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Cold-drawn unalloyed steel wire for springs

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(ISO 8458-2:2002, Steel wire for mechanical springs - Part 2: Patented cold-drawn
non-alloy steel wire, MOD)

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Table of Contents

Foreword.....	4
1 Scope	6
2 Normative references.....	6
3 Terms and definitions.....	7
4 Classification and marking	9
4.1 Classification	9
4.2 Marking	9
5 Order contents.....	10
6 Dimensions and shape requirements.....	10
6.1 Dimensions and allowable deviation	10
6.2 Out-of-roundness.....	12
6.3 Cast of steel wire.....	13
6.4 Straightness of straight wire	13
7 Technical requirements	14
7.1 Materials	14
7.2 Surface state and requirements.....	14
7.3 Surface quality	16
7.4 Mechanical properties	16
7.5 Process performance	16
7.6 Welding	17
8 Test methods.....	22
8.1 Dimensions and appearance.....	22
8.2 Plating.....	22
8.3 Surface quality	23
8.4 Mechanical properties.....	23
8.5 Process performance	23
8.6 Other test methods.....	23
9 Inspection rules	24
9.1 Inspection and acceptance	24
9.2 Group-batching rules	24
9.3 Spot check and sampling.....	24
9.4 Re-inspection	24
9.5 Numerical rounding and determination	24

10 Packaging, transportation, storage, marking, quality certificate	26
10.1 Packaging, transportation, storage	26
10.2 Markings and quality certificates	26
Appendix A (Informative) Comparison of structure numbers between this document and ISO 8458-2:2002	27
Appendix B (Informative) Technical differences between this document and ISO 8458-2:2002 and their reasons	28
Appendix C (Informative) Suggestions for the use of steel wires	30
References.....	33

Cold-drawn unalloyed steel wire for springs

1 Scope

This document specifies the classification and marking, order content, size and shape requirements, technical requirements, test methods, inspection rules, packaging, transportation, storage, marking, quality certificates for the manufacture of cold-drawn non-alloy steel wire for springs.

This document applies to cold-drawn non-alloy steel wire for spring (hereinafter referred to as steel wire) of circular cross-section, for the manufacture of mechanical springs for static and dynamic load applications. The standard tensile strength of special-shaped (such as square) spring steel wire can adopt the value, which is corresponding to the specification of the equivalent cross-sectional area, in this document.

This document does not apply to steel wire for the manufacture of springs, which have high fatigue strength (e.g., valve springs).

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 222 Permissible tolerances for chemical composition of steel products

GB/T 224 Determination of the depth of decarburization of steels (GB/T 224-2019, ISO 3887:2017, MOD)

GB/T 228.1 Metallic materials - Tensile testing - Part 1: Method of test at room temperature (GB/T 228.1-2010, ISO 6892-1: 2009, MOD)

GB/T 239.1 Metallic materials - Wire - Part 1: Simple torsion test (GB/T 239.1-2012, ISO 7800: 2003, MOD)

GB/T 341 Steel wire - Classification and terminology

GB/T 342-2017 Dimension, shape, mass and tolerance of cold-drawn round square and hexagonal steel wires (ISO 22034-2:2016, NEQ)

GB/T 1839 Test method for gravimetric determination of the mass per unit area of

galvanized coatings on steel products (GB/T 1839-2008, ISO 1460:1992, MOD)

GB/T 2103 General requirements for acceptance, packing, marking and quality certification of steel wire

GB/T 2976 Metallic materials - Wire - Wrapping test (GB/T 2976-2020, ISO 7802:2013, MOD)

GB/T 18253-2018 Steel and steel products - Types of inspection documents (ISO 10474-2013, IDT)

GB/T 24242.1 Non-alloy steel wire rod for conversion to wire - Part 1: General requirements (GB/T 24242.1-2020, ISO 16120-1: 2017, MOD)

GB/T 24242.2 Non-alloy steel wire rod for conversion to wire - Part 2: Specific requirements for general purpose wire rod (GB/T 24242.2-2020, ISO 16120-2:2017, MOD)

GB/T 24242.4 Non-alloy steel wire rod for conversion to wire - Part 4: Specific requirements for special purpose wire rod (GB/T 24242.4-2020, ISO 16120-4:2017, MOD)

GB/T 40342 Method for determination of aluminum content in hot dipped zinc-aluminum alloy coating on steel wire

YB/T 081 Rule for rounding off of numerical values and judgement of testing values for technical standards of metallurgy

3 Terms and definitions

The terms and definitions, which are defined in GB/T 341, as well as the following terms and definitions, apply to this document.

3.1

Patented

A heat treatment method, which places the medium carbon steel or high carbon steel, that was heated for austenitizing, in a hot bath of appropriate temperature (such as lead bath, salt bath, water bath, etc.) OR in a forced air flow (such as controlled air cooling after rolling in a steel mill), for cooling purposes, to obtain sorbite or sorbite-based metallography.

[Source: 5.50 of GB/T 7232-2012, and 3.3.14 of GB/T 341-2008, with modifications]

3.2

The 4.50 mm galvanized steel wire, which has high tensile strength grade AND is suitable for statically loaded springs, is marked as:

4.50-SH-ZN-GB/T 4357-2022

5 Order contents

The order contracts under this document shall contain the following requirements:

- a) This document number;
- b) Nominal diameter of steel wire;
- c) Quantity;
- d) Classification code (Table 1);
- e) Surface state (7.2);
- f) Delivery form (10.1) and unit weight (if there are specific requirements);
- g) Other requirements.

6 Dimensions and shape requirements

6.1 Dimensions and allowable deviation

6.1.1 The allowable deviation of the diameter of the coiled steel wire shall meet the requirements of Table 2. The allowable deviation of the diameter of the straight steel wire shall meet the requirements of Table 3.

6.1.2 For the length deviation of the straight steel wire, it shall select an appropriate level, according to GB/T 342-2017. If there is no requirement, it is defaulted to level III.

7.3 Surface quality

7.3.1 The surface of the steel wire shall be smooth; there shall be no surface defects, such as pull marks, tears, rust, burrs, etc., which have obvious adverse effects on the application of the steel wire.

7.3.2 The steel wires (DM and DH), for dynamic load springs, shall be subjected to surface inspection. The radial depth of cracks or other surface defects shall comply with the requirements in Table 6. By mutual agreement, eddy current testing can be carried out.

7.3.3 For the steel wire for dynamic load spring (DM and DH), the full decarburization layer shall not appear on the cross section, whilst the radial depth of the partial decarburization shall not be greater than the value, which is specified in Table 6.

7.4 Mechanical properties

7.4.1 The tensile strength and reduction in area of the steel wire shall meet the requirements of Table 6.

7.4.2 The fluctuation range of the tensile strength of the same coil of steel wire shall meet the requirements in Table 7. Table 7 is not applicable to steel wire, which is galvanized or plated with zinc-aluminum alloy. If there is requirement, it shall be negotiated separately.

7.5 Process performance

7.5.1 Winding test

When requested by the purchaser, the steel wire, which has a nominal diameter of less than 3.00 mm, may adopt winding test; it shall not have any cracks.

7.5.2 Torsion test

7.5.2.1 The torsion test shall be carried out, for the steel wire which has a nominal diameter in the range of $0.70\text{ mm} < d \leq 6.00\text{ mm}$. For the steel wire, which has a nominal diameter in the range of $6.00\text{ mm} < d \leq 10.00\text{ mm}$, the torsion test shall be determined, by both parties through negotiation. The steel wire shall not break, when twisted to the numbers, which are specified in Table 6, according to the requirements of GB/T 239.1; there shall be no torsional cracks or delamination, on the surface.

7.5.2.2 The test shall be carried out until fracture. The initial fracture surface shall be perpendicular to the axis of the steel wire AND the surface shall not be torn. When the steel wire is twisted back, the possible second fracture shall be ignored.

8.3 Surface quality

8.3.1 Visual inspection shall be adopted, for the appearance and surface quality.

8.3.2 Depth of surface defect: It is measured on the cross-section of the steel wire, by metallographic method. Acid leaching can be used for steel wires, which have a nominal diameter of not less than 2 mm; there shall be no surface defects after acid leaching. In case of dispute, it shall use the metallographic inspection. The acid leaching test method is as follows: Before the test, the specimen can be subjected to stress relief treatment; then the normal temperature specimen is immersed in a solution, which has a temperature of 75 °C and a volume ratio of hydrochloric acid to water of 1:1. The acid leaching is terminated, after the diameter is reduced by about 1%. Visually check whether there is surface defect.

8.4 Mechanical properties

The tensile strength shall be calculated, from the measured diameter.

When measuring the size required for calculating the reduction of cross-section, the measurement error shall not be greater than $\pm 1\%$.

8.5 Process performance

8.5.1 Winding test: The steel wire is tightly wound at least four turns, on a mandrel, which has a diameter equal to its own diameter. Then the surface is visually inspected.

8.5.2 Method of bending test: Bend the steel wire 180° around a mandrel into a U shape; then visually inspect the surface. For steel wires, which have a nominal diameter greater than 3.00 mm but not greater than 6.50 mm, the diameter of the mandrel is twice the nominal diameter of the steel wire. For steel wires, which have a nominal diameter greater than 6.5 mm, the diameter of the mandrel is three times the nominal diameter of the steel wire.

8.5.3 Coil spring test method: Take a specimen, which is about 500 mm long. The steel wire is tightly wound, by a relatively uniform slight tension. The diameter of the mandrel is 3 ~ 3.5 times the nominal diameter of the steel wire, which is not less than 1.00 mm. Then pull open the steel wire ring next to each other, so that the static length after unloading is about 3 times the original length.

8.6 Other test methods

Other test methods shall comply with the provisions of Table 8.

9 Inspection rules

9.1 Inspection and acceptance

Unless there is a special agreement between the supplier and the buyer, all tests shall be carried out at the supplier's premises.

9.2 Group-batching rules

Unless there is an agreement between the supplier and the buyer, the steel wire shall be accepted in batches.

A production batch consists of steel wires of the same designation, the same heat number (or the same production batch number), the same shape, the same dimension, the same delivery state.

9.3 Spot check and sampling

The sampling location is any end of a piece of steel wire; take one sample from each piece.

Sampling ratio requirements shall be in accordance with Table 8. When taking 10% of the number of steel wire pieces, in each production batch, take a maximum of 10 pieces; but for a batch of 20 pieces or less, take at least 2 pieces.

9.4 Re-inspection

The re-inspection and judgment rules of steel wire shall be carried out, in accordance with the provisions of GB/T 2103.

9.5 Numerical rounding and determination

If it is not specified in the test method, the rounding of the test results of the steel wire and the judgment of the test value shall be carried out, according to YB/T 081.

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