1 (C1) : Heavy duty parts or those that fulfil a vital function in the operation of the vehicle.
- category 2 (C2) : Other parts.

1.1 - Wording of purchase orders

The particulars required for the execution of the order, especially those concerning the application of paragraphs 1, 2.1, 2.1.3, 2.2.1.2, 2.2.1.4, 2.2.1.5, 2.2.3, 3.2.2, 3.2.3, 4.1, 4.2.2, 4.2.4.6, 4.2.4.8, 4.2.4.9, 4.2.4.10, 4.2.4.11 in this specification should be mentioned in the order or its appended documents.

1.2 - List of reference documents

In this Specification, reference is made to the following documents :

- ISO Recommendations : ISO/R 79
- ISO/R 80
- ISO/R 81
- ISO/R 82
- ISO/R 148

ASTM Standard E 446.75

(1) Including automatic coupler components, except for the coupler head for which a separate Specification is provided.

2 - CHARACTERISTICS

2.1 - Material

The castings shall be manufactured from one of the following grades of steel :

- E 230-400 - M
- E 260-450 - M
- E 300-520 - M
- E 370-620 - M (1)
- E 420-630 - M (1)

- the letter «E» shows that the main characteristic of these grades of steel is the yield point ;

- the first 3-digit number shows the minimum yield point expressed in MPa ;

- the second 3-digit number shows the minimum tensile strength expressed in MPa ;

- the letter «M» preceded by a dash shows that the symbol applies to cast products.

- In addition, for grades to be used in the manufacture of parts which are to be welded, the above identification shall be completed by the letter «S» and the requirements of Footnote (1) in § 2.1.1 of this specification shall be observed.

In all cases, identification of the grade must be followed by the category C1 or C2 in which the casting is classified.

Example of identification :

E 260-450 - MS C1

(1) Grades used for certain parts of the automatic coupler, Grade E 370-620 - M being intended for surface treated parts.

2.1.1 - Chemical characteristics (sample removed from casting)

Grade	Carbon %	Silicon %	Manganese %	Chromium %	Nickel %	Molybdenum %	Phosphorus %	Sulphur %
E 230-400-M	(1)	(1)	(1)	(1)	(1)	(1)	≤ 0.04 (2)	≤ 0.04 (2)
E 260-450-M	0.42/0.50	0.25/0.60	0.50/0.80				≤ 0.04	≤ 0.04
E 300-520-M	≤ 0.30	≤ 0.60	≤ 1.50	≤ 0.25	≤ 0.35	≤ 0.10	≤ 0.04	≤ 0.04
E 370-620-M								
E 420-630-M								

(1) If the castings are to be welded, the following composition must be adhered to :
 C ≤ 0.25%, Si ≤ 0.50%, Mn ≤ 1.00%, Cr ≤ 0.25%, Ni ≤ 0.35%, Mo ≤ 0.10%.

(2) 0.05% for grades obtained by an acid process

2.1.2 - Mechanical characteristics

Grade	Delivery condition	Yield point at 0.2% MPa	Tensile strength MPa	Elongation after fracture %	Notched bar impact strength at +20°C (V notch) Fracture energy J	Variation of Brinell hardness on castings in the same batch
E 230-400-M	(1)	≥ 230	≥ 400	≥ 25	≥ (2)	≤
E 260-450-M	N	260	≥ 450	20	30	30
E 300-520-M	N	300	≥ 520	17	25	30
E 370-620-M	N	370	620/770	14	20	30
E 420-630-M	TR (3)	420	630/780	15	15	30

(1) N = Normalised ; TR = Hardened and tempered.

(2) Average result of 3 tests : no individual result must be less than 2/3 of the value laid down.

(3) In normalised condition, the characteristics of this steel are those of E 300-520-M.

2.1.3 - Magnetic characteristics

- Grades E 260-450 - M and E 260-450 - MS

When a verification of magnetic characteristics is specified in the purchase order or its appended documents, the requirements in the following table must be met :

Number of Ampere-turns per metre	750	1 500	3 000	6 000	12 000	25 000
Minimum induction in Tesla	1.00	1.37	1.55	1.70	1.83	2.00

For other grades, the magnetic characteristics must be stated in the order or its appended documents.

2.2 - Castings

2.2.1 - Physical characteristics

2.2.1.1 - Appearance

The castings must be carefully fettled, trimmed, freed of any loose oxide and casting gates, risers and feeder heads. All these operations must be conducted in such a way as to ensure that the appearance is satisfactory and that the casting can be fitted and can function without difficulty.

2.2.1.2 - Soundness

The parts must be sound throughout and show no defect likely to be harmful in use.

When a magnetic particle or dye penetrant test is required for the whole or part of the casting, no unit of area measuring 105 mm x 148 mm shall contain line or volume defects corresponding to a quality classification, as defined by the tables in the appendix, which is higher than that specified in the order or its appended documents.

When an ultrasonic examination is specified, the results to be obtained must be stated in the order or its appended documents.

When a radiographic examination is specified, the radiographs obtained must not reveal defects greater than those represented on the reference radiographs in Standard ASTM E 446-75 corresponding to the quality classification specified for each type of defect in the order or its appended documents.

2.2.1.3 - Texture

The texture must be fine, uniform and free from bright crystals,

2.2.1.4 - Leak and pressure tightness

The castings must withstand any leak or pressure test conditions stated in the order or its appended documents, without leakage, sweating or deformation.

2.2.1.5 - Weight

The weight and permitted tolerances shall be as stated in the purchase order or its appended documents.

2.2.2 - Geometrical characteristics

The shape, dimensions and permitted tolerances on these dimensions shall comply with those stated in the purchase order or its appended documents. Where no tolerances are given in these documents, the values in the following table shall be applied :

TABLE 1

On the distance between two rough surfaces or where only one surface is rough.

The dimensions measured in mm	Greatest dimensions of the parts		
	up to 250 mm	above 250 and up to 1000 mm	above 1000 mm
up to 40	± 1	± 1.5	± 2
above 40 up to 100	± 2	± 2	± 2.5
above 100 up to 250	± 2	± 3	± 3
above 250 up to 400	-	± 3	± 4
above 400 up to 630	-	± 4	± 5
above 630 up to 1000	-	± 6	± 6
above 1000 up to 1800	-	-	± 8
above 1800 up to 2500	-	-	± 11

TABLE 2

Over the distance between two machined surfaces :

- Linear dimensions

Nominal dimensions in millimeters	above 0.5 up to 6	above 6 up to 30	above 30 up to 120	above 120 up to 315	above 315 up to 1000	above 1000 up to 2000
Tolerances in millimetres	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2

- Angular dimensions

TOLERANCES	Length, in millimeters, of the shortest side of the angle			
	up to 10	above 10 up to 50	above 50 up to 120	above 120 up to 400
in millimeters per 100 millimeters	± 1.8	± 0.9	± 0.6	± 0.3
in degrees and minutes	± 1°	± 30'	± 20'	± 10'

On the distance between the centres of two bolt holes :

- machined : refer to Table 2
- rough : refer to Table 1

On the diameter of the bolt holes :

- obtained by drilling : refer to Table 2, but apply, as tolerances, the total of the absolute values.
- as cast : H 16.

2.2.3 - Marking

Each part shall be marked, during the casting process, with the manufacturer's particulars stated below, in the position and dimensions specified in the purchase order or its appended documents :

- the mark of the supplier,
- the identification mark of the batch,
- the date of manufacture (month and the last two figures of the year of manufacture).

3 - MANUFACTURE

3.1 - Steel-making process

The steel used for the manufacture of the castings must be made by the electric or open-hearth process, by a top blown oxygen process or by any other process accepted as equivalent by the Railway.

3.3 - Manufacture of the castings

The manufacture of the castings may only be entrusted to suppliers approved by the Railway.

3.2.1 - Type of mould and casting

Unless otherwise stated in the purchase order or its appended documents, the supplier is free to choose the type of mould and method of casting.

Coolers and core supports incorporated in the casting must be as small as possible, and their number must not exceed the minimum necessary : they must be of a grade of metal similar to that of the casting and must not show any traces of rust.

When the texture test is to be performed on a coupon attached to the casting, at least one coupon measuring 10 mm to 15 mm in thickness and 15 mm to 20 mm in width shall be cast solid on the casting for this purpose. This coupon, or one of them, if there are several, must be cast on the thickest section of the casting, and the coupons shall remain attached until all heat treatment has been completed.

At least three test blocks shall be made from each cast of metal. These blocks shall be approximately 28 mm thick and of sufficient length to allow removal of tensile and impact test specimens, also a sample for chemical analysis, and if required a specimen for testing magnetic permeability.

When the shape or the weight of the castings permits, each test block shall be cast solid with a casting, and shall not be removed until all heat treatment has been completed.

When, however, the shape or weight of the castings makes it impossible to ensure the proper feed of molten metal to the test blocks, these may be cast separately ; in this case they shall be marked and cast at the same time as the castings, from the same cast of steel, in a mould set up in the same way and made of the same material as the moulds used for the manufacture of the castings. The test blocks shall be subjected to the same heat treatment as the castings and placed near them in the annealing furnace.

3.2.2 - Heat treatment

The castings shall be subjected to a normalising heat treatment, also any other heat treatment specified in the order or its appended documents.

The normalising heat treatment must be completed before the surface hardening operation.

Surface hardening, when required, must be carried out so as to obtain the hardness characteristics specified in the purchase order or its appended documents.

3.2.3 - Machining

The surface condition of the machined castings shall be as specified in the purchase order or its appended documents.

3.2.4 - Rectification of defects, if any

The prior agreement of the Railway's representative is required on the method of rectification and especially on subsequent heat treatment procedures, before any rectification is carried out.

Surface defects may be eliminated by removal of the metal under cold conditions, provided dimensional tolerances are complied with, and that there is not even partial destruction of the effects of any previous heat treatment, or of any corrosion-proof surface coating, and provided also that such repair is not harmful to the use of the casting.

4 - INSPECTION

4.1 - Inspection during manufacture

The Railway's representative shall be given facilities for particular inspection, during manufacture, of the first castings, on which he shall make all the examinations (magnetic particle testing, cutting through certain areas, etc.) which he may consider necessary to make sure that the castings are sound.

He shall be entitled to check any stage of manufacture.

Before making the castings available for inspection, the maker shall carry out any tests specified in the order or its appended documents, such as leak and pressure testing, magnetic crack and dye penetrant testing, ultrasonic and radiographic examinations.

4.2 - Inspection of castings

4.2.1 - Submission for acceptance

4.2.1.1 - Condition of castings when submitted for acceptance

The castings shall be submitted for acceptance in delivery condition before protective treatment.

4.2.1.2 - Grouping into batches

The castings submitted shall be grouped into batches ; each batch shall include only items from the same cast of steel which have been subjected to the same heat treatment ; the batch shall not be more than 10 tonnes in weight.

4.2.1.3 - Presentation procedure

The Railway's representative shall be notified in writing of the date when the material is available for inspection. The notification shall be signed by the works manager or his authorised representative, and shall state the number of items submitted in each cast, as well as the references on the relevant purchase order.

When the material is submitted, a Certificate shall be supplied to the Railway's representative stating that the manufacturing requirements have been complied with and that any tests specified have been duly performed.

4.2.2 - Nature and proportion of the inspections and tests

The castings shall be subjected to the following inspections and tests :

Inspection or test	Number of inspections, tests or examinations per batch	
	C1	C2
- Chemical analysis	1	1
- Tensile test	1	1
- Notched bar impact test at +20°C (V-notch)	3	3 (1)
- Brinell hardness test	5% (2)	5% (2)
- Rockwell or Vickers hardness test (parts subjected to surface hardening)	5% (2)	5% (2)
- Examination of the texture	(3)	(3)
- Leak or pressure test (1)	100%	100%
- Verification of magnetic permeability (1)	1	1
- Dye penetrant test (1)	100%	100%
- Magnetic crack test	100%	100% (1)
- Ultrasonic examination (1)	100%	
- Radiographic examination (1)	100% (4)	
- Inspection of appearance - dimensions	100%	100%

(1) Performed only if specified in the purchase order its appended documents.

(2) With a minimum of 3 castings.

(3) This examination is performed by the statistical method described in Appendix 2. After prior agreement with the Railway, coupons may be left attached to castings that have not been examined, otherwise they must be removed before delivery.

(4) The number of radiographic images per batch shall be stated in the order or its appended documents.

4.2.3 - Selection and preparation of samples and test pieces

In each batch submitted, the Railway's representative shall select, at random, the test blocks and castings to be used for testing, and shall mark them indelibly.

The samples shall be cut and the test pieces machined under cold conditions, taking care that no appreciable heating of the metal occurs.

The stamp of the Railway's representative shall remain permanently on samples and test pieces, and he alone is entitled to change the place of any marking.

4.2.3.1 - Chemical analysis

Unless otherwise stated in the purchase order or its appended documents, a section of test block about 10 mm thick shall be used for the chemical analysis.

4.2.3.2 - Tensile and notched bar impact tests

Test pieces for tensile and notched bar impact tests shall be cut out parallel to the centre-line of the test block.

4.2.3.3 - Hardness

Hardness tests shall be performed on the castings at the point indicated in the order or its appended documents, or failing such indication, the point selected by the Railway's representative.

4.2.3.4 - Texture

The texture test shall be carried out on a coupon. For small castings however, the test may be performed on the casting, with the agreement of the Railway's representative.

The coupon or casting shall be notched on one side to a depth of less than 1/4 of the thickness ; the notch on the coupon shall be as near as possible to the area of the casting with which it is solid.

4.2.3.5 - Magnetic permeability

Magnetic permeability shall be tested on a test piece measuring 200 mm (±1) x 10 mm (±0.5) x 10 mm (± 0.5) cut from an unmachined bar selected as described in § 3.2.1.

4.2.4 - Inspection and test procedure

4.2.4.1 - Tensile test

The tensile test piece and test procedure shall be in accordance with Recommendation ISO/R 82 ; the gauge length shall be calculated by means of the formula :

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

4.2.4.2 - Notched bar impact test

The notched bar impact test-piece and test procedure shall be in accordance with Recommendation ISO/R 148.

4.2.4.3 - Brinell hardness test

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

4.2.4.4 - Rockwell or Vickers hardness test

The hardness tests shall be conducted in accordance with ISO Recommendations R 80 and R 81.

4.2.4.5 - Texture test

The coupons or castings for the texture test shall be broken with a hammer, the impact being applied on the notch side.

4.2.4.6 - Leak or pressure test

The leak or pressure test shall be conducted in accordance with the requirements of the order or its appended documents, which shall state the nature of the test fluid, and the duration and pressure of the test.

4.2.4.7 - Examination of magnetic permeability

Magnetic permeability shall be examined with an Ililovici permeameter.

4.2.4.8. - Dye penetrant test

When a penetrant fluid test is stipulated in the purchase order or its appended documents, the requirement shall state :

- the parts of the casting to be examined ;
- the type or types of defect to be detected, their pattern and the quality requirement with regard to each type of defect and each part of the casting.

The types of defect and quality classification are defined in the Appendix to this Technical Specification.

The choice of penetrant fluid testing process is left to the discretion of the supplier, however the operating method and products used shall be submitted to the prior approval of the Railway.

The examination to detect defects shall be performed on a casting free of any surface coating, under normal visual conditions, or with an enlargement ≤ 3 , in a lighting suitable for the process selected, on castings in delivery condition. After the examination, the castings shall be cleaned and dried before any protection against rust is applied.

4.2.4.9 - Magnetic particle test

When a magnetic particle test is required in the order or its appended documents, the following must be stated :

- the parts of the casting to be examined (1) ;
- the type or types of defect to be detected, the direction(s) of the magnetization field, the quality requirement with regard to each type of defect and each part of the casting. The types of defect and quality classification are defined in the Appendix to this Technical Specification.

(1) The other parts are examined by visual inspection only.

The equipment and method of detection used must be submitted to the prior approval of the Railway. A minimum intensity of magnetization shall be observed :

- either by measurement of induction in a cut 1 mm wide and 5 mm deep, machined in the area to be examined perpendicularly to the direction of magnetization (minimum value to be recorded in this case : $200 \cdot 10^{-4}$ tesla).
- or, in special cases and after prior agreement of the Railway, by measurement of induction on the surface of the casting in the area to be examined and perpendicularly to the direction of magnetization (minimum value to be recorded in this case : $40 \cdot 10^{-4}$ tesla).

Defects shall be detected by means of magnetic fluid, consisting of ferromagnetic powder with fluorescent coating in suspension in a carrier liquid with a good wetting power and with no chemical action on the powder or the castings ; the reference gauge to be used for magnetic crack detection shall be as defined in the Railway's national standards, or a calibration specimen approved by the Railway's representative.

The examination to detect defects shall be performed under normal conditions of vision or by magnifying ≤ 3 times under ultra-violet light. Should the shape of the castings make it necessary, detection of defects may be carried out by using dry powder, subject to the agreement of the Railway.

Unless otherwise stated in the order or its appended documents, magnetic crack detection shall be performed on castings in delivery condition, but unpainted ; no residual magnetism which would prevent proper use of the casting should remain after the inspection.

4.2.4.10 - Ultrasonic examination

When an ultrasonic examination is specified in the order or its appended documents, the areas to be examined and conditions of the examination shall be stated. Any doubtful areas shall be subjected to radiographic examination if this is stated in the order or its appended documents.

4.2.4.11 - Radiographic examination

When a radiographic examination is specified in the purchase order or its appended documents, these shall state the areas to be examined, the quality classification to be reached with regard to each type of defect, and the image quality indicator (IQI) to assess radiographic sensitivity.

All parts examined by radiography shall be identified by a clear marking which is visible on the negative.

When this examination reveals defects, the casting may be cut up, to determine accurately the extent of the defects.

4.2.4.12 - Checking of dimensions

Dimensions shall be checked by any suitable method, and in particular by means of correctly-calibrated gauges which the supplier shall place at the disposal of the Railway's representative.

4.3 - Conclusion of inspections

When any defect in appearance or dimensions is noted by the Railway's representative during inspection, the corresponding batch may be rejected. However, any casting on which a defect appears only after machining may be subjected to a special examination at the supplier's request, to demonstrate that their operating characteristics are unimpaired.

Furthermore, any unsatisfactory result of chemical analysis, tensile, notched bar impact and hardness tests, examination of texture, leak or pressure tests, and magnetic particle or penetrant fluid, ultrasonic, radiographic and magnetic permeability examinations recorded during an inspection carried out by the Railway's representative may entitle him to reject the batch in question.

No re-testing may be carried out at the manufacturer's request either with or without rectification, unless the prior written consent of the Railway is obtained.

5 - DELIVERY

5.1 - Protection against rust

Immediately after manufacture, all machined parts of castings shall be protected by greasing, oiling or any other method approved by the Railway.

Unless otherwise stated in the purchase order or its appended documents, machined parts of castings shall be given a coat of non-flaking varnish approved by the Railway after inspection and before storing or dispatch. Where castings include screw threads and plain or tapped holes, protective greasing or oiling shall be renewed.

5.1.1 - Packing

Machined castings, and those that because of their shape or dimensions may be deformed or damaged during transport, shall be protected with suitable packing.

6 - GUARANTEE

The steel castings shall be guaranteed by the maker for 2 years against any defect that can be attributed to their manufacture. This period shall run from the end of the month marked on the casting.

If the castings are fitted onto new rolling stock, the date of delivery of the vehicles on which they are fitted shall be considered as the beginning of the guarantee period.

During the guarantee period, any castings revealing defects which make them unfit for use, or are likely to reduce their service life, shall be rejected.

Where more than 5% of castings from the same delivery are found to have defects resulting in rejection, the Railway may reject the whole of the delivery.

Rejected castings shall be held at the disposal of the supplier with a view to replacement or reimbursement of their value in new condition at the date when they are taken out of service.

MAGNETIC PARTICLE AND DYE PENETRANT TESTING OF STEEL CASTINGS

1 - MAGNETIC PARTICLE TEST

1.1 - Types of defect

The following two types of defect shall be detected by means of the magnetoscopic spectra observed :

- line defects (1) revealed by a magnetoscopic spectrum, in which the greater dimension is at least three times as long as the smaller ;
- volume defects (1) revealed by a magnetoscopic spectrum forming a closed contour or a spot.

1.2 - Quality classification

The following quality classification shall apply according to the type of defect. The surface condition of the castings or parts of castings to be examined shall be such as to allow detection of defects to comply with the standard of quality required.

The appended documents must specify the areas to be examined and the corresponding standards of quality, taking into account :

- the volume or design of the casting ;

(1) In the event of doubt when identifying the type of defect, it may be necessary to magnetize the casting in two perpendicular directions.

- the geometrical particularities of the area concerned (edges where stresses occur, transition areas, connections),
- the stress factors (static and dynamic) and the natural fatigue resistance characteristics of the material.

1.2.1 - Line defects

Quality classification	Minimum surface condition required (1)		Maximum length of an individual defect mm	Aggregate length of defects in a rectangle measuring 105 mm x 148 mm	Minimum distance between defects mm
Lm1		1S2	1	1,5	20
Lm2	1S1	2S2-3S2	2	4	25
Lm3	2S1	4S2	4	6	25
Lm4	3S1-4S1	5S2	6	10 ⁽²⁾	30
Lm5	5S1-6S1	5S2	10	16 ⁽²⁾	30
Lm6	5S1-6S1	5S2	16	25 ⁽²⁾	30

1) Specimens approved by the Railway. The surface conditions mentioned in this leaflet are those of the reference specimens of the «Bureau de Normalisation des Industries de la Fonderie Française».

2) Defects less than 2 mm in length shall be disregarded.

1.2.2 - Volumes defects

Quality classification	Minimum surface condition required (1)		Maximum transversal dimension of an individual defect mm	Aggregate area of defects in a rectangle measuring 100 mm x 148 mm mm ²	Minimum distance between defects mm
Sm1		1S2	2	15	10
Sm2	1S1	2S2-3S2	4	35	10 ⁽²⁾
Sm3	2S1	4S2	6	70 ⁽³⁾	
Sm4	3S1-4S1	5S2	10	200 ⁽³⁾	
Sm5	5S1-6S1	5S2	16	500 ⁽³⁾	
Sm6	5S1-6S1	5S2	25	1200 ⁽³⁾	

(1) Specimens approved by the Railway. The surface conditions mentioned in this leaflet are those of the reference specimens of the «Bureau de Normalisation des Industries de la Fonderie Française».

(2) Defects less than 2 mm in width shall be disregarded.

(3) Defects less than 4 mm in width shall be disregarded.

2 - DYE PENETRANT TEST

2.1 - Types of defect

The following two types of defect shall be detected by means of the image observed :

- line defects revealed by an image in which the greater dimension is at least three times as long as the smaller ;

- volume defects revealed by an image forming a closed contour or a spot.

2.2 - Quality classification

The following quality classification shall apply according to the type of defect.

2.2.1 - Line defects

Quality Classification	Maximum length of an individual defect mm	Aggregate length of defects in a rectangle measuring 105 mm x 148 mm mm	Minimum distance between defects mm
Lr1	2	4	25
Lr2	4	6	25
Lr3	6	10 ⁽¹⁾	30
Lr4	10	16 ⁽¹⁾	30
Lr5	16	25 ⁽¹⁾	30

(1) Defects less than 2 mm in length shall be disregarded.

2.2.2 - Volume defects

Quality classification	Maximum number of dye penetrant spots in a rectangle measuring 105 mm x 148 mm
Sr1	5
Sr2	8
Sr3	12
Sr4	20
Sr5	31

2.3 - Condition of surfaces

The surface condition and cleanness of the castings or parts of castings shall be such as to allow detection of defects to comply with the standard of quality required.

STATISTICAL TEXTURE INSPECTION METHOD

The statistical texture inspection of steel castings shall be conducted as stated below :

1 - STATEMENT OF NON-COMPLIANCE

Any casting the texture of which does not comply with this technical specification (§ 2.2.1.3) shall be considered as defective.

2 - GROUPING INTO BATCHES

Batches shall be made up as stated in this technical specification (§ 4.2.1.2).

3 - PROPORTION OF CASTINGS INSPECTED

Number of castings in the batch (N)	Proportion of castings inspected	Rejection criterion
$N \leq 150$	13(1)	1
$150 < N \leq 500$	50	2
$500 < N \leq 1\ 200$	80	3

(1) If the number of castings in the batch is less than or equal to the number of samples required, the batch shall be inspected 100%.

APPLICATION

With effect from 1 January 1981.

All Railways in the Union.

RECORD REFERENCES

Headings under which the question has been dealt with :

- Preparation of standard specifications for :

- a) packing-rings for brake-cylinder pistons ;
- b) articles in cast steel of limited weight ;
- c) copper alloys for cocks, taps and fittings ;
- d) steel plates for locomotive fireboxes.

(5th Committee -R.S.- : Budapest, June 1958. - Board of Management : December, 1958).

- Preparation of specifications for the supply of automatic couplers.

(Traction and Rolling Stock Committee : Graz, June 1972).

- *Question 5/Sa/Fic* - Revision and amendment of leaflets managed by the Sub-Committee for Specifications.

(Traction and Rolling Stock Committee : Oslo, June 1980).