

6th edition, December 2003

Translation

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Technical specification for the supply of spring steel flat bars for parallel leaf or volute springs

*Spécification technique pour la fourniture de barres d'acier à ressorts méplates pour ressorts à lames
parallèles ou en volutes*

Technische Lieferbedingungen für Flachfederstahl für Blatt-Oder Kegelfedern



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

Leaflet to be classified in Volumes :

V - Rolling Stock

VI - Traction

VIII - Technical specifications

Application :

With effect from 1 July 1977

All Railways in the Union; unlimited exemption is made, however, for the ÖBB.

Record of updates

5th edition, July 1977

6th edition, December 2003

Retyped in FrameMaker and update of references to ISO Standards following changes made between 1977 and 2003.

- ISO 82:1974: Steel - Tensile testing (standard withdrawn on 1.7.1984) is mentioned in the 5th edition of UIC Leaflet 820 dated 1.7.1977. SC03 of the CTR suggests ISO Standard 6892:1998 as replacement document.

- ISO R/404 is mentioned in the 5th edition of UIC Leaflet 820 dated 1.7.1977. SC03 of the CTR suggests ISO Standard 10474: 1991: as replacement document.

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Summary

The present specification defines the materials, as well as the physical, geometrical and mechanical characteristics of flat steel bars used in the manufacture of parallel-leaf or volute springs.

It describes the inspections to be carried out as part of this process.

1 - Scope

1.1 - Type of stock

This specification governs the supply of spring steel flat bars used in the manufacture of parallel leaf or volute springs for tractive and hauled stock.

All details necessary for carrying out the contract, especially those relating to application of points [2.2.1.2 - page 3](#), [2.2.3.2](#), [2.2.4 - page 5](#), [4.1 - page 7](#), [4.2.4.2 - page 8](#) of the present specification, must be indicated in the order itself or in its appended documents.

1.2 - List of reference documents

The following documents are quoted in the present Technical Specification:

- ISO Standards ([see Bibliography - page 13](#)):
 - *ISO 83*
 - *ISO 377*
 - *ISO 683-14*
 - *ISO 6892*
 - *ISO 10474*.

2 - Characteristics

2.1 - Material

The characteristics of steel used in the manufacture of bars must conform with those laid down for steels Nos. 1, 4, 6, 7, 8, 13 and 14 of ISO International Standard 683-14, supplemented with the special particulars contained in the present Specification.

2.2 - Characteristics of the bars

2.2.1 - Physical characteristics

2.2.1.1 - Appearance

Spring steel flat bars must have a smooth surface over their complete length, with no cracks, flaws, burrs, lack of material, folds or defects whatsoever likely to affect their use adversely.

2.2.1.2 - Soundness

Bars must be sound over their complete length.

When, in accordance with the conditions and procedure laid down in point 4.2.5.6 - page 10, an ultrasonic inspection is stipulated in orders for bars for the manufacture of springs falling in category 1 of *UIC Leaflet 821* (see *Bibliography - page 13*), these bars must not have:

- more than 2 irregularities per meter along the length of the bar, and then only if:
 - these irregularities are more than 150 mm apart,
 - there is no fault echo higher than half the height of the screen,
 - there is no attenuation of the base echoes of over 90%,
 - there is no indication of irregularity lasting for a probe movement of over 10 mm.

The following shall be considered to be irregularities:

- either a fault echo higher than 1/3 of the height of the screen,
- or a 50% (or more) attenuation of successive base echoes.

Whenever a bar reveals an irregularity as defined above, on being tested along two generatrices, it shall undergo additional exploratory tests along two generatrices symmetrical to the previous ones in relation to the longitudinal axis.

2.2.2 - Geometrical characteristics

Unless otherwise specified in the order or its appended documents:

- the length of bars ordered in standard lengths shall be over 5 metres (however 10% of the bars may be accepted with lengths between 3 and 5 metres, including test bars),
- tolerances relating to length shall be as follows:
 - lengths of bars ordered in multiple lengths: ± 25 mm
 - length of bars ordered in fixed lengths: $\begin{cases} + 5 \\ - 0 \end{cases}$ mm
- tolerances relating to transversal dimensions shall be as follows:

		Tolerances
<i>all bars</i>	width: ≤ 120 mm	$\pm 0,5$ mm
	> 120 mm	+ 0,7 mm - 0,5 mm
	edge thickness	$\pm 0,2$ mm
<i>grooved bars</i>	radius of groove	+ 0,5 mm + 0
	radius of rib	- 0 - 0,5 mm
	radius of neck of rib	- 0 - 0,5 mm
	radius of neck of groove	+ 1 mm + 0
	lateral distance off-centre of groove and rib:	
	width ≤ 120 mm	$\leq 0,3$ mm
	width > 120 mm	$\leq 0,5$ mm
non-coaxiality of groove and rib	$\leq 0,3$ mm	

No convexity shall be permitted on the width of the faces; the latter may be slightly concave, provided that the resulting decrease in thickness does not exceed 0.3 mm.

Straightness:

- on the flat surface: the deflection must not exceed 10 mm per metre,
- on edges: unless otherwise stipulated, the deflection measured in the surface planes with a 1 m rule must not exceed 2 mm at any point of the bar.

2.2.3 - Mechanical characteristics

2.2.3.1 - Tensile and impact strength

Mechanical characteristics obtained with test pieces selected from a sample which has been subjected to a reference heat treatment, as laid down in *ISO Standard 683-14, Table 8*, must conform with the specifications given in *Table 5* of this same standard.

Impact strength (KU) characteristics must be:

Type of steel	KU at 20°C (in joules)
4	≥ 12
6	≥ 10
13	≥ 10

2.2.3.2 - Special characteristics

Bars made of steel type No. 14 type must, if so stipulated in the order, have the following characteristics after completion of the relevant heat treatment:

- $R_{0,2} \geq 1\,280 \text{ N/mm}^2$
- $R \geq 1\,380 \text{ N/mm}^2$
- $A \% \geq 8$
- $KU \text{ at } 20^\circ\text{C} \geq 15 \text{ J}$

2.2.4 - Manufacturer's markings

Each bar shall bear the following manufacturer's marks at one of its ends, in dimensions stated in the order:

- cast number,
- manufacturer's name,
- grade of steel.

These marks may be applied by hot or cold stamping, or may be painted, in accordance with the terms of the order.

3 - Manufacture

3.1 - Manufacturing processes

Steel used for the manufacture of the bars shall be produced from killed heats of steel prepared by the open hearth or electric furnace method using a pure oxygen top blasting process or any other equivalent process authorised by the purchasing Railway.

3.2 - Removal of surface defects

Any removal of surface defects for purposes of concealment shall be strictly forbidden and shall result in rejection of the entire batch.

4 - Inspection

The bars shall be submitted to a representative of the purchasing Railway for inspection of their manufacture and characteristics.

However, if so stipulated in the order or its appended documents, the bars may be delivered with the certificate 3.1B, as laid down in *ISO Standard 10474*.

4.1 - Inspection during manufacture

Representatives of purchasing Railways must be provided with facilities for conducting any inspections they consider necessary to ensure that manufacturing conditions laid down in the order or its appended documents are properly observed.

For this purpose, the manufacturing and inspection drawings must be submitted to them and they must be kept advised of any modifications that might be made.

4.2 - Inspection of bars

4.2.1 - Submission for acceptance

The date of submission shall be announced in writing to the purchasing Railway's representative in a note signed by the Works Manager or by his authorised representative. Indication must be given in this note of the number of bars in each batch, together with the relevant order reference number.

When the bars are submitted ready for delivery, a certificate stating that the manufacturing conditions laid down have been observed, and giving results of tests and checks for which the supplier is responsible, shall be delivered to the representative of the purchasing Railway.

4.2.2 - Batch procedure

The spring steel bars shall be submitted for acceptance as ready for delivery, grouped into batches which may all contain bars of different sections, provided that they are all from the same cast.

4.2.3 - Type and proportion of inspections and tests

- Tensile test (Rm, R 0,2, A%)	}	1 series of tests per batch or part of batch < 25t
- Impact test - KU		2 series of tests per batch over 25t
- Check of chemical composition		1 per cast
- Ultrasonic inspection of Category 1 main leaf springs		all bars as laid down in the order or its appended documents
- Check of appearance and dimensions		as decided by the representative of the purchasing Railway

4.2.4 - Selection and preparation of samples and test-pieces

4.2.4.1 - Selection

The purchasing Railway's representative shall indicate which bars he/she wishes to have checked and tested in each batch. He/she shall mark them indelibly. Markings and stamps of the purchasing Railway must not be removed from test-pieces, and their transfer must take place in the presence of the purchasing Railway's representative.

4.2.4.2 - Preparation of samples and test-pieces

Unless otherwise stipulated, samples and test-pieces shall be prepared according to the *ISO Standard 377*.

A sample shall be removed from one end of the bar selected for testing, of sufficient length to allow lengthwise cutting of one piece for tensile testing and two pieces for impact testing.

Test-pieces must undergo the reference heat treatment mentioned in point [2.2.3 - page 5](#) or, for steel type No. 14 and if so stipulated in the order, the necessary heat treatment for obtaining the characteristics given in point [2.2.3](#).

4.2.4.2.1 - Tensile tests

The test-piece shall be removed lengthwise at the place shown in figure [1 - page 9](#).

4.2.4.2.2 - KU impact tests

The two test-pieces shall be removed lengthwise at the places shown in figure [1](#), near to a surface in as-rolled condition.

The generatrix of the bottom of the notch must be perpendicular to the rolled surface of the test bar.

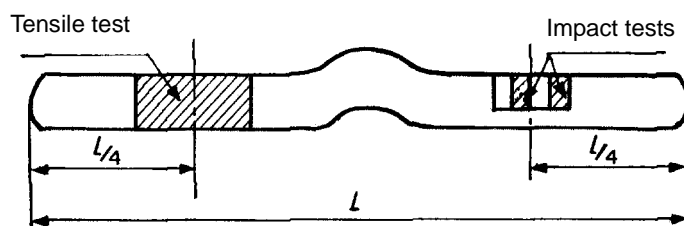


Fig. 1 -

4.2.4.2.3 - Determination of chemical composition

The chemical composition shall be determined:

- either by removal of a sample and preparation according to *ISO Standard 377*,
- or by removal of a test-piece of a quarter of the width of the bar of a spectrographic analysis is to be made.

4.2.5 - Checking and testing procedures

4.2.5.1 - Checking of dimensions

Dimensions of bars shall be checked by any appropriate means, in particular by use of gauges supplied by the manufacturer.

The conditions in point [2.2.2 - page 4](#) must be respected.

4.2.5.2 - Checking of appearance

The conditions of the surfaces shall be examined, and if there is any doubt, the representative of the purchasing Railway may use additional inspection techniques, such as penetrant fluid or magnetic crack detection.

The conditions in point [2.2.1.1 - page 3](#) must be observed.

4.2.5.3 - Tensile test

The tensile test shall be carried out in accordance with the regulations laid down in *ISO Standard 6892*.

Results obtained must comply with the conditions in point [2.2.3 - page 5](#).

4.2.5.4 - Impact test

The impact test on a U-notched test-piece shall be carried out in accordance with the regulations laid down in *ISO Standard 83*.

Neither of the two test-pieces shall give results lower than the figures contained in point [2.2.3](#).

4.2.5.5 - Checking of chemical composition

The methods for quantitative analysis of the various compounds shall be those laid down in each case by ISO Standards, or in case of dispute, any other methods acceptable to the purchasing Railway.

Chemical characteristics must comply with those laid down in point 2.1 - page 3.

4.2.5.6 - Procedure for ultrasonic inspection

4.2.5.6.1 - Basic principles

Until such time as a standard is issued by the UIC or ISO, the following method shall be used unless otherwise stipulated in the order:

- ultrasonic inspection of bars shall be carried out in accordance with the "pulse-echo" principle, using a single transmitter-receiver probe which transmits longitudinal waves propagated in a direction perpendicular to the surfaces of the bar.

If this is done, irregularities will be shown on the reflectogram:

- either by the appearance of fault echoes between the first signal and the first base echo, or between the successive base echoes,
- or by the attenuation of successive base echoes.

It should be noted that base echo attenuation may be the result of an impaired surface condition.

4.2.5.6.2 - Method of operation

The inspection shall be carried out by immersing the bar in a liquid (e.g. water...):

- in order to ensure that acoustic coupling is stable,
- and to avoid the presence, in the bar, of a large shadowed area caused by the presence of the transmission signal on the reflectogram.

The bar shall be examined by moving:

- either the bar,
- or the probe,

following the probing procedure as described below.

Several identical probes may be used for exploration.

The speed of movements must take account of the response time which may be required by an automatic monitoring system, and must also allow time for reading the peaks on the reflectogram which represent abnormal echoes.

1. Preparation

Surfaces of bars must be free of any substance which is liable to hinder penetration of ultrasonic pulses into the steel (e.g. loose scale, extensive oxidation, ...).

2. Equipment

- The usual type of ultrasonic apparatus which produces a readable reflectogram on the screen of a cathode ray tube, i.e. peaks representing fault echoes which are clearly distinct from peaks representing base echoes; there must be no blocking of the amplifier after successive base echoes.
- A water-tight probe for examination by immersion, with a frequency of 4 or 5 MHz and diameter of 10 to 15 mm.

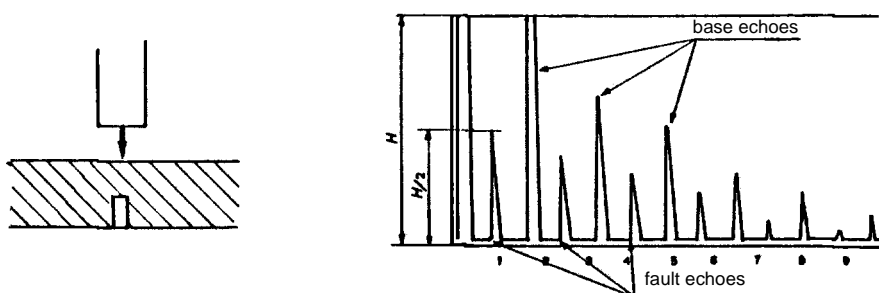
3. Settings

• Distances

A probing depth is set on the horizontal scale of the screen to allow observation of several successive movements across the bar (about 6).

• Power output and amplification

- Power output and amplification shall be adjusted simultaneously using a calibration bar of the same type as the bars which are to be inspected, and which contains artificial faults (holes with flat bottoms).
- The probe is placed opposite a hole with a flat bottom, 3 mm \varnothing , drilled to half the thickness of the bar:
 - then the maximum amplitude of the first fault echo is sought,
 - this amplitude is then set so as to reach halfway up the screen.



It is recommended that the lowest output levels (short pulses) be used, adjusting only the amplification as far as possible.

4. Operational checking

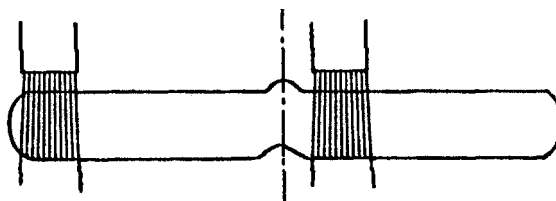
The calibration bar used for setting must undergo periodic inspection under the same conditions as are imposed for the bars which are actually subject to inspection, so as to ensure proper operational stability.

4.2.5.6.3 - Probing procedure

Probing shall be carried out from the ribbed side.

Each bar shall be examined along two generatrices:

- one outer generatrix,
- one inner generatrix.



The conditions for acceptance of bars shall be those defined in point [2.2.1.2 - page 3](#).

4.3 - Results of inspection

Any fault in appearance or dimensions, and all faults more significant than those allowed by the present Specification for the ultrasonic examination, shall result in rejection of the bar.

Any other results which fail to comply with the required characteristics shall entail rejection of the entire batch.

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3. International standards

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ISO 377: 1997: Steel and steel products. Location and preparation of samples and test pieces for mechanical testing, 1977

ISO 683-14: 1992: Heat-treatable steels, alloy steels and free-cutting steels. Part 14: Hot-rolled steels for quenched and tempered springs, 1992

ISO 6892: 1998: Metallic materials. Tensile testing at ambient temperature, 1998

ISO 10474: 1991: Steel and steel products - Inspection documents, 1991

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