

5th edition, November 2003

Translation

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Technical specification for the supply of helical compression springs, hot or cold coiled, for tractive and trailing stock

Spécification technique pour la fourniture de ressorts en hélice de compression formés à chaud ou à froid pour matériel roulant moteur et remorqué

Technische Lieferbedingungen für warm- oder kaltgeformte Druckschraubenfedern für Triebfahrzeuge und Wagen



UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volumes:

V - Rolling Stock

VIII - Technical Specifications

Application:

With effect from 1 July 1974, except:

- point 6, 1st paragraph (guarantee period) (1.10.75)

All members of the International Union of Railways

Record of updates

4th edition, July 1974

with its erratum dated 1.10.74 and its Amendments dated 1.10.75 and 1.1.85

5th edition, November 2003

Retyped in FrameMaker and up-date of references to ISO standards following changes made between 1974 and 2003:

- ISO/R 79:1968: Brinell hardness test for steel (standard withdrawn on 1.9.1981) and

- ISO/R 80:1968: Rockwell hardness test (B and C scales) for steel (standard withdrawn on 1.11.1986)

are mentioned in the 4th edition of UIC Leaflet 822 dated 1.7.1974. SC03 of the CTR suggests ISO Standards ISO 6506-1:1999 and 6508-1:1999 respectively as replacement documents.

The person responsible for this leaflet is named in the UIC Code

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Summary

This specification governs the supply of helical compression springs, hot or cold coiled, intended particularly for use as suspension, buffing or draw gear for tractive and trailing stock.

It also applies to all springs which are comparable to the above by virtue of their functional or dimensional characteristics.

1 - Purpose

1.1 - Nature of the parts

This specification governs the supply of helical compression springs, hot or cold coiled, intended particularly for use as suspension, buffing or draw gear for tractive and trailing stock.

It also applies to all springs which are comparable to the above by virtue of their functional or dimensional characteristics.

1.2 - Classification

There shall be three categories of springs (1 - 3), taking account of the severity of the conditions to which they are subjected in service (see table in point [4.2.2.2 - page 10](#)).

The contract or the order and their appended documents must give all the relevant details necessary for the satisfactory execution of the supply in question, and in particular to enable the following paragraphs of this technical specification to be applied.

[2.1](#), [2.2.1.2](#), [2.2.1.3](#), [2.2.2 - page 3](#), [2.2.3.1](#), [2.2.3.2 - page 4](#), [2.2.3.3](#), [2.2.3.4](#), [2.2.3.5](#), [2.2.3.6 - page 5](#), [3.1 - page 7](#), [3.2.3](#), [3.2.5 - page 8](#), [4.1 - page 9](#), [4.2.2.2 - page 10](#), [4.2.2.3.2](#), 1st paragraph, [4.2.2.4.1](#), [4.2.2.4.3 - page 11](#), [4.2.2.4.5](#) and [4.2.2.4.8 - page 12](#), 1st paragraph,

Drawings of springs must specify:

- the nature of the metal and the reference number of the document governing the supply,
- the surface condition of the bars,
- the category of the spring,
- the characteristics of the spring, especially the loading deflection requirements,
- reference to this specification.

1.3 - List of reference documents

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

- *ISO Standards 683-14, 6506-1 and 6508-1.*

2 - Characteristics

2.1 - Material

The bars of steel used for the manufacture of springs to this technical specification must possess the chemical, physical, mechanical and geometrical characteristics indicated by International Standard *ISO 683-14* for the type of steel required in the drawings.

In particular, the shape and dimensions of the section and condition of the surface of the bars (as rolled or turned) shall be such that all the characteristics required of the finished spring can be obtained.

If required on the drawing, special guarantees as to the purity of the steel and the decarburisation depth shall be given by the supplier.

2.2 - Springs

2.2.1 - Physical characteristics

2.2.1.1 - Appearance

The surface of the springs shall not show any trace of scale or lack of material, or any defects which would prove detrimental in use.

No trace of arc burns or spots on the springs due to the passage of electric current following magnetic crack detection, shall be permitted.

The tapered ends of the coils shall be carefully deburred, have no sharp edge, and shall be finished by a curve to a radius sufficient to avoid accidental damage during manipulation. The deburring operation must be effected without damaging the adjacent coils.

2.2.1.2 - Soundness

The springs shall be sound throughout.

The indication obtained in the course of magnetic crack detection (or dye penetrant test), made after final shot peening where applicable, shall not show any straight or sinuous lines formed by accumulation of powder or dye.

2.2.1.3 - Protection against corrosion

Any protective coating which is required by the drawing shall at all points conform to the specification.

2.2.2 - Geometrical characteristics

The shape, dimensions and direction of coiling shall conform to the drawing. When it is not stated, the direction of coiling shall be to the right.

In the absence of a contrary indication on the drawing, the extremity of the end coil shall not have a thickness greater than 0,25 of the nominal diameter of the wire or bar after setting of the base of the spring.

Under compression, particularly in the load deflection test, the contact between the tapered end of each coil and the next turn shall be made over a length at least equal to one-third of the mean diameter of the coil of the spring in order to avoid localised contact likely to damage the surfaces.

The base of the spring shall be perpendicular to the axis of the imaginary cylinder concentric with the external surface of the coils, to the tolerances indicated in the drawing.

When these latter are not indicated, the tolerance to be applied is that indicated in the following table.

Dimensions	Tolerances
Cross section	Given in the National Standards of the purchasing Railway
Height of a spring under a load equal to 0,1 P ^a	± 2,5% ^b
Interior diameter	± 1,5%
Exterior diameter	± 1,5%
Departure from perpendicularity of the base to the axis	≤ 2% for springs ≤ 150 mm in height, ≤ 1% for springs > 150 mm in height
Parallelism of one base compared with the other	≤ 3%

a. The height is measured after subjecting a spring to the compression shown in point 4.2.2.4.3.

b. When the drawing indicates a tolerance on the height of the spring when loaded, the tolerance on free heights indicated above is not applicable.

2.2.3 - Mechanical characteristics

The mechanical characteristics as defined below shall be obtained on the springs in delivered condition, i.e. after shot peening or application of protective coating against corrosion, and after each spring has been submitted by the supplier to the test of short duration elasticity as described in point 4.2.2.4.3 - page 11 but before application of the protective coating required in point 5 - page 14.

2.2.3.1 - Compressive residual stresses obtained by shot peening

The compressive residual stresses obtained by shot peening, as required on the drawing for springs in type 1, shall comply with the conditions given in the latter.

In the absence of this information, shot peening shall be carried out so as to satisfy the requirements given in Appendix A - page 16.

2.2.3.2 - Hardness

The hardness values measured on springs shall conform to those indicated on the drawing.

2.2.3.3 - Elasticity test (short or long duration)

The springs shall be able to support, without cracking, two successive compressions effected in accordance with the indications in points 4.2.2.4.3 - page 11 or 4.2.2.4.4 - page 12, depending on whether the drawing prescribes the short duration or the long duration elasticity test.

No difference shall be observed between the height of the spring measured under 0,1 P after the first compression and that measured with the same load after the second compression, P being the load deflection characteristic given by the drawing.

The free height of the spring after the elasticity test shall be within the tolerances prescribed by the drawing, or those in point 2.2.2 - page 3.

2.2.3.4 - Load deflection characteristics

These shall conform to the drawings.

When they are not given, the load deflection characteristics shall be as follows:

1st case: tolerance on the height which the spring assumes under load P is not given on the drawing.

Ratio $\frac{L_{0,1 P} - L_P}{0,9 P}$, defines the flexibility of the spring per unit load, when $L_{0,1 P}$ and L_P are the heights measured respectively under these loads, and shall be within a tolerance of $\pm 8\%$ of the theoretical deformation under these loads.

2nd case: tolerance on the height taken up by the spring under load P is indicated on the drawing.

Ratio $2 \frac{(L_{0,4 P} - L_{0,9 P})}{P}$ or, in the case of the suspension spring, ratio $2 \frac{(L_{0,9 P} - L_{1,4 P})}{P}$, defining the deflection of the spring per unit load in which the heights $L_{0,4 P}$, $L_{0,9 P}$ and $L_{1,4 P}$ are the figures measured respectively under these loads, and shall be within a tolerance $\pm 5\%$ as compared with the theoretical deformation under load P.

2.2.3.5 - Endurance

The springs shall be able to support, without cracking, a series of deformations of which the amplitude, number and the frequency of application are indicated on the drawing, and then satisfy the short duration elasticity test (see points 2.2.3.3 - page 5 and 4.2.2.4.3 - page 11) and the load deflection test (see points 2.2.3.4 and 4.2.2.4.5 - page 12).

2.2.3.6 - Lateral deflection or bowing

When prescribed in the order, the lateral deflection shall be checked by means of a device approved by the purchasing Railway.

2.2.3.7 - Markings

Unless otherwise stipulated in the order or its appended documents, each spring with a nominal wire diameter of at least 10 mm shall carry, on the extremity of one of the end coils, hot-stamped wherever possible by means of blunt-edged stamps¹, the marks shown on the drawing, and at all events obligatorily:

- the manufacturer's mark,
- the last two digits of the year of manufacture (example: XY - 72).

For springs with a nominal wire diameter of less than 10 mm, no markings shall be required unless otherwise specified by the purchasing Railway.

1. For category 1 springs, which are under particular stress, ring marking may be stipulated.

3 - Manufacture

Manufacture of the springs covered by this technical specification may only be entrusted to factories previously approved by the purchasing Railway.

3.1 - Material

Steel bars used for the manufacture of springs shall be made to ISO International Standard 683-14.

Circular section bars intended for the manufacture of springs in category 1, and springs in category 2 when so specified in the order, must be carefully ground or turned either on a centreless grinder, or with a tool or else by any other method approved by the purchasing Railway and ensuring a comparable surface finish. This surface finish must match, for quality, either the sample supplied to the manufacturer by the purchasing Railway, or the degree of roughness prescribed by the drawing.

3.2 - Springs

3.2.1 - Forming

The springs shall be made as follows:

- when a progressive tapering of the end coils is required, this can be produced by a method chosen by the manufacturer, either hot or by cold sawing. Trimming can be done by oxy-cutting provided that no trace of the process remains in the springs in the delivery condition;
- coiling of the springs shall be done hot. There shall be given to the pitch of each end coil and on at least three quarters of the latter a value equal to the nominal diameter or nominal thickness of the wire in order to produce, after coiling, even bases;
- coiling of each end turn shall, in addition, be effected in such a manner as to satisfy the requirements of paragraph 4 of point 2.2.2 - page 3;
- in principle, after coiling, the springs shall be allowed to cool slowly in still air or under controlled cooling conditions.

However, springs with a wire diameter of 16 mm or under can be cold-coiled subject to the agreement of the purchasing Railway; the coils must then be hardened with subsequent tempering.

3.2.2 - Heat treatment

The springs shall be submitted to the heat treatment, which must consist of quenching in water or oil according to the steel used, and tempering followed by slow cooling in still air.

For the springs in category 1 and for others if the drawing requires, the heat treatment shall not be carried out until after complete cooling following hot coiling.

In order to ensure the best possible heat treatment, it is recommended that the temperature for quenching and tempering shall be determined in advance according to the chemical composition of the steel and the actual temperatures shall be within $\pm 10^{\circ}\text{C}$ of this figure.

The heat treatment shall be carried out so as to avoid deformation of the springs and any formation of scale detrimental to the performance of the spring in service, and so as to ensure the homogeneity of the characteristics of springs in the batch.

The temperatures of heat treatment shall be controlled by a recording pyrometer correctly calibrated.

3.2.3 - Shot peening

Shot peening shall be effected according to the conditions described on the drawing. In the absence of any information, shot peening shall be as uniform as possible and carried out to the specified requirements of Appendix A - page 16.

The use of shot with sharp edges is forbidden.

3.2.4 - Local repairs

All repairing is strictly forbidden and involves the rejection of the whole manufacture.

3.2.5 - Protection against corrosion

The application of protective coatings against corrosion shall be carried out in accordance with the requirements of the drawing or of the documents (ISO/R or national standards of the purchasing Railway) to which the drawing refers.

When the protection against corrosion consists of electrolysis treatment, this must be followed by degassing.

4 - Acceptance inspection

The materials to be used in the manufacture of springs and the finished springs are subject to inspection by a representative of the purchasing Railway to ascertain the quality of the material and the characteristics of the finished springs.

4.1 - Inspection during manufacture

The representative of the purchasing Railway shall be permitted to carry out all the verifications necessary to ensure that all the conditions specified by the order or its appended documents, in particular the drawings, for the manufacture at the material and of the springs, are adhered to.

The manufacturer shall furnish heat treatment temperature charts so as to verify the temperatures of the heat treatment furnaces procedure, and shall verify the effectiveness and the regularity of shot peening, when prescribed, as required by point [4.2.2.4.1 - page 11](#).

4.2 - Checking of the characteristics

4.2.1 - Material

The material used for the manufacture of the springs shall always have passed inspection and fulfilled the requirements of *ISO 683-14* before being used for production.

4.2.2 - Springs

The inspection of the characteristics of the finished springs shall be carried out in accordance with the conditions below.

4.2.2.1 - Presentation

4.2.2.1.1 - State of springs on presentation

The springs ordered with the protective coating against corrosion shall be presented before and after application of the coating.

4.2.2.1.2 - Batching

The springs shall be presented in batches. Each batch shall consist only of springs of identical manufacture from steel from the same cast and of the same heat treatment.

4.2.2.1.3 - Notification of presentation

The representative of the purchasing Railway shall be notified of the date of presentation, by a written statement signed by the manager of the producing factory or his authorised representative. This statement shall indicate, with regard to their designation, the number of springs presented in each batch, also the references on the order to which they refer.

At the time of presentation, a certificate attesting that the prescribed conditions of manufacture have been respected, and giving the result of the test which the manufacturer has carried out on his own responsibility, is delivered to the representative of the purchasing Railway.

4.2.2.2 - Type and number of checks and tests

After presentation, each batch of springs must be submitted to the tests corresponding to the category of the spring indicated by the drawing. The nature and number of tests required are indicated in the following table.

Nature of checks and tests	Category of spring			Number of springs required for batches							
	1	2	3	10 to 50	51 to 150	151 to 300	301 to 500	501 to 800	801 to 1 300	1301 to 2 000	2001 to 3 000
Effectiveness of shot peening	x			To be determined by the purchasing Railway, in agreement with the manufacturer, according to the shot peening conditions							
Hardness ^a	x	x		5	6% or more as required by the purchasing Railway's representative						
Elasticity short duration ^a	x	x	x	5	8	12	17	23	30	38	47
Elasticity, long duration	x	x		3	4	6	9	12	15	19	24
Load deflection test	x	x	x	3	4	5	7	9	11	14	17
Endurance ^b	x										
Lateral deflection or bowing	x			← All →							
Crack testing ^{c a d} (magnetic crack detection)	x	x		3	4	5	7	9	11	14	17
Appearance and dimensions	x	x	x	As required by the purchasing Railway's representative							

- a. Each spring of the batch shall, before presentation, and under the responsibility of the manufacturer, have satisfied the short duration elasticity test and, when prescribed, the hardness test and the magnetic crack detection test.
- b. This test is only carried out if required on the drawings, as an acceptance test for a new type of spring or a new method of production. It applies more particularly to cold-coiled springs.
- c. If required on the drawing, a second magnetic crack detection test (or dye penetrant test) shall be made on all springs which have satisfied all other tests prescribed.
- d. Magnetic crack testing can be replaced, by special requirements in the drawing, by dye penetrant testing.

4.2.2.3 - Sampling and preparation of the test pieces

4.2.2.3.1 - Taking of samples

The representative of the purchasing Railway shall take, at random, from each batch presented, the samples intended for tests and mark them in a permanent manner as near as possible to the end of one of the terminal coils and on a flat part of this, where possible.

The samples and test pieces must retain the stamps of the representative of the purchasing Railway.

The springs subjected to the following tests:

- long duration elasticity test,
- load deflection,
- endurance,

shall be chosen from those on which the representative of the purchasing Railway has carried out the short duration elasticity test.

4.2.2.3.2 - Preparation of test pieces

1. Verification of the effectiveness of shot peening

The test pieces and the material necessary for the verification of the effectiveness of shot peening shall conform to the indications on the drawing.

When shot peening is prescribed, without the conditions relating to the checking of the effectiveness being specified, the test pieces and material necessary for this check must conform to the indications in Appendix A - page 16.

2. Other tests

For tests such as hardness, short and long duration elasticity, load deflection, endurance, lateral deflection and general condition, the test piece shall consist of the spring itself.

4.2.2.4 - Carrying out of the checks and tests

4.2.2.4.1 - Effectiveness of shot peening

The effectiveness of shot peening is tested as indicated on the drawings.

Failing details of the method of verification, this shall be carried out in accordance with the indications in Appendix A.

4.2.2.4.2 - Hardness

The hardness test shall be made according to the requirements of ISO standards:

- *ISO 6506-1* for Brinell test,
- *ISO 6508-1* for Rockwell test.

The hardness test must be made on one of the end coils, the position being specified by the drawing.

4.2.2.4.3 - Elasticity, short duration

The spring is placed on a flat, rigid metal plate, a load equal to 0,1 P is applied, and the height measured.

The spring is then submitted to two successive compressions and the following operations are carried out:

- progressive application followed by the maintenance, for two minutes, of the elasticity test load shown on the drawing, or, if a figure is not given, of a load which deflects the spring to the closed coil position,
- release of the load,
- measurement of the height under load of 0,1 P.

4.2.2.4.4 - Elasticity, long duration

This test only differs from that defined in point 4.2.2.4.3 - page 11 in that the duration of the second compression is 48 hours.

The apparatus whereby the spring is held compressed must be designed so as to guarantee the maintenance of the load for the duration of the test.

4.2.2.4.5 - Load deflection test

The spring, placed on a flat rigid metal support, is submitted to incrementally increasing loads up to a figure indicated on the drawing.

Each load is maintained for a period of two minutes, after which the corresponding height of the spring (under load) is determined.

4.2.2.4.6 - Endurance

The spring, placed on a flat, rigid metal support, is submitted:

- first to a series of deflections of which the amplitude, number and frequency are shown on the drawing,
- then to the short duration elasticity test as defined in point 4.2.2.4.3,
- then to the load deflection test as defined in point 4.2.2.4.5.

The apparatus in which the endurance test is carried out should be designed to ensure that the spring cannot be changed during the course of the test.

4.2.2.4.7 - Lateral deflection or bowing

In cases where its determination is stipulated, an indication of the direction of the lateral force under the load prescribed in the order or the drawing shall be made directly on the springs either by means of a paint mark or with adhesive tape.

This mark is placed on the first active coil from the bottom and indicates the direction in which the lower supporting coil moves furthest away from the unloaded position.

4.2.2.4.8 - Metallurgical quality

1. Magnetic crack detection

This test shall be carried out according to the requirements of the national standards of the supplier. The sensitivity of the method employed shall, in every case, be controlled with the aid of an indication of magnetic field strength. The test shall be capable of detecting defects more or less parallel to the axis of the bar (called longitudinal defects), and those more or less transverse to the bar (called transverse defects). If no other methods are specified, those described in Appendix B - page 19 may be used.

When magnetisation is achieved by current flow in the spring, every precaution must be taken to avoid any crater or arc spot on the material of the spring.

After crack testing, the springs shall be demagnetised. The effectiveness of demagnetisation shall be verified by checking that the springs exert no attraction on a non-magnetised piece of ferromagnetic steel, or with the aid of a device such as a field strength meter.

2. Examination by dye penetrant

The spring to be examined is first carefully cleaned of all trace of oxide and then degreased and dried.

It is then impregnated with a suitable liquid having a bright colour, such as the "Organol" red, or with a fluorescent liquid.

The impregnation can be realised by painting with a brush, by immersion, by spraying.

In the case of impregnation by painting or by spraying, the surface of the spring should remain reasonably covered by the liquid for at least ten minutes to permit penetration.

The excess of dye is then removed by washing in cold water, brushing, or by cleaning with or without a solvent. The spring is then carefully dried, preferably with a stream of compressed air.

The surface of the spring thus prepared is then coated with a thin and uniform layer of developer having a good absorbing capacity for dye. The developer should remain attached to the surface of the spring, and in the case of a fluorescent dye being used, should not fluoresce itself.

The developers, of a colour contrasting with that of the dye, can be a dry powder (talc, silica) or a volatile liquid containing a colloidal solution in suspension.

Some minutes after the application of the developer, the spring shall be examined with the naked eye:

- either by normal lighting if impregnation has been effected with a coloured dye,
- or in shade or darkness and examined under ultraviolet light from a suitable lamp, if it has been impregnated with a fluorescent liquid.

4.2.2.4.9 - Checking of dimensions

Checking of dimensions is effected by any appropriate method, but particularly by using calibrated fixtures supplied by the manufacturer.

4.3 - Conclusion of the inspections

Any defects in appearance or dimensions shall lead to the rejection of the relevant part.

Any physical or mechanical characteristic not in accordance with the required conditions shall lead to rejection of the relevant batch.

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

5 - Delivery - Protection against corrosion

Failing provision to the contrary in the order or its appended documents, after inspection and stamping by the representative of the purchasing Railway, and before storage or despatch, springs which have not received a protective coating against corrosion shall be given a protective coating approved by the purchasing Railway.

6 - Guarantee

The springs shall be guaranteed for a period of one year against any defect imputable to the manufacture. This period shall count with effect from the end of the year, the last two figures of which are shown on the springs or on the collars reserved for marking attached thereto.

If the springs are to be fitted to new stock, the delivery date of the vehicles to which they are fitted shall be regarded as the date of commencement of the guarantee period.

Springs which, during the guarantee period, show defects making them either unfit for service or reducing their period of service, are rejected.

Before being finally rejected, defective springs can however be submitted to a counter examination between the purchasing Railway and the supplier, if the latter so requests.

When the counter examination confirms that the defects are definitely imputable either to the manufacture, or to a lack of protection against impact, the defective spring shall be finally rejected.

In the event that the results of the counter examination do not enable an agreement to be reached between the purchasing Railway and the supplier, experts approved by both parties shall be called in to settle the dispute. The costs shall then be borne by the party found to be responsible.

When more than 5% of springs from the same delivery show defects leading to rejection, the purchasing Railway may reject the entire supply.

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

Appendix A - Checking of the effectiveness of the shot peening by the ALMEN method

A.1 - Purpose and scope

The ALMEN method described below is applied when the order or its appended documents prescribe shot peening of the spring without specifying the methods of checking its effectiveness.

A.2 - Principle of the method

If a steel strip held in a supporting holder is shot peened on one of its surfaces only, this strip will be concave when removed from the holder, the convex surface being the shot peened side. The magnitude of the deflection depends on the effective intensity of the shot peening check.

The test piece held in this way is exposed to the same cycle of shot peening as the springs, observing the following parameters:

- speed of movement of the springs in the shot peening machine,
- velocity of projection of the shot,
- nature and dimensions of the shot.

A.3 - Equipment used

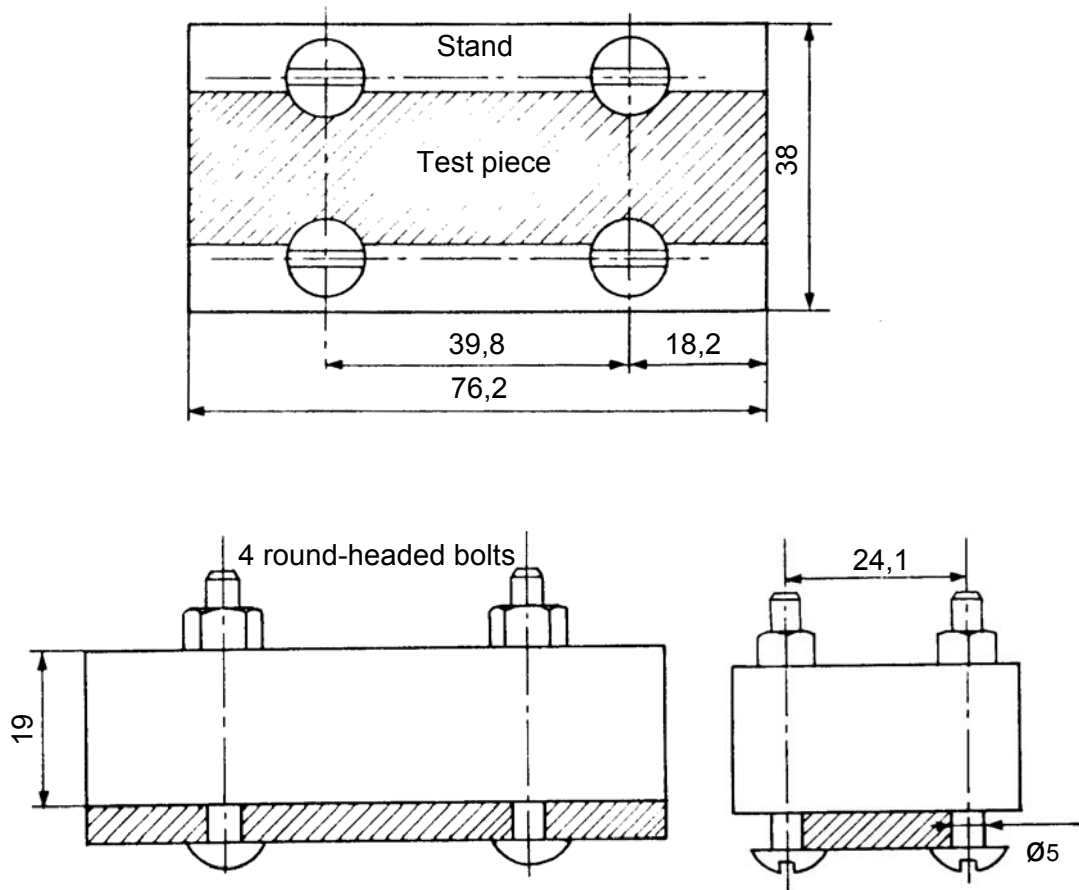
A.3.1 - ALMEN A2 test piece

Applicable for arc heights of less than 0,609 mm.

Characteristics	
Steel:	cold rolled with the following chemical composition:
	$0,65 \leq C \leq 0,73$ $0,40 \leq Mn \leq 0,70$ $0,15 \leq Si \leq 0,35$ $P \leq 0,035$ $S \leq 0,035$
Hardness:	44 - 50 HR _C
Length:	76,2 mm ± 0,4
Width:	19 mm ^{+0,05} _{-0,10}
Thickness:	1,30 mm ^{+0,02} _{-0,03}
Flatness:	± 0,04 on the height of the arc

A.3.2 - Test piece holder

The standardised test piece holder is shown in the following drawing:

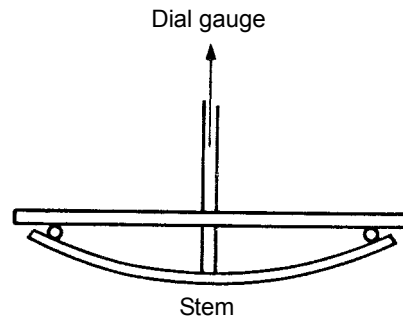


Hardness of the steel of the steel strip holder: 62 - 65 HR_C.

This test piece holder is fixed to a suitable assembly so that the test piece is exposed to the shot peening under the same conditions as the springs.

A.3.3 - ALMEN indicator

The indicator is used to determine the curvature of the test strip. It consists of a dial gauge (graduated in 1/100 mm) mounted on a plate with four hardened steel balls forming the corners of a rectangle and situated strictly in the same plane. The stem of the dial gauge is perpendicular to the centre of the rectangle. The movement of the stem makes a measurement which depends on the transverse and longitudinal curvature of the test piece.



The measurement of deflection is made on the smooth concave side to eliminate any variation due to the roughness of the shot peened surface.

A.4 - Criterion of the effectiveness of the shot peening

The effectiveness of the shot peening may be regarded as satisfactory if the deformation of the ALMEN A2 test piece used is between 0,4 and 0,5 mm, the recording being taken with the appropriate ALMEN indicator.

Appendix B - Methods of inspection by magnetic crack detection of the helical springs

B.1 - Purpose

These instructions define the method of checking by magnetic crack detection of helical springs, with a view to detecting defects more or less parallel to the axis of the bar (called longitudinal defects), and those more or less transverse to the axis of the bar (called transverse defects).

B.2 - Methods of detection

B.2.1 - Operative method

The inspection of helical springs by magnetic crack detection requires the method of magnetisation to be adapted to suit the orientation of the defects sought, i.e.:

- *longitudinal defects*: magnetisation by current flow along the axis of the wire constituting the spring (see point B.3.1 - page 22),
- *transverse defects*: induced magnetisation by passing current through a threading bar placed along the axis of the solenoid formed by the springs (see point B.4.1 - page 23).

The intensities of the magnetising currents are adjusted in relation to the dimensions of the springs, by reference to the relevant points B.3.2 - page 22 and B.4.2 - page 23.

The surface of the wire must:

- be free from anything which may decrease the sensitivity or interfere with the distribution of the magnetic powder (grease, scale, thick paint, unevenness),
- have a background capable of providing good contrast with the magnetic ink used.

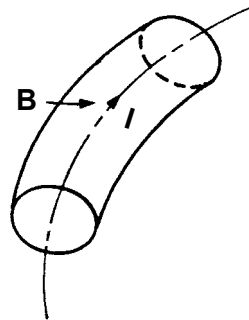
Detection is carried out by generously spraying the whole surface of the wire of the spring with magnetic ink during the magnetisation phase. The quality and concentration of iron oxide in the liquid must be checked periodically.

After the magnetisation operation, considerable residual magnetism may persist, especially at the ends of the springs. It is therefore obligatory for the magnetic crack detection to be followed by a demagnetisation operation, which may be effected by passing alternating current through the wire of the spring, and steadily decreasing the intensity from the maximum value used down to zero.

B.2.2 - Detection of longitudinal defects

B.2.2.1 - Principle

To create a circular magnetic field by passing alternating current through the wire of the spring.



B.2.2.2 - Carrying out the test

The general provisions relating to the method defined in point 2.1 - page 3 shall be complied with.

The intensity of the magnetising current passing through the spring is regulated in relation to the diameter of the wire (see point B.3.2 - page 22).

The whole spring is included in the magnetisation circuit, especially the end coils where risks of failure are highest.

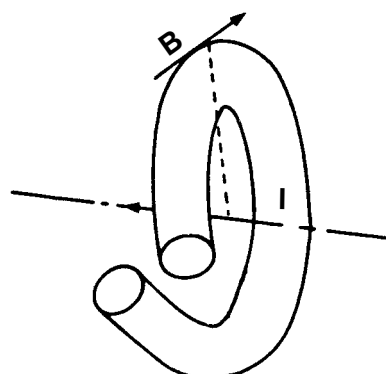
Any indication due to local accumulation of iron oxide, which persists under the conditions indicated, shall lead to rejection of the part.

To ensure a good electrical connection, it is recommended that electrodes conforming to the bases of the spring (circular plates), should be used and should make a good connection before switching on the current.

B.2.3 - Detection of transverse defects

B.2.3.1 - Principle

To create a magnetic field concentric with the axis of the spring by passing alternating current through a threading bar placed along the axis of the coils.



B.2.3.2 - Carrying out the test

The general provisions relating to the operative method defined in point 2.1 - page 3 shall be complied with.

The intensity of the magnetising current (see point B.4.2 - page 23) which must pass through the threading bar is regulated in relation to the diameter of the coils.

Any local accumulation of iron oxide, which persists under the conditions indicated, shall lead to rejection of the part.

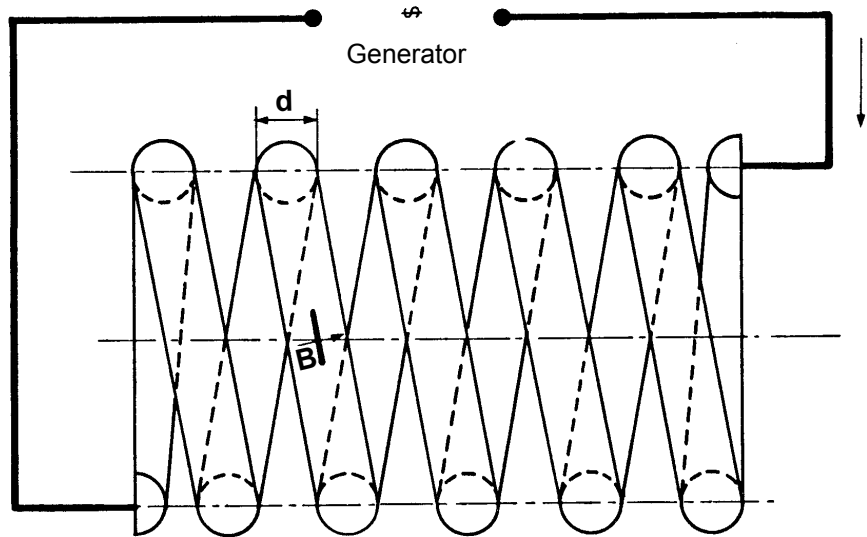
NB : the diameter of the threading bar has no effect on the sealed strength if it is not magnetic material.

Remark:

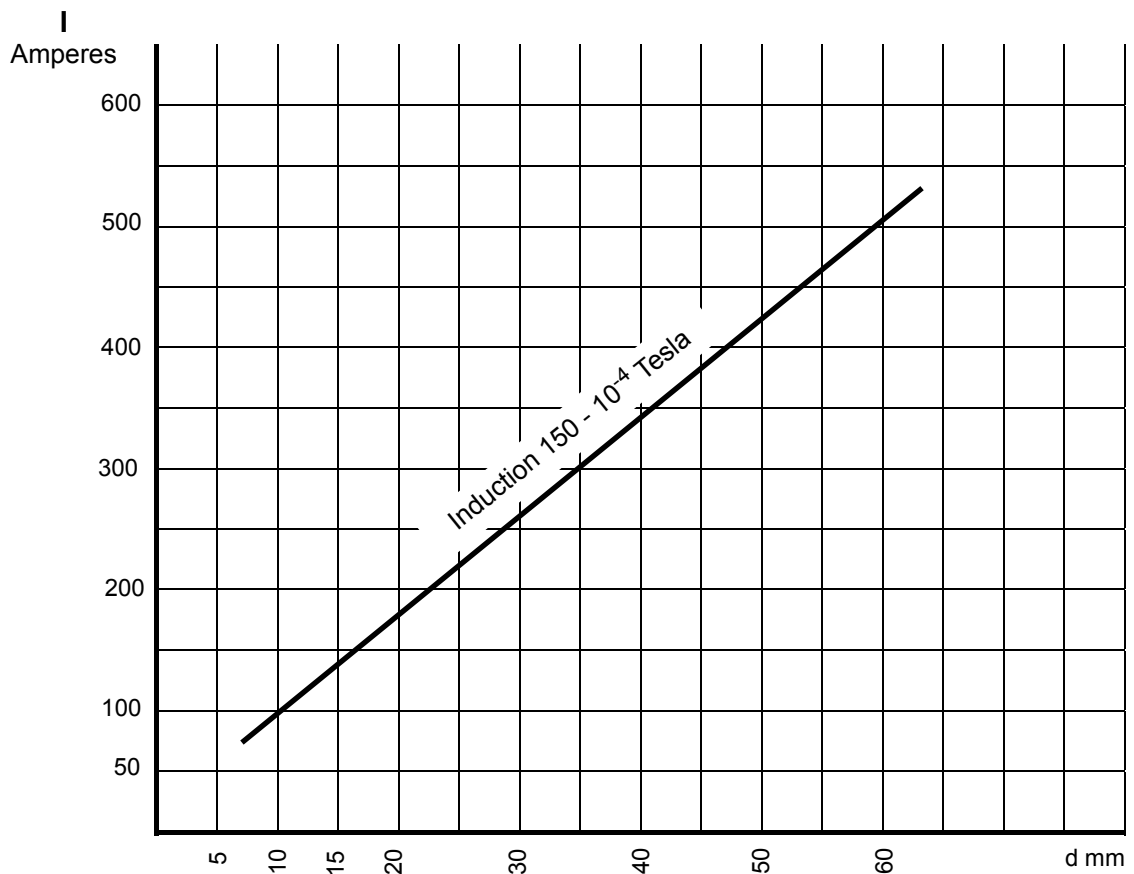
The detection of defects having other orientations than those previously mentioned, may be effected with the some magnetisation processes but with higher magnetising intensities: in this case the appearance of "longitudinal" or "transverse" crack indications need not involve systematic rejection.

B.3 - Detection of longitudinal defects

B.3.1 - Magnetic crack detection of springs

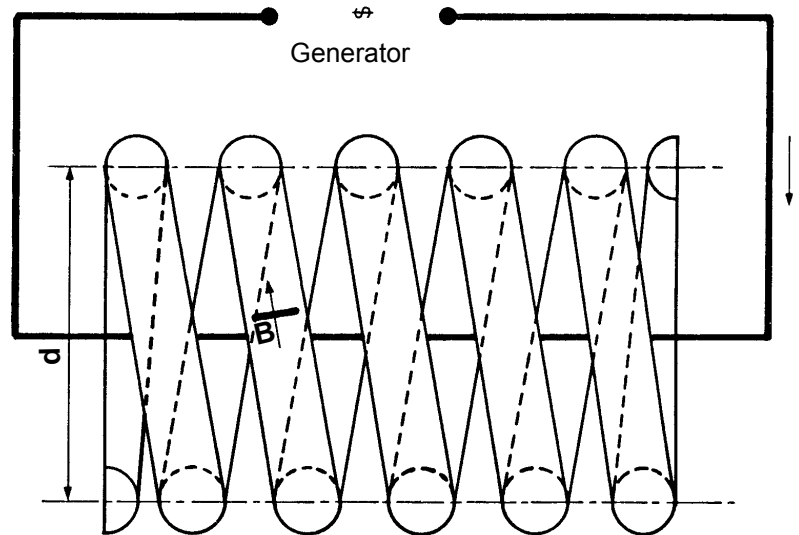


B.3.2 - Magnetising intensity in relation to the diameter of the wire for detecting longitudinal defects

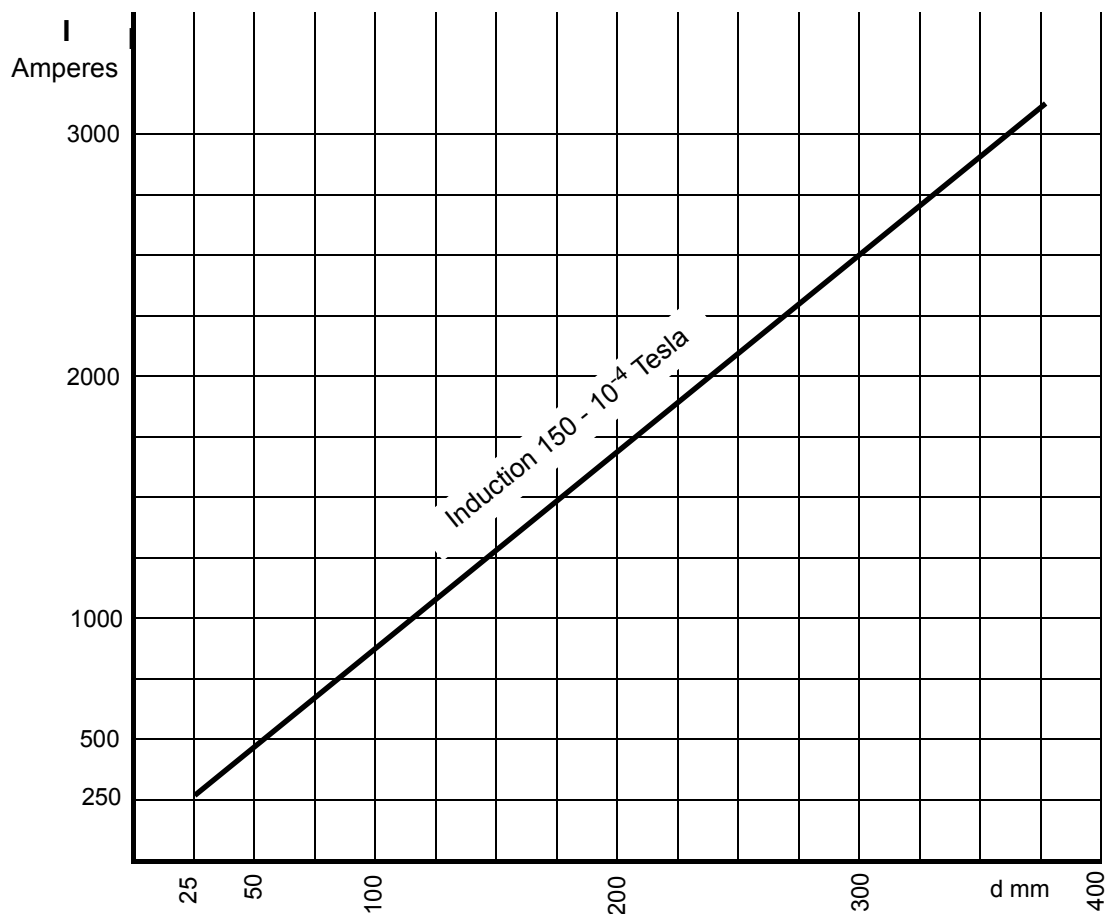


B.4 - Detection of transverse defects

B.4.1 - Magnetic crack detection of springs



B.4.2 - Magnetising intensity in relation to the diameter of the wire for detecting transverse defects



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Printed by the International Union of Railways (UIC)
16, rue Jean Rey 75015 Paris - France, November 2003
Dépôt Légal November 2003

ISBN 2-7461-0581-0 (French version)
ISBN 2-7461-0582-9 (German version)
ISBN 2-7461-0583-7 (English version)