INTERNATIONAL STANDARD

ISO 6361-1

Second edition
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Wrought aluminium and aluminium alloys — Sheets, strips and plates —

Part 1: Technical conditions for inspection and delivery

Aluminium et alliages d'aluminium corroyés — Tôles, bandes et tôles épaisses —

Partie 1: Conditions techniques de contrôle et de livraison

Reference number
ISO 6361-1:2011(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6361-1 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 6, *Wrought aluminium and aluminium alloys*.

This second edition cancels and replaces the first edition (ISO 6361-1:1986), which has been technically revised.

ISO 6361 consists of the following parts, under the general title *Wrought aluminium and aluminium alloys — Sheets, strips and plates*:

— *Part 1: Technical conditions for inspection and delivery*

— *Part 2: Mechanical properties*

— *Part 3: Strips: Tolerances on shape and dimensions*

— *Part 4: Sheets and plates: Tolerances on shape and dimensions*

— *Part 5: Chemical composition*

Wrought aluminium and aluminium alloys — Sheets, strips and plates —

Part 1:
Technical conditions for inspection and delivery

1 Scope

This part of ISO 6361 specifies the technical conditions for inspection and delivery of wrought aluminium and aluminium alloy sheets, strips and plates for general engineering applications.

It applies to flat-rolled products with a thickness over 0,15 mm up to and including 400 mm.

It does not directly apply to semi-finished rolled products in coiled form to be subjected to further rolling (reroll stock) or to special applications, such as aerospace, can stock, fin stock, etc.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6361-2:2011, *Wrought aluminium and aluminium alloys — Sheets, strips and plates — Part 2: Mechanical properties*

ISO 6361-3:2011, *Wrought aluminium and aluminium alloys — Sheets, strips and plates — Part 3: Strips:Tolerances on shape and dimensions*

ISO 6361-4:2011, *Wrought aluminium and aluminium alloys — Sheets, strips and plates — Part 4: Sheets and plates: Tolerances on shape and dimensions*

ISO 6361-5:2011, *Wrought aluminium and aluminium alloys — Sheets, strips and plates — Part 5: Chemical composition*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7438, *Metallic materials — Bend test*

ISO 9591, *Corrosion of aluminium alloys — Determination of resistance to stress corrosion cracking*

ISO 11881, *Corrosion of metals and alloys — Exfoliation corrosion testing of aluminium alloys*

ASTM E34, *Standard Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys*

ASTM G34, *Standard Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)*

ASTM G47, *Standard Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products*

ASTM G66, *Standard Test Method for Visual Assessment of Exfoliation Corrosion Susceptibility of 5XXX Series Aluminum Alloys (ASSET Test)*

ASTM G67, *Standard Test Method for Determining the Susceptibility to Intergranular Corrosion of 5XXX Series Aluminum Alloys by Mass Loss After Exposure to Nitric Acid (NAMLT Test)*

ASTM E716, *Standard Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis*

ASTM B557M, *Standard Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products [Metric]*

ASTM E607, *Standard Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere*

ASTM E1251, *Standard Test Method for Analysis of Aluminum and Aluminum Alloys by Atomic Emission Spectrometry*

EN 485-1, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 1: Technical conditions for inspection and delivery*

EN 14242, *Aluminium and aluminium alloys — Chemical analysis — Inductively coupled plasma optical emission spectral analysis*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
sheet
rolled product that is rectangular in cross-section with nominal thickness less than 6 mm, but not less than 0,20 mm, and with slit, sheared or sawed edges

NOTE 1 A sheet can be supplied in a corrugated, embossed, coated, edge-conditioned or perforated form.

NOTE 2 A sheet between 3 mm and 6 mm is sometimes called “shate”.

NOTE 3 In some regions, the term “sheet” is only used for rolled products supplied in straight length; for coiled sheet, the term “strip” is used.

NOTE 4 In the USA, there is an overlap in the thickness range 0,15 mm to 0,20 mm defined for foil and sheet. Sheet products in this gauge range are supplied according to sheet product specifications.

3.2
strip
flat-rolled product of rectangular cross-section with uniform thickness less than 6 mm, but not less than 0,20 mm, supplied in coils usually with trimmed edges, with thickness not exceeding one-tenth of the width

NOTE 1 Corrugated, embossed (with patterns, for example grooves, ribs, checkers, tears, buttons, lozenges), coated, edge conditioned and perforated products in this general form when derived from strip as defined above are classified as strip.

NOTE 2 Strip is sometimes called coil.

3.3
plate
rolled product that is rectangular in cross-section and with thickness not less than 6 mm with sheared or sawn edges

3.4
inspection lot
consignment, or a part thereof, submitted for inspection, comprising products of the same grade or alloy, form, temper, thickness or cross-section, and processed in the same manner

3.5
heat-treatment batch
heat-treatment lot
quantity of products of the same grade or alloy, form, thickness or cross-section and produced in the same way, heat-treated in one furnace load, or such products so solution-treated and subsequently precipitation-treated in one furnace load

NOTE 1 More than one solution-treatment lot may be included in a furnace load.

NOTE 2 For the heat-treatment in a continuous furnace, the products heat-treated during a period of time less than 8 h may be considered as belonging to the same heat-treatment lot. The limit of 8 h may be exceeded, in the case of a heavy plate solution-treated in a continuous furnace.

3.6
sample
one or more products taken from an inspection lot

3.7
specimen
one or more pieces taken from each product in the sample, for the purpose of producing test pieces

3.8
test piece
piece taken from each specimen and suitably prepared for the test

3.9
test
operation to which the test piece is subjected in order to measure or classify a property

4 Orders or tenders

The order or tender shall define the product required and shall contain the following details:

a) type and form of product:

   — designation of the aluminium or aluminium alloy;

   — form of the product (sheet, strip, plate, etc.);

b) metallurgical temper (degree of hardness or heat treatment condition) of the material for delivery and, if different, metallurgical temper for use;

c) number of this part of ISO 6361 or specification number, or, where none exists, properties agreed between the supplier and the purchaser;

d) dimensions and shape of the product (thickness, width, length, diameter of the coil);

e) tolerances of the dimensions and form, with reference to the appropriate part of ISO 6361;

f) quantity;

g) any requirements for certificates of conformity, test and/or analysis;

h) any special requirements agreed between the supplier and the purchaser (for example drawings).

5 Requirements

5.1 Production and manufacturing processes

Unless otherwise specified in the order, the production and manufacturing processes shall be left to the discretion of the producer. Unless it is explicitly stated otherwise in the order, no obligation shall be placed on the producer to use the same processes for subsequent and similar orders.

5.2 Quality control

The supplier shall be responsible for the performances of all inspection and tests required by the relevant International Standard or specification, prior to shipment of the product. If the purchaser wishes to inspect the product at the supplier's works, he shall notify the supplier at the time of placing the order.

5.3 Chemical composition

The chemical composition shall comply with the requirements specified in ISO 6361-5.

If the purchaser requires content limits for elements not specified in ISO 6361-5, these limits shall be stated in the order document.

5.4 Mechanical properties

The mechanical properties shall be in conformity with those specified in ISO 6361-2 or those agreed upon between the supplier and the purchaser and stated on the order.

5.5 Corrosion behaviour

Products made of 5XXX alloys with nominal magnesium content equal to or higher than 3 % in the H116 and H321 tempers shall be capable of exhibiting no evidence of exfoliation corrosion when subjected to the ASTM G66 accelerated exfoliation corrosion susceptibility test and/or intergranular corrosion susceptibility according to ASTM G67.

Plate exhibit, made of alloys 7010 and 7075 in the T73 and T7351 tempers and over 25 mm in thickness, shall exhibit no evidence of stress-corrosion cracking when tested in accordance with ASTM G47 or with ISO 9591.

Products made of alloys 7010 and 7075 in the tempers T76 and T7651 shall exhibit evidence of exfoliation corrosion below grade EB only, as defined in ASTM G34 or ISO 11881, when subjected to the test specified in 6.2.8.2.

Plate exhibit, made of alloys 7050 in the T7451 and T7651 tempers and over 20 mm in thickness, shall exhibit no evidence of stress-corrosion cracking when tested. The test method is given in the footnotes of Table 57 in ISO 6361-2:2011.

5.6 Surface finish

The products shall be free from defects detrimental to their use. Whilst an operation designed to mask a fault is not permitted, the elimination of a superficial fault is permissible, provided that the dimensional tolerances continue to be observed.

5.7 Dimensional tolerances

The dimensions and form tolerances shall be in conformity with ISO 6361-3 for strip and ISO 6361-4 for sheet, or with the International Standard agreed between the supplier and the purchaser and stated on the order.

Unless otherwise agreed, the purchaser may only reject those products having dimensions not complying with the specified tolerances.

6 Test procedure

6.1 Sampling

6.1.1 Chemical analysis

The specimens for chemical analysis shall be taken at the time of casting. Their shape and conditions of production (mould design, cooling rate, mass, etc.) shall be so designed that their composition is homogeneous, and shall be suitable for the method of analysis.

6.1.2 Specimens for mechanical testing

6.1.2.1 Location and size

Specimens shall be taken from samples in such a way that it is possible to orientate the test pieces in relation to the product, as specified in 6.1.2.2.

The specimens shall be large enough to allow the manufacture of sufficient test pieces for the required tests, and for any retests which may be required.

6.1.2.2 Orientation of specimens

Normally, tests in the transverse (or long transverse for plate) direction are required. If the width is insufficient (less than 300 mm) to obtain a transverse specimen, then tests in the longitudinal direction are permitted.

6.1.2.3 Identification of specimens

Each specimen shall be marked in such a manner that, after removal, it is still possible to identify the product from which it was taken and its location and orientation. If, during the course of subsequent operations, removal of the markings cannot be avoided, new markings shall be made before the originals are removed.

6.1.2.4 Preparation of specimens

Specimens shall be taken from the sample after completion of all the mechanical and heat treatments that the product has to undergo before delivery, and which may influence the mechanical properties of the metal. In cases where this is not possible, the sample or specimens may be taken at an earlier stage, but they shall be subjected to the same treatment as that to which it is intended to submit the product concerned.

NOTE If the purchaser intends to convert the material to a final temper which is different from the “as supplied” temper, then additional testing can be requested by the purchaser in order to satisfy himself that the material is capable of meeting the specified properties of the final temper. It is only necessary for the supplier to confirm that selected samples, heat-treated using the supplier's laboratory conditions, meet the properties specified for the final temper required by the purchaser.

Cutting shall be carried out in such a manner that it does not change the characteristics of the part prepared. Thus, the dimensions of the specimens shall provide an adequate machining allowance to permit removal of the zone affected by cutting.

Specimens shall not be machined or treated in any way such that their mechanical properties may be altered. Any straightening required shall be carried out with great care, preferably by hand.

6.1.2.5 Number of specimens

Unless otherwise specified, one specimen shall be taken from each inspection lot of 10 000 kg or part thereof, or from each heat treatment batch or lot. For single plates or for coils weighing more than 10 000 kg each, only one specimen per plate or coil shall be taken.

6.1.3 Test pieces for tensile test

6.1.3.1 Identification of test pieces

Each test piece shall be marked in such a manner that it is possible to identify the inspection lot from which it was taken and, if required, its location and orientation in the product.

If a test piece is marked by stamping, this shall not be in a place or manner which may interfere with subsequent testing.

Where it is not convenient to mark a test piece, an identification tag may be attached.

NOTE Alternative methods, such as specially designed boxes, can be used for the purpose of test-piece identification.

6.1.3.2 Machining

Any machining necessary shall be carried out in such a manner that it does not change the characteristics of the metal in the test piece.

6.1.3.3 Number of test pieces

One test piece shall be taken from each specimen.

The recommended shapes and dimensions for test pieces are specified in ISO 6892-1, ASTM B557M or EN 485-1.

6.1.3.4 Type and location of test pieces

Flat test pieces shall be used for specified thicknesses up to and including 12,5 mm. The test piece shall be prepared so that both rolled surfaces are included in an undisturbed condition.

For specified thicknesses exceeding 12,5 mm, round test pieces shall be used.

For specified thicknesses up to and including 40 mm, the longitudinal axis of the round test pieces shall be located at a distance from the surface equal to half the thickness.

For specified thicknesses over 40 mm, the longitudinal axis of the round test pieces shall be located at a distance from one of the surfaces equal to one quarter of the thickness.

6.1.4 Test pieces for bend test

The procedures shall be agreed between the supplier and the purchaser.

6.2 Test methods

6.2.1 Chemical analysis

Methods of analysis shall be at the discretion of the supplier using ASTM E34, ASTM E607, ASTM E716, ASTM E1251 or EN 14242. The range of application and accuracy of the test procedure used shall be validated and approved by the supplier. In case of dispute concerning the chemical composition, referee analysis shall be carried out by the methods specified in the relevant standards and the results obtained by these methods shall be accepted.

NOTE For heavy plate analysis, variations of composition might occur across the thickness.

6.2.2 Tensile test

The tensile test shall be carried out in accordance with ISO 6892-1 or ASTM B557M.

6.2.3 Bend test

The bend test shall be applied only when agreed between the supplier and the purchaser. The bend test shall either be carried out in accordance with ISO 7438 or agreed upon by the supplier and the purchaser.

6.2.4 Electrical conductivity

Electrical conductivity measurements are required for lot-acceptance purposes in the case of alloys 7010 and 7075 in tempers T73, T7351, T76 and T7651, and alloy 7050 in tempers T7451 and T7651, in order to assess the resistance to stress corrosion cracking or the exfoliation-corrosion resistance of the material, as applicable.

The specimen for electrical conductivity testing shall be taken adjacent to the tensile test specimen.

The measurement shall be carried out by the eddy current method as agreed between the supplier and purchaser. The reference blocks to be used shall be agreed between the supplier and purchaser. The results shall be rounded to the nearest 0,1 MS/m, using the rounding rules.

The acceptance criteria are given in Tables 53, 57 and 58 of ISO 6361-2:2011.

6.2.5 Measurement of dimensions

The dimensions shall be measured by means of measuring instruments which are of the accuracy required by the dimensions and the dimensional tolerances.

All dimensions shall be checked at the ambient temperature of the workshop or laboratory and, in case of dispute, at a temperature between 10 °C and 35 °C.

6.2.6 Surface finish

Unless otherwise specified, examination of surface appearance shall be carried out without the assistance of magnifying apparatus on products before delivery.

For products intended to be anodized for general architectural and decorative applications, or for bright anodizing, it is recommended that an anodizability test be carried out by the producer on the products before delivery. The frequency and the conditions of the test may be agreed between the supplier and purchaser.

For special products intended to be provided with an anodizing quality suitable for architectural applications, the supplier shall carry out an anodizability test on the products before delivery. The test shall be applied to samples from each casting batch, the appearance shall be measured after the test and the results and the samples shall be retained for at least 5 years. If the products are to be etched before anodizing, the anodizability test shall include etching using conditions to be agreed between the supplier, the purchaser and the anodizer.

6.2.7 Stress corrosion resistance

For the purposes of this part of ISO 6361, the following provisions shall apply:

— a minimum of three adjacent replicate test pieces shall be taken from each specimen and submitted to the test;

— exposure shall be carried out by alternate immersion in a 3,5 % by mass sodium chloride solution in water;

— test pieces shall be stressed in the short transverse direction with a stress level of 75 % of the specified proof stress;

— no stress-corrosion-related rupture shall be observed after a minimum exposure time of 20 days.

The method of stressing (bending, uniaxial loading, C-ring, etc.), the shape and dimensions of the test pieces and the frequency of the test are left to the discretion of the manufacturer. The manufacturer shall keep records of all lots so tested and shall make them available for examination at the manufacturer's facility for at least 5 years.

For lot-acceptance purposes, resistance to stress corrosion cracking for each lot of material shall be established by testing the previously selected tensile test specimens according to the criteria given in Tables 53, 57 and 58 of ISO 6361-2:2011.

6.2.8 Exfoliation and intergranular corrosion resistance (5XXX series alloys)

6.2.8.1 General

The test shall be carried out on full-thickness test pieces for material less than 2,5 mm in thickness. For material 2,5 mm or more in thickness, 10 % of the thickness shall be removed by machining, from one as-rolled surface, and both the machined and as-rolled surfaces shall be submitted to the test and evaluated.

For lot-acceptance purposes, the acceptability of each lot of material mentioned in 5.5 shall be determined either by testing each lot according to ASTM G66 and ASTM G67, or by metallographic examination of one specimen per lot selected from the midsection at one end of a random sheet, plate or coil, using the following procedure:

— a section perpendicular to the rolling surface and parallel to the rolling direction shall be polished (preferably electrolytic polish) and then microetched for 3 min, using a solution of 40 ml of 85 % phosphoric acid in 60 ml of distilled water, at (35 $\pm$ 5) °C;

— metallographic examination shall be carried out at 500 $\times$ magnification.

The revealed microstructure shall be predominantly free of a continuous grain-boundary network of aluminium material. If the microstructure shows evidence of Al_3Mg_2 precipitates in excess of the relevant reference, the lot is either rejected or subjected to the test in ASTM G66.

Reference photomicrographs shall be established on acceptable material (according to ASTM G66), for each thickness range specified in Table 40 (5059), Table 44 (5083), Table 45 (5383) or Table 46 (5086) of ISO 6361-2:2011. Production practices shall not be changed after establishment of these references.

Significant changes in production practices that alter the microstructures of the alloy shall require the establishment of new reference photomicrographs as described above.

The manufacturer shall maintain at the producing facility all records relating to the establishment of reference photomicrographs and production practices.

6.2.8.2 Exfoliation corrosion resistance (7XXX series alloys)

For lot-acceptance purposes, resistance to exfoliation corrosion for each lot of material shall be established by testing the previously selected tensile test specimens according to the criteria shown in Tables 53, 57 and 58 of ISO 6361-2:2011.

When carried out, for monitoring purposes, the test shall be in accordance with ASTM G34, and the following additional requirements shall apply:

— specimens for testing shall be selected at random from material considered acceptable in accordance with the lot acceptance criteria given in Tables 53, 57 and 58 of ISO 6361-2:2011, for each thickness range listed in these tables;

— test pieces shall be a minimum of 50 mm × 100 mm with the 50 mm dimension parallel to the direction of final rolling. They shall include the full-section thickness of the material, except for material at least 2,5 mm in thickness, 10 % of the thickness shall be removed by machining the test surface. For machined test pieces, the machined surface shall be evaluated by exposure to the test solution;

— frequency of the test is left to the discretion of the producer, who shall keep records of all lots so tested and shall make them available for examination at the manufacturer's facility for at least five years.

6.3 Retests

6.3.1 Mechanical properties

If any one of the test pieces first selected fails to meet the requirements of the mechanical tests, the following procedure shall apply:

— if an error is clearly identified, either in the test piece preparation or in the test procedure, then the corresponding result shall be disregarded and the testing carried out as initially required;

— if this is not the case then two further specimens shall be taken from the same lot, one being from the same unit of product (sheet, strip, etc.) from which the original specimen was taken, unless that piece of product has been withdrawn by the supplier.

If both test pieces from these additional specimens meet the requirement, the lot which they represent shall be deemed to comply with the requirements of this part of ISO 6361. Should one test piece fail:

— the lot shall be deemed not to comply with the requirements of this part of ISO 6361;

— or, where applicable, the lot may be submitted to additional thermal treatment(s) and then retested as a new lot.

6.3.2 Other properties

The retests of other properties shall be agreed between the supplier and purchaser.

7 Inspection documents

7.1 General

If requested by the purchaser, the order shall provide one or more of the documents in 7.2 to 7.4, as applicable.

The following documents are established on the basis of inspections and tests performed by qualified personnel who are involved in the manufacturing process and/or belong to the quality-control department.

7.2 Certificate of conformity

The certificate of conformity is a document by which the producer certifies that, according to inspections and results of representative tests, the products for delivery comply with the relevant standards and with the additional requirements in the order, if any.

7.3 Test report

The test report is a document by which the producer certifies that the products for delivery comply with the requirements specified on the order. The document details the results of the current production controls carried out on identical products made using the same methods as the products for delivery but not necessarily on the products for delivery themselves.

7.4 Specific test report

The specific test report is a document by which the producer certifies that the products for delivery comply with the requirements specified on the order. This document details the chemical composition and the results of prescribed mechanical tests and of any other test specified on the order. It is established on the basis of tests carried out on specimens taken from among the products for delivery themselves. The delivery of such a certificate generally implies inspection tests on individual lots.

8 Marking

Marking of products is only undertaken when agreed upon between the supplier and purchaser and is stated on the order. This marking shall not adversely affect the final use of the product.

9 Packing

Unless otherwise specified in International Standards relating to special products or specified in the order, the method of packing shall be determined by the supplier who shall take all suitable precautions to ensure that, under the usual conditions of transportation, the products are delivered in a condition suitable for use.

10 Arbitration tests

In cases of dispute concerning conformity with the requirement of this part of ISO 6361 or of a specification cited on the order, testing should be carried out by an arbitrator chosen by mutual agreement between the supplier and purchaser.

The arbitrator's decision shall be final.

ICS 77.150.10

Price based on 10 pages