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**Varmvalsade stål för seghärdade fjädrar –
Tekniska leveransbestämmelser**

**Hot-rolled steels for quenched and tempered
springs – Technical delivery conditions**

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Postadress: SIS Förlag AB, 118 80 STOCKHOLM

Telefon: 08 - 555 523 10. *Telefax:* 08 - 555 523 11

E-post: sis.sales@sis.se. *Internet:* www.sis.se

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English version

Hot-rolled steels for quenched and tempered springs - Technical delivery conditions

Aciers laminés à chaud pour ressorts trempés et revenus -
Conditions techniques de livraison

Warmgewalzte Stähle für vergütbare Federn - Technische
Lieferbedingungen

This European Standard was approved by CEN on 1 November 2002.

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Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

	page
Foreword.....	3
1 Scope	4
2 Normative references	4
3 Terms and definitions.....	5
4 Classification and designation	5
4.1 Classification.....	5
4.2 Designation.....	5
5 Information to be supplied by the purchaser.....	6
5.1 Mandatory information	6
5.2 Options.....	6
6 Manufacturing process	7
6.1 General.....	7
6.2 Deoxidation.....	7
6.3 Heat-treatment and surface condition at delivery	7
7 Requirements	7
7.1 Chemical composition, hardness and hardenability.....	7
7.2 Shearability.....	8
7.3 Structure	8
7.4 Internal soundness	8
7.5 Surface quality and decarburisation.....	8
7.6 Dimensions, tolerances on dimensions and shape	8
8 Inspection and testing.....	8
8.1 Types and contents of inspection documents	8
8.2 Specific inspection and testing	9
9 Marking	10
Annex A (normative) Supplementary or special requirements	29
A.1 Content of non-metallic inclusions	29
A.2 Non-destructive testing.....	29
A.3 Product analysis	29
A.4 Special agreements for marking	29
Annex B (informative) Maximum dimensions for rounds and flats based on the 100% hardenability scatterband (see Table 7).....	30
Annex C (informative) Dimensional standards applicable to products complying with this European Standard.....	31
Annex D (informative) Guidance values for the mechanical properties of quenched and tempered test pieces (maximum dimensions as given in Table 5)	32
Bibliography	33

Foreword

This document (EN 10089:2002) has been prepared by Technical Committee ECISS/TC 23, "Steels for heat treatment, alloy steels and free-cutting steels - Qualities and dimensions", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2003, and conflicting national standards shall be withdrawn at the latest by June 2003.

In this European Standard annex A is normative and annexes B, C and D are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

EN 10089:2002 (E)

1 Scope

1.1 This European Standard specifies the technical delivery requirements for round and flat bars, ribbed and grooved bars and rod manufactured from the alloy steels listed in Table 3, intended for hot-formed and subsequently heat-treated springs or cold-formed and subsequently heat-treated springs. The products are supplied in one of the heat-treatment conditions given for the different types of products in Table 1, lines 2 to 6, and in one of the surface conditions given in Table 2.

1.2 In special cases, variations in these technical delivery requirements or additions to them may form the subject of an agreement at the time of enquiry and order (see annex A).

1.3 In addition to the specifications of this European Standard, the general technical delivery requirements of EN 10021 are applicable.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10020, *Definition and classification of grades of steel.*

EN 10021, *General technical delivery requirements for steel and iron products.*

EN 10027-1, *Designation systems for steel — Part 1: Steel names, principal symbols.*

EN 10027-2, *Designation systems for steel — Part 2: Numerical system.*

EN 10052, *Vocabulary of heat treatment terms for ferrous products.*

EN 10079, *Definition of steel products.*

EN 10204, *Metallic products — Types of inspection documents.*

EN 10221, *Surface quality classes for hot-rolled bars and rods — Technical delivery conditions.*

EN ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997).*

EN ISO 642, *Steel — Hardenability test by end quenching (Jominy test) (ISO 642:1999).*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:1999).*

EN ISO 6508-1, *Metallic materials — Rockwell hardness test - Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)(ISO 6508-1:1999).*

EN ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*

CR 10260, *Designation systems for steels — Additional symbols.*

CR 10261, *ECISS Information Circular 11 - Iron and steel — Review of available methods of chemical analysis.*

EURONORM 103¹⁾, *Microscopic determination of the ferritic or austenitic grain size of steels.*

EURONORM 104¹⁾, *Determination of the depth of decarburization of non-alloy and low alloy structural steels.*

3 Terms and definitions

For the purposes of this European Standard, the following term and definition apply in addition to the terms and definitions given in EN 10020, EN 10052, EN 10079, EN ISO 377 and EN ISO 14284.

3.1

spring steels

materials which are, because of their properties in the quenched and tempered condition, particularly suitable for the manufacture of spring like components of all kinds. The resilience of the steels depends on their elastic deformability, which enables them to sustain loading within a given range without exhibiting any permanent deformation when the load is removed. The properties required of the steels for springs are obtained by higher carbon contents and alloying constituents such as silicon, manganese, chromium, molybdenum and vanadium, and also by heat-treatment, i. e. hardening with subsequent tempering.

4 Classification and designation

4.1 Classification

All steels covered by this European Standard are classified as alloy special steels according to EN 10020.

4.2 Designation

4.2.1 Steel names

For the steel grades covered by this European Standard, the steel names as given in the relevant tables are allocated in accordance with EN 10027-1 and CR 10260.

4.2.2 Steel numbers

For the steel grades covered by this European Standard, the steel numbers as given in the relevant tables are allocated in accordance with EN 10027-2.

¹⁾ It may be agreed at the time of ordering, until these EURONORMS have been adopted as European Standard, that these EURONORMS or the corresponding national standards should be applied.

EN 10089:2002 (E)

5 Information to be supplied by the purchaser

5.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

- a) the quantity to be delivered;
- b) the designation of the product form (e. g. round or square);
- c) the number of the dimensional standard;
- d) the dimensions and tolerances on dimensions and shape and, if applicable, letters denoting relevant special tolerances;
- e) the number of this European Standard (EN 10089);
- f) steel name or steel number (see 4.2);
- g) if appropriate, the symbol for the heat treatment condition at delivery (see 6.3.1, 6.3.2 and Table 1);
- h) if appropriate, the symbol for the surface condition at delivery (see 6.3.3 and Table 2);
- i) if required, the type of inspection document in accordance with EN 10204 (see 8.1).

EXAMPLE 20 rounds prEN 10060 - 20 × 8000
 EN 10089 - 51CrV4+A
 EN 10204 - 3.1.B

or

20 rounds prEN 10060 - 20 × 8000
EN 10089 - 1.8159+A
EN 10204 - 3.1.B

5.2 Options

A number of options are specified in this European Standard and listed below. If the purchaser does not indicate his wish to implement one of these options, the supplier shall supply in accordance with the basis specification of this European Standard (see 5.1).

- a) any requirement concerning grain size (see 7.3 and 8.2.3);
- b) any requirement concerning non-metallic inclusion content (see 7.3.2 and clause A.1);
- c) any requirement for internal soundness (see 7.4 and clause A.2);
- d) any requirement relating to surface quality (see 7.5.2);
- e) any requirement relating to removal of surface defects (see 7.5.4);
- f) any requirement concerning special marking of the products (see clauses 9 and A.4);
- g) any verification of the product analysis (see Table 10 and clause A.3).

6 Manufacturing process

6.1 General

The manufacturing process of the steel and of the products is left to the discretion of the manufacturer with the restrictions given by the requirements in 6.2 and 6.3.

6.2 Deoxidation

All steels shall be fully killed.

6.3 Heat-treatment and surface condition at delivery

6.3.1 Normal condition at delivery

Unless otherwise agreed at the time of enquiry and order, the products shall be delivered in the untreated, i. e. as rolled, condition.

6.3.2 Particular heat-treatment condition

If so agreed at the time of enquiry and order, the products shall be delivered in one of the heat-treatment conditions given in Table 1, lines 3 to 6.

6.3.3 Particular surface condition

If so agreed at the time of enquiry and order, the products shall be delivered in one of the particular surface conditions given in Table 2, lines 3 to 6.

6.3.4 Cast separation

The steels shall be delivered separated by casts.

7 Requirements

7.1 Chemical composition, hardness and hardenability

7.1.1 Table 1 gives a survey of combinations of usual heat-treatment conditions at delivery, product forms and requirements according to Tables 3 to 8 (chemical composition, maximum dimensions for a minimum core hardness, hardenability, maximum hardness).

7.1.2 Where the steel is not ordered according to core hardness or restricted hardenability requirements, i. e. where the steel type designations of Table 3, Table 6 or Table 7 and not the designations given in Table 5 or Table 8 are applied, the requirements for chemical composition, hardenability and maximum hardness cited in Table 1, (column 5) apply as appropriate, for the particular heat-treatment condition.

7.1.3 Where the steel is, by using the designations given in Table 5, ordered according to core hardness requirements, the values of core hardenability given in Table 5 or Table B.1 apply, in addition to the requirements cited in Table 1, columns 5 (1) and 5 (2). In this case, the values of end-quench hardenability given in Table 7 or Table 8 are for guidance purposes only.

NOTE The maximum dimensions given in Table 5 correspond to the restricted hardenability scatterband according to Table 8. For smaller sizes (Table B.1) the normal hardenability scatterband according to Table 7 can be sufficient.

7.1.4 Where the steel is, by using the designations given in Table 8, ordered according to restricted hardenability requirements, the values of restricted hardenability given in Table 8 apply, in addition to the requirements cited in Table 1, columns 5 (1) and 5 (2).

EN 10089:2002 (E)

7.2 Shearability

Under suitable shearing conditions (avoiding local stress peaks, preheating, application of blades with a profile adapted to that of the product, etc.) all steels are normally shearable in the as-rolled condition (+AR), except in abnormal circumstances where it may be necessary to supply in conditions +S or +A (see Table 6).

7.3 Structure

7.3.1 The steel, when tested in accordance with one of the methods described in EURONORM 103 shall show an austenitic grain size of 6 or finer.

7.3.2 For the content of non-metallic inclusions, see A.1.

7.4 Internal soundness

Requirements for internal soundness may be agreed upon at the time of enquiry and order, e.g. on the basis of non-destructive tests (see A.2).

7.5 Surface quality and decarburisation

7.5.1 All products shall have a workmanlike finish.

7.5.2 At the time of enquiry and order, agreements may be made with regard to the required surface quality.

In the case of hot-rolled round bars and rods, such agreements shall be based on the requirements of EN 10221.

7.5.3 The values for the admissible partial surface decarburisation given in Table 9 apply for the as rolled condition (+AR), for the treated to improve shearability condition (+S), for the soft annealed condition (+A) and for the annealed to achieve spheroidization of the carbides condition (+AC) and for the testing conditions given in 8.2.2.2.

7.5.4 Removal of surface discontinuities by welding is not permitted.

If surface discontinuities are to be removed by other methods, the kind and permissible depth for removal of surface discontinuities should, where appropriate, be agreed upon at the time of enquiry and order.

7.6 Dimensions, tolerances on dimensions and shape

The nominal dimensions, tolerances on dimensions and shape for the product shall be agreed at the time of enquiry and order, if possible, with reference to the dimensional standards applicable (see Annex C).

8 Inspection and testing

8.1 Types and contents of inspection documents

8.1.1 For each delivery, the issue of any inspection document according to EN 10204 may be agreed upon at the time of enquiry and order.

8.1.2 If, in accordance with the agreements made at the time of enquiry and order, a test report is to be provided, this shall cover:

- a) the statement that the material complies with the requirements of the order;
- b) the results of the cast analysis for all elements specified for the type of steel supplied.

8.1.3 If, in accordance with the agreements in the order, an inspection certificate 3.1.A, 3.1.B or 3.1.C or an inspection report 3.2 (see EN 10204) is to be provided, the specific inspections and tests described in 8.2 shall be carried out and their results shall be certified in the document.

In addition the document shall cover

- a) for all elements specified for the steel type concerned, the results of the cast analysis given by the manufacturer;
- b) the result of all inspections and tests ordered by supplementary requirements (according to Annex A);
- c) the symbol letters or numbers relating the inspection documents, the test pieces and products to each other.

8.2 Specific inspection and testing

8.2.1 Verification of the hardenability and hardness

8.2.1.1 For steels ordered with the designation given in Tables 7 or 8, unless otherwise agreed, only the end-quench hardenability requirements according to Tables 7 or 8 shall be verified.

For steels ordered without end-quench hardenability requirements but with core hardness requirements, i. e. with the symbol +CH in the designation, the hardness requirements given for the relevant heat-treatment condition in Table 1, column 5 (2) and the hardness requirements for core hardenability according to Table 5 shall be verified.

8.2.1.2 The amount of testing, the sampling conditions and the test methods to be applied for the verification of the requirements shall be in accordance with the specifications in Table 10.

8.2.2 Testing of the surface quality and decarburization

8.2.2.1 For round bars and rods, the verification of the surface quality shall be in accordance with EN 10221, unless otherwise agreed. For flat bars, the details of verification are to be agreed upon at the time of enquiry and order.

8.2.2.2 For testing the depth of decarburisation, the amount of testing is, unless otherwise agreed, left to the manufacturer. The test is carried out by using the micrographic method specified in EURONORM 104 and under the following conditions.

- For round products, the measurement starts at the deepest uniformly decarburised zone, then three further measurements are made at right angles. The average of these four measurements is then taken.
- For flat products, the measurement is carried out on the inner third of the product and is started at the deepest uniformly decarburised zone, followed by a measurement on the opposite side. The average of these two measurements is then taken.
- Surface discontinuities are excluded from decarburisation measurements.

8.2.3 Verification of grain size

In case the verification of the fine grain structure is specified, the method for determination of grain size according to EURONORM 103, the amount of testing and the testing conditions shall be agreed at the time of enquiry and order.

8.2.4 Visual and dimensional inspection

A sufficient number of products shall be inspected to ensure compliance with the specification.

8.2.5 Retests

For retests, EN 10021 shall apply.