BS EN 754-1:2016

BSI Standards Publication

Aluminium and aluminium alloys — Cold drawn rod/bar and tube

Part 1: Technical conditions for inspection and delivery

National foreword

This British Standard is the UK implementation of EN 754-1:2016. It supersedes BS EN 754-1:2008 which is withdrawn.

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Aluminium und Aluminiumlegierungen - Gezogene Stangen und Rohre - Teil 1: Technische Lieferbedingungen

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European foreword

This document (EN 754-1:2016) has been prepared by Technical Committee CEN/TC 132 “Aluminium and aluminium alloys”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

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

This document supersedes EN 754-1:2008.

Within its programme of work, Technical committee CEN/TC 132 entrusted CEN/TC 132/WG 5 "Extruded and drawn products" to revise EN 754-1:2008.

The following technical modifications have been introduced during the revision:

— In the Normative references clause, EN 10002-1 was replaced by EN ISO 6892-1.

EN 754, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube* comprises the following parts:

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

— *Part 2: Mechanical properties*

— *Part 3: Round bars, tolerances on dimensions and form*

— *Part 4: Square bars, tolerances on dimensions and form*

— *Part 5: Rectangular bars, tolerances on dimensions and form*

— *Part 6: Hexagonal bars, tolerances on dimensions and form*

— *Part 7: Seamless tubes, tolerances on dimensions and form*

— *Part 8: Porthole tubes, tolerances on dimensions and form*

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1 Scope

This European Standard specifies the technical conditions for inspection and delivery of aluminium and aluminium alloy cold drawn rod/bar and tube for general engineering applications.

This document applies to products which are extruded and then cold drawn.

This document does not apply to:

— forging stock (EN 603),

— products delivered in coils (EN 13958),

— coiled tubes cut to length (EN 13958).

2 Normative references

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

EN 515, *Aluminium and aluminium alloys — Wrought products — Temper designations*

EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition and form of products*

EN 754-2, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 2: Mechanical properties*

EN 754-3, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 3: Round bars, tolerances on dimensions and form*

EN 754-4, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 4: Square bars, tolerances on dimensions and form*

EN 754-5, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 5: Rectangular bars, tolerances on dimensions and form*

EN 754-6, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 6: Hexagonal bars, tolerances on dimensions and form*

EN 754-7, *Aluminium and aluminium alloys - Cold drawn rod/bar and tube - Part 7: Seamless tubes, tolerances on dimensions and form*

EN 754-8, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 8: Porthole tubes, tolerances on dimensions and form*

EN 2004-1, *Aerospace series — Test methods for aluminium and aluminium alloy products — Part 1: Determination of electrical conductivity of wrought aluminium alloys*

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

EN 12258-1:2012, *Aluminium and aluminium alloys — Terms and definitions — Part 1: General terms*

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

EN 14361, *Aluminium and aluminium alloys — Chemical analysis — Sampling from metal melts*

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

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12258-1:2012 and the following apply.

3.1
order document
document or set of documents agreed between supplier and purchaser at the time of ordering

[SOURCE: EN 13957:2008, 3.1]

4 Ordering information

The order document shall contain the following:

a) form and type of product:

   1) form of the product (cold drawn rod/bar or tube). If tube, whether seamless or porthole/bridge;

   2) reference to EN 573-3 for chemical composition limits;

   3) reference to EN 515 for temper designation;

   4) purchaser application, in particular whether subsequent anodising is intended. This shall be clearly stated on the order document;

b) reference to EN 754-2 for mechanical property limits;

c) a reference to this document (EN 754-1);

d) dimensions and shape of the product:

   1) round tube:

      i) length;

      and only two of the following dimensions:

ii) outside diameter;

iii) inside diameter;

iv) the tolerances for outside or inside diameter shall state as to whether the proposed tolerances are mean or inclusive of ovality (i.e. the maximum allowable deviation at any point from the specified diameter. If this is not made clear on the order, then the supplier shall assume that the specified tolerances for either or both outside and inside diameters are inclusive of ovality. However, if the purchaser specifically requires that the outside and/or inside diameter tolerances must be both mean and inclusive of ovality then this shall be clearly stated on the order;

v) wall thickness;

2) round bar:

i) diameter;

ii) length;

3) square and hexagonal bar:

i) width across flats;

ii) length;

4) rectangular bar:

i) width;

ii) thickness;

iii) length;

5) all other cases:

i) drawing of cross section;

ii) length;

e) tolerances on dimensions and form, with reference to the appropriate European Standard and/or a drawing;

f) quantity:

1) mass;

2) number of pieces;

3) total length;

4) tolerance on quantity;

g) any requirements for inspection documents;

h) any special requirements agreed between supplier and purchaser:

1) marking of products;

2) reference to drawings, part numbers, etc.;

3) additional or special testing, e.g. stress corrosion testing;

4) surface finish requirements;

5) surface protection;

6) packaging;

7) inspection prior to delivery;

8) use of A_{50mm} value instead of A value for elongation;

i) for products intended to be anodised by the purchaser, the order document shall also contain the information about the intended particular surface treatment with reference to the relevant European Standard.

5 Requirements

5.1 Production and manufacturing processes

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

5.2 Quality control

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

5.3 Chemical composition limits

The chemical composition limits shall be in conformity with the requirements specified in EN 573-3.

If the purchaser requires closer limits for elements than those specified in the above standard, these limits shall be according to an agreement between supplier and purchaser and stated in the order document.

5.4 Mechanical properties

The mechanical properties shall be in conformity with those specified in EN 754-2 or those agreed between supplier and purchaser and stated in the order document.

Typical Brinell hardness values are given in EN 754-2, but they are not binding for acceptance purposes. However, a Brinell hardness value may be agreed upon for acceptance testing.

5.5 Freedom from surface defects

The surface shall be free from defects prejudicial to its suitable and proper use.

The product shall have a smooth and clean surface. However, small surface defects such as light scratches, indentations, laminations, discolouration and non-uniform surface appearance resulting from heat-treatment, etc., which cannot always be totally avoided, are generally permitted on the product surface.

Whilst an operation designed to mask a fault is not permitted, the elimination of a superficial fault is permissible provided that the dimensional tolerances and material properties continue to meet the specification.

For products intended for surface treatment, the superficial defects (discolouration, mechanical or structural) shall not be so extensive as to impair the decorative appearance of the surface after the agreed surface treatment. Limiting samples may be agreed between supplier and purchaser.

5.6 Tolerances on dimensions and form

For the different forms of products, if not otherwise agreed between supplier and purchaser, the tolerances on dimensions and form shall be in conformity with the relevant European Standards EN 754-3, EN 754-4, EN 754-5, EN 754-6, EN 754-7 and EN 754-8.

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

5.7 Stress corrosion cracking resistance

The products of alloy EN AW-7075, in tempers T73, T7351, T73510 and T73511, for thicknesses equal to or greater than 20 mm, shall exhibit no evidence of stress corrosion cracking when tested in accordance with ASTM G47 or ISO 9591 in the transverse direction at a stress level of 75 % of the specified $R_{p0,2}$.

If such testing is required this has to be specified in the order document.

5.8 Additional requirements

Any additional requirements shall be agreed between supplier and purchaser and stated in the order document.

6 Test procedures

6.1 Sampling

6.1.1 Samples for chemical analysis

Sampling shall be carried out at the time of casting according to EN 14361. The average content of each sample shall be within the specification for the chemical composition limits.

NOTE EN 14361 includes criteria on how to determine number, volume and shape of samples, about time and location of sampling and about the design and maintenance of the tools, in order to make sure that the average chemical composition for the sample is representative of the average chemical composition for the whole melt.

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 sufficiently large to allow manufacture of the test pieces necessary to carry out the required test, and shall include sufficient metal to allow manufacture of test pieces for any re-tests required.

6.1.2.2 Orientation

All products shall be tested in the longitudinal direction in order to provide guaranteed mechanical properties.

Tests in other directions may be carried out and property limits established. However, this shall be agreed between supplier and purchaser and shall be stated in the order document. It should be noted that the mechanical properties obtained may differ from those for the longitudinal direction quoted in the relevant standard.

6.1.2.3 Identification

Each specimen shall be marked in such manner that, after removal, it is always possible to identify the inspection lot from which it was taken, and if required, the 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

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 might 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 treatments as that to which it is intended to submit the product concerned.

If the purchaser intends to convert the material to a final temper which is different from the "as supplied" temper, then additional testing may 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 essential for the supplier to confirm that selected specimens, heat treated using supplier 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 of the specimen from which the test pieces are to be 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 by which their mechanical properties can be altered. Any straightening required shall be carried out with great care, preferably by hand.

6.1.2.5 Number

Unless otherwise specified, the minimum number of specimens shall be as follows:

— for products having a nominal mass up to and including 1 kg/m, one specimen shall be taken for each lot of 1 000 kg or part thereof;

— for products having a nominal mass greater than 1 kg/m up to and including 5 kg/m, one specimen shall be taken for each lot of 2 000 kg or part thereof;

— for products having a nominal mass greater than 5 kg/m, one specimen shall be taken for each lot of
3 000 kg or part thereof.

Not less than one representative specimen shall be taken from any given inspection or heat-treatment lot.

6.1.3 Test pieces for tensile test

6.1.3.1 Identification

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, the location and orientation in the product.

If a test piece is identified by stamping, this shall not be in a place or manner which can interfere with subsequent testing. Where it is not convenient to mark a test piece, an identification tag may be attached.

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, type and location of test pieces

One test piece shall be taken from each specimen. The recommended shapes and dimensions of test pieces are specified in EN ISO 6892-1.

Details of location of the test pieces are given in Annex A.

6.2 Test methods

6.2.1 Chemical composition limits

The ranges of application and the accuracy of the test procedure used shall be validated and proved by the supplier. In case of dispute concerning the chemical composition limits, referee analysis shall be carried out in accordance with EN 14242.

NOTE For the rapid determination of the chemical composition limits different spectral analysis methods can be used (e.g. S-OES, XRF, GDOES). For S-OES, see EN 14726.

6.2.2 Tensile testing

The tensile test shall be carried out in accordance with EN ISO 6892-1.

6.2.3 Brinell hardness testing

The Brinell hardness test shall be carried out in accordance with EN ISO 6506-1.

6.2.4 Measurement of dimensions

All dimensions shall be measured with suitably calibrated instruments which are appropriate to the range of dimensions under consideration. The measurements shall be made at ambient temperature or, in the case of dispute, at a temperature between 15 °C and 25 °C.

6.2.5 Surface finish

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

For products intended to be anodized, it is recommended that an anodizing test be carried out by the manufacturer on the product before delivery. The frequency and the conditions of the test can then be agreed between supplier and purchaser.

6.2.6 Resistance to stress corrosion cracking

The products of alloy EN AW-7075, in tempers T73, T7351, T73510 and T73511, for thicknesses equal to or greater than 20 mm the stress corrosion behaviour shall be tested according to ASTM G47 or ISO 9591.

Testing according to ASTM G47 or ISO 9591 shall be at least one specimen per 6 months unless otherwise agreed and stated in the order document.

An electrical conductivity test shall be carried out on at least one specimen per each heat treatment lot in accordance with Annex B.

6.2.7 Additional tests

If any other tests are required, these shall be agreed between supplier and purchaser. These tests shall be carried out in accordance with the existing European Standards or a method agreed between supplier and purchaser.

6.3 Re-tests

6.3.1 Chemical composition limits

If any analysis does not meet the requirements of EN 573-3 with respect to chemical composition limits, the cast shall be rejected.

An individual analysis outside specified compositional limits may not result in the rejection of the lot if written agreement has been obtained from the purchaser after a request for a concession has been made.

6.3.2 Mechanical properties

If one or more of the test pieces first selected fails to meet the requirements for the mechanical tests, the following procedure shall be applied:

— 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 recommenced as initially required;

— if this is not the case, then two further specimens shall be taken from the same inspection lot, one being from the same unit of product (rod/bar or tube) from which the original specimen was taken, unless that unit of product has been withdrawn by the supplier. If both test pieces from these additional specimens meet the requirements, the inspection lot which they represent shall be deemed to comply with the requirements of this document.

Should one test piece fail to meet the required limits:

— the inspection lot shall be deemed not to comply with the requirements of this document;

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

6.3.3 Other properties

The re-tests of other properties shall be agreed upon between purchaser and supplier.

7 Inspection documents

When requested by the purchaser and agreed upon by the supplier, the supplier shall provide the appropriate inspection documents in accordance with EN 10204 or other inspection documents such as certificate of conformity.

8 Marking of products

Marking of products shall be undertaken when specified in the standard or when agreed upon between supplier and purchaser and stated in the order document. This marking shall not adversely affect the final use of the product. The detail of information required in the marking shall be agreed between supplier and purchaser.

9 Packaging

Unless otherwise specified in European Standards relating to special products or specified in the order document, the type of packaging shall be specified by the supplier who shall take all suitable precautions to ensure that, under the usual conditions of transportation, the products shall be delivered in a condition suitable for use.

The product for delivery will not normally be treated with a corrosion preventative. If a corrosion preventative is required, it shall be specified in the order document and agreed with the supplier. The type of corrosion preventative used shall also be agreed between supplier and purchaser.

10 Arbitration

In cases of dispute concerning conformity with the requirements of this document or specification cited in the order document before rejecting the products, testing and examination shall be carried out by an arbitrator chosen by mutual agreement between supplier and purchaser.

The decision of the arbitrator shall be final.

Annex A
(normative)

Location of test pieces

A.1 Round, square and hexagonal bar

A.1.1 For diameter (*D*) or width across flats (*S*) up to and including 40 mm:

A round standard test piece (10 mm diameter or less) taken from the centre of the bar, shown as a cross hatched area in Figure A.1, shall be used.

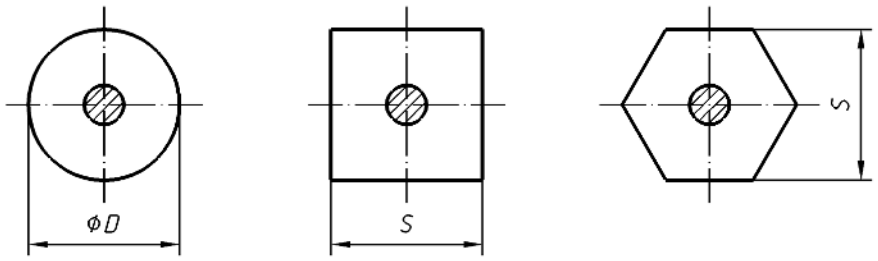

Figure A.1 — Round, square and hexagonal bar

A.1.2 For diameter (*D*) or width across flats (*S*) over 40 mm:

A round standard 10 mm diameter test piece located and shown as a cross hatched area in Figure A.2 shall be used.

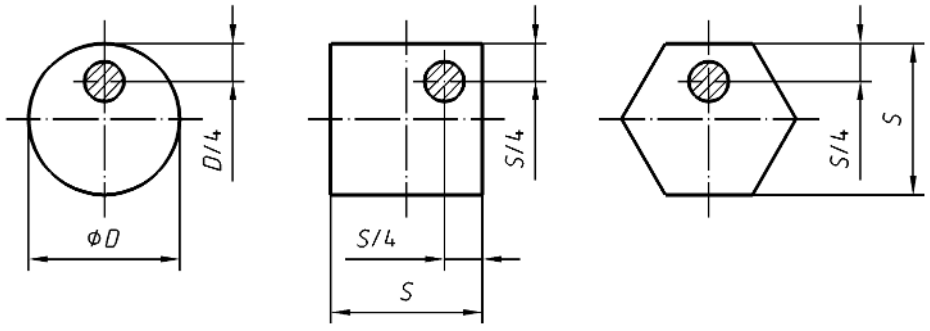

Figure A.2 — Round, square and hexagonal bar

A.2 Rectangular bar

A.2.1 For thickness up to and including 12,5 mm:

A rectangular test piece shall be used. The test piece shall be prepared such that the two fabricated surfaces are preserved without modification.

A.2.2 For thickness (*T*) over 12,5 mm and up to and including 40 mm:

A round standard test piece (10 mm diameter or less) located and shown as a cross hatched area in Figure A.3 shall be used. It is to the discretion of the producer to choose either of the two locations shown in the figure.

Dimensions in millimetres

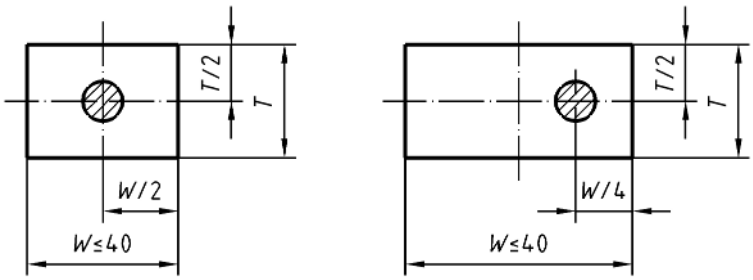

Figure A.3 — Rectangular bar

A.2.3 For thickness (*T*) exceeding 40 mm:

A round standard 10 mm test piece located and shown as a cross hatched area in Figure A.4 shall be used.

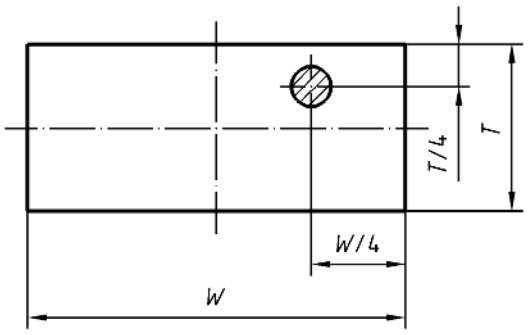

Figure A.4 — Rectangular bar

A.3 Tube

Test pieces should be prepared from specimens as given in Table A.1.

Table A.1 — Test piece requirements for tubes

Description	Round tube	Square tube	Rectangular and polygonal tube
Full section test piece	Area ≤ 150 mm^2 and D ≤ 25 mm	Area ≤ 150 mm^2 and D ≤ 25 mm	-
Rectangular machined test piece	Wall thickness ≤ 12,5 mm	Wall thickness ≤ 12,5 mm	Wall thickness ≤ 12,5 mm
Round machined test piece	Wall thickness > 12,5 mm	Wall thickness > 12,5 mm	Wall thickness > 12,5 mm

Annex B
(normative)

Resistance to stress-corrosion cracking for alloy EN AW-7075 in tempers T73, T7351, T73510 and T73511 – Electrical conductivity

The electrical conductivity of the specimen for tensile testing of each lot shall be determined in accordance with EN 2004-1. Table B.1 specifies the minimum frequency but additional testing may be carried out upon agreement between purchaser and supplier.

Table B.1 — Lot acceptance criteria on tempers T73, T7351, T73510 and T73511 for alloy EN AW-7075

Electrical conductivity γ MS/m	**Level of mechanical properties**	**Lot acceptance status**
$\gamma \geq 23$	Per standard requirements	acceptable
$22 \leq \gamma < 23$	Per standard requirements and $R_{p0,2}$ does not exceed minimum by more than 85 MPa	acceptable
	Per standard requirements, but $R_{p0,2}$ exceeds minimum by more than 85 MPa	suspect [a]
$\gamma < 22$	Any level	unacceptable[b]

[a] When the lot acceptance status is found to be "suspect", material shall be reprocessed or a test piece of the material shall be heat treated for not less than 30 min at 465 °C ± 5 °C and quenched into cold water. Electrical conductivity shall then be measured within 15 min of quenching. If the difference between this measurement and the original measurement on the material is 3,5 MS/m or more, the production lot is acceptable. If the difference is less than 3,5 MS/m, the production lot is unacceptable and shall be reprocessed (additional precipitation heat treatment or re-solution treatment and precipitation heat treatment).

[b] When the lot acceptance status is "unacceptable", the material may be reprocessed (additional precipitation heat treatment or re-solution treatment and precipitation heat treatment).

Bibliography

[1] EN 603 (all parts), *Aluminium and aluminium alloys — Wrought forging stock*

[2] EN 13958, *Aluminium and aluminium alloys — Cold drawn, round, coiled tube for general applications — Specification*

[3] EN 14726, *Aluminium and aluminium alloys — Chemical analysis — Guideline for spark optical emission spectrometric analysis*

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