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SELECTION AND PREPARATION OF SAMPLES AND TEST PIECES FOR WROUGHT STEEL

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BRIEF HISTORY

The ISO Recommendation R 377, *Selection and Preparation of Samples and Test Pieces for Wrought Steel*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1953 and led, in 1962, to the adoption of a Draft ISO Recommendation.

In October 1962, this Draft ISO Recommendation (No. 527) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Australia	Germany	Portugal
Austria	Hungary	Romania
Belgium	Iran	Spain
Burma	Ireland	Sweden
Canada	India	Switzerland
Chili	Italy	Turkey
Czechoslovakia	Japan	United Kingdom
Denmark	Netherlands	U.S.A.
Egypt	New Zealand	U.S.S.R.
Finland	Norway	Yugoslavia
France	Poland	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in August 1964, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 377 August 1964

SELECTION AND PREPARATION OF SAMPLES AND TEST PIECES FOR WROUGHT STEEL

1. SCOPE

The object of this ISO Recommendation is to define the operations by which test pieces for mechanical tests and samples for chemical analysis are obtained from a wrought steel product.

The product from which test pieces for mechanical tests are selected can be either one of the products presented for acceptance, or a sample-product, depending upon the requirements of the order.

2. SELECTION AND PREPARATION OF SAMPLES AND TEST PIECES FOR MECHANICAL TESTS

2.1 General

The requirements specified vary according to whether the tests are used to determine the characteristics:

of the condition at the time of delivery, or

of some other condition, different from the delivery condition.

The tests should be carried out in accordance with the test methods specified in the material specification.

2.2 Definitions

2.2.1 *Sample.* Material taken from a product for the purpose of producing one or more test pieces.
In certain cases, the sample may be the product itself.

2.2.2 *Test piece.* Part of the sample, with specified dimensions, unmachined or machined, and suitably prepared for the test.
In certain cases the test piece may be the sample itself.

2.2.3 *Test.* Sequence of operations to which the test piece is subjected to determine whether the material meets the specified requirements.

2.2.4 *Selection of the sample.* Sequence of operations by which a sufficient quantity of material is obtained for the provision of the test pieces necessary for the specified tests.

2.2.5 *Preparation of the sample.* Sequence of operations (cf.2.3.4.3) which provides a sample in the condition required for the preparation of the test piece.

2.2.6 *Preparation of the test piece.* Sequence of operations on the test sample (cf. 2.2.4 and 2.2.5) by which a test piece is prepared for testing.

2.3 Method of selection and preparation of the sample

2.3.1 *Location of the sample*

The sample is taken so that the location and orientation of the test pieces in relation to the product correspond to the requirements of the material specification.
The sample should be large enough to allow the manufacture of the test pieces necessary to carry out the required tests.

2.3.2 *Identification of the sample*

Each sample should be marked in such a manner that, after removal, is it still possible to identify it with the product from which it was taken and, if required, its location and orientation in the product. Therefore, if, during the course of subsequent operations, removal of the marks cannot be avoided, new marks should be made before the previous marks are removed. These new marks should be made in the presence of the inspector, if he so desires.

2.3.3 *Test on product in delivery condition*

2.3.3.1 CUTTING

Unless otherwise agreed, the sample should not in general be removed until after the completion of all the mechanical or heat treatment operations that the product has to undergo before delivery.
In exceptional cases where the sample cannot remain attached to the product until manufacture has been completed (for example, when plates are sheared before annealing, the sample being taken from the shear scrap), the stage at which the sample is cut from the product is specified by the material specification or by special agreement. The treatments that the sample subsequently undergoes are as far as possible the same as those given to the product; in particular, it is heat-treated as a rule at the same time and under the same conditions as the product itself.
The cutting should be done in such a manner that it does not change the characteristics of the part of the sample from which the test pieces are made.

2.3.3.2 STRAIGHTENING

When it is necessary to straighten a sample in order to make correct test pieces from it, unless otherwise agreed, this should be done cold. Straightening is not considered as mechanical treatment within the meaning of clause 2.3.4.3.provided it does not cause appreciable work hardening.
If, in exceptional cases, the straightening causes an appreciable change in the form of the sample, the method of preparation should be agreed by the parties. Failing agreement, new samples should be selected, using a method which obviates the straightening.
Straightening is not permitted in samples which are to be used for the preparation of test pieces for impact tests.

2.3.3.3 PREPARATION

The sample should not be subjected to any further manipulation or treatment.

2.3.4 *Test on product in a given condition distinct from the delivery condition*

2.3.4.1 CUTTING

The sample is cut from the product at the stage of manufacture specified by the material specification.
Cutting may be done by any process, provided this does not cause a change remaining after subsequent heat treatment. Where a change would occur, sufficient extra material should be provided.

2.3.4.2 STRAIGHTENING

Straightening, before heat treatment, may be done either hot or cold.

2.3.4.3 PREPARATION

(*a*) *Mechanical treatment*

The material specification should specify the requirements for mechanical treatments (for example, forging, rolling, drawing, etc.) which the sample may undergo, particularly with reference to the initial and final dimensions of the sample.

(*b*) *Machining in preparation for heat treatment*

When a sample is to be made smaller for the purposes of heat treatment, the material specification prescribes the dimensions to which it is to be reduced. When necessary, the material specification should also give the process by which this is to be done.

(*c*) *Heat treatment*

The heating of a sample for heat treatment should take place in a furnace or a bath where the uniformity of the temperature is adequately assured. Heating in a forge or with an oxyhydrogen blow-pipe is prohibited.

The temperature reached by the sample is measured by an appropriate apparatus.

The heat treatment should conform to the requirements of the material specification.

In general, a test sample should not be given the required heat treatment more than once, and any subsequent re-tests should be carried out on a new sample.

2.4 Method of preparing the test piece

2.4.1 *Identification of the test pieces*

Each test piece should be marked in such a manner that, after machining, it is still possible to identify it with the product from which it was taken and, if required, its location and orientation in the product. Therefore, if, during the course of the preparation of the test piece, removal of the identification marks cannot be avoided, new marks should be made before the previous marks are removed. These new marks should be made in the presence of the inspector, if he so desires.

2.4.2 *Machining*

Machining should be carried out cold, and precautions should be taken to avoid superficial work-hardening and appreciable heating of the metal.

If, after machining, the test piece has tool marks which might be detrimental to the results of the test, they may be removed either by grinding (with ample coolant supply) or by polishing with a fine file and emery paper, provided that the method of removal chosen maintains the dimensions and shape of the test piece within the tolerances shown in the ISO Recommendation for the appropriate test.

The dimensional tolerances of the test pieces are specified in the relevant test method standards (see ISO Recommendations R 82 — *Tensile testing of steel*, R 204 — *Non-interrupted creep testing of steel at elevated temperatures*, R. 205 — *Determination of proof stress and proving test for steel at elevated temperatures*, R 206 — *Creep stress rupture testing of steel at elevated temperatures*).

2.4.3 *Treatment*

Any treatment of the test piece, and the stage of manufacture, and the dimensions in which it is carried out, should be specified by the material specification.

If it is a heat treatment, these provisions are the same as those for the sample (see clause 2.3.4.3 (*c*)).

3. SELECTION AND PREPARATION OF SAMPLES FOR CHEMICAL ANALYSES

Note. — The clauses of this section do not apply to the special methods, such as spectrographic methods, for which other conditions would be necessary.

3.1 Definitions

3.1.1 *Sample-product.* Product from which the sample is selected.

NOTE. — Samples taken at the time of casting are also considered as sample-products.

3.1.2 *Sample.* Quantity of finely divided material taken from a normal section of the sample-product so as to represent the average chemical composition of this section.

NOTE. — Where products are liable to chemical changes in the surface, decarburization, for example, it may be agreed to discard from the sample the parts (i.e. the surface) that have undergone chemical change.

3.1.3 *Sample for chemical analysis.* Part of the sample taken in such a manner as to represent the average chemical composition and intended to be used for the analysis proper.
The appropriate ISO Recommendations for methods of analysis should state the additional processes which the sample for chemical analysis should undergo in the laboratory to prepare it for the analysis proper.

3.2 Method of selecting samples

3.2.1 *Selection and identification*

The sample-products required by particular specification or called for by the inspector should be provided with the necessary reference numbers or other identification marks. The samples should be selected from these sample-products.

3.2.2 *Location*

The selection is made in the section at the location specified by the material specification. Failing a standard specification, the locations are spread evenly over the whole section.

3.2.3 *Preparation of the location*

If necessary, the metal is completely cleaned, at the location, by sand blasting, grinding or any other suitable method, and finally degreased by means of a suitable solvent. After preparation, the locations should be kept perfectly clean.

3.2.4 *Method of selection*

If the sample is to be taken from the whole of the section, planing, milling or turning should be used. If the sample may be taken from a part of the section only or from prescribed locations, drilling or one of the above-mentioned processes can be used, as required.

3.2.4.1 SPECIAL PRECAUTIONS

No water, oil or any other lubricant may be used.
The metal should not be heated to the point of oxidation.

3.2.4.2 PARTICLE SIZE

The particles obtained should be small enough to reduce to a minimum the subsequent operation of fragmentation carried out on the sample before chemical analysis (see clause 3.3.1).