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# Unalloyed aluminium ingots for remelting — Classification and composition

*Aluminium non allié en lingots pour refusion — Classification et composition*



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## Foreword

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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 115 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 4, *Unalloyed (refined) aluminium ingots*.

This first edition cancels and replaces ISO Recommendation ISO/R 115:1968.

# Unalloyed aluminium ingots for remelting — Classification and composition

## 1 Scope

This International Standard defines the requirements for grades of unalloyed aluminium ingots intended for remelting. It specifies the classification and designation applicable to these grades, the conditions in which they are produced, their properties and the marks by which they are identified.

## 2 Order

The order, in the form agreed upon between supplier and purchaser, shall contain the following information:

a) designation of the unalloyed aluminium in accordance with this International Standard or the customer code after agreement between supplier and purchaser;

b) specification of the form of the products, including mass and dimensions of individual ingot and bundles;

c) quantity: mass, in tonnes (quantity tolerances if required);

d) any requirements for certificates of conformity, test and/or analysis reports or inspection certificates;

e) any additional requirements agreed between supplier and purchaser.



If special requirements, which differ from requirements specified in this International Standard, are specified in the order between supplier and purchaser, then these special requirements shall apply.

## 3 Requirements

### 3.1 Production and manufacturing processes

Unless otherwise specified on the order, the production and manufacturing processes shall be left to the discretion of the manufacturer.

Unless otherwise specified on the order, no obligation shall be placed on the manufacturer to use the same processes for subsequent and similar orders.

### 3.2 Quality control

The supplier shall be responsible for carrying out all inspection and tests required by this International Standard and additional requirements, prior to shipment of the product. If the purchaser wishes to inspect the product at the supplier's works, the purchaser shall stipulate this at the time of placing the order.

### 3.3 Chemical composition

Each grade of unalloyed aluminium, including refined aluminium, with a specified minimum aluminium content shall be in accordance with the designations and chemical composition given in Table 1.

Each grade of unalloyed aluminium without a specified minimum aluminium content shall be in accordance with the designations and chemical compositions given in Table 2.

The compositions, except that for aluminium, shown in Table 1 and Table 2 are given in maximum mass percentage.

For the interpretation of the results of chemical analysis, the number representing the result of the determination of an element content shall be rounded to the same number of decimal places as the corresponding number in this International Standard.

The writing rules for designations and chemical compositions shall be applied in accordance with Annex A.

If the purchaser requires content limits for elements not specified in this International Standard, these limits shall be stated on the order, after agreement between supplier and purchaser.

**Table 1 — Unalloyed aluminium with specified minimum aluminium content — Chemical composition in maximum percentage by mass**

| Designation | Si | Fe | Cu | Mn | Mg | Zn | Ti | Ga | V | Others each | Al min. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Al 99,995[a] | 0,002 0 | 0,002 0 | 0,002 0 | 0,001 | 0,003 0 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 99,995 |
| Al 99,990[a] | 0,003 0 | 0,003 0 | 0,004 0 | 0,001 | 0,003 0 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 99,990 |
| Al 99,99[a] | 0,004 0 | 0,003 0 | 0,002 0 | 0,001 | 0,001 0 | 0,004 | 0,002 | 0,003 0 | 0,001 | 0,001 | 99,99 |
| Al 99,98[a] | 0,006 | 0,006 | 0,002 0 | 0,002 | 0,002 | 0,004 | 0,002 | 0,003 | 0,001 | 0,001 | 99,98 |
| Al 99,97[a] | 0,008 | 0,008 | 0,004 | 0,003 | 0,002 | 0,005 | 0,002 | 0,004 | 0,001 | 0,001 | 99,97 |
| Al 99,94[a] | 0,030 | 0,030 | 0,005 | 0,010 | 0,010 | 0,010 | 0,005 | 0,02 | — | 0,010 | 99,94 |
| Al 99,70[a] | 0,10 | 0,20 | 0,01 | — | 0,02 | 0,03 | 0,02 | 0,03 | 0,03 | 0,03 | 99,70 |
| Al 99,7E[a,b] | 0,07 | 0,20 | 0,01 | 0,005 | 0,02 | 0,04 | — | — | — | 0,03 | 99,70 |
| Al 99,6E[a,c] | 0,10 | 0,30 | 0,01 | 0,007 | 0,02 | 0,04 | — | — | — | 0,03 | 99,60 |

[a] Cd + Hg + Pb max. 0,009 5; As max. 0,009.

[b] B max. 0,04; Cr max. 0,004; Mn + Ti + Cr + V max. 0,020.

[c] B max. 0,04; Cr max. 0,005; Mn + Ti + Cr + V max. 0,030.



**Table 2 — Unalloyed aluminium without specified minimum aluminium content — Chemical composition in maximum percentage by mass**

| Designation | Si | Fe | Zn | Ga | V | Others each | Others total | Al |
|---|---|---|---|---|---|---|---|---|
| P0404A[a] | 0,04 | 0,04 | 0,03 | 0,03 | 0,01 | 0,01 | 0,03 | Remainder |
| P0406A[a] | 0,04 | 0,06 | 0,03 | 0,03 | 0,02 | 0,02 | 0,04 | Remainder |
| P0610A[a] | 0,06 | 0,10 | 0,03 | 0,04 | 0,02 | 0,02 | 0,05 | Remainder |
| P1020A[a] | 0,10 | 0,20 | 0,03 | 0,04 | 0,03 | 0,03 | 0,10 | Remainder |
| P1020G[a,b] | 0,10 | 0,20 | 0,03 | 0,04 | 0,03 | 0,03 | 0,10 | Remainder |
| P1535A[a] | 0,15 | 0,35 | 0,03 | 0,04 | 0,03 | 0,03 | 0,10 | Remainder |

[a] Cd + Hg + Pb max. 0,009 5; As max. 0,009.

[b] Mg max. 0,003; Na max. 0,001 0; Li max. 0,000 1.

## 3.4 Freedom from contamination and hazardous materials

The ingots shall be free from asbestos and other hazardous foreign material and show no indication of increased radioactivity.

To a standard agreed between supplier and purchaser, the ingots shall be reasonably free from:

a) visible surface conditions and contamination such as grease, dirt, products of corrosion, dross or any other foreign bodies including paint, apart from that which is approved for marking purposes;

b) metallic or non-metallic inclusions;

c) gas porosity.

The ingots may have shrinkage holes or cavities which can retain water. Ingots shall therefore be thoroughly dried and preheated by the purchaser before charging to a melting furnace, in order to reduce the risk of violent explosions.

### 3.5 Form of products

There are several possible shapes of ingots, e.g.:

— trapezoidal, which can be stacked;

NOTE This type of ingot may have one or more notches to enable it to be divided into pieces if required.

— T-bars, sows or other shapes.

The shape, the dimensions, the dimensional tolerances and the tolerances on unit masses of the individual ingots and bundles shall be defined by agreement between supplier and purchaser at the time of ordering.

## 4 Product inspection and testing methods



### 4.1 General



Sampling procedures and analytical tests shall be carried out in accordance with quality assurance procedures (see e.g. ISO 9001). The results shall be traceable to International Standard reference materials. The accuracy of analytical procedures shall be verified.

The melt shall be clearly identified by means of a traceable number. The shape of the samples and the sampling conditions for chemical analysis shall be so designed that they are representative of the melt being cast. At least two analytical samples shall be taken, one from the beginning and one from the end of every melt. They shall be taken during casting, from the distribution system or directly from molten metal freshly poured into moulds.

Each analytical sample shall be suitably machined and, on analysis by emission spectrometry, shall be sparked at least twice. The result of the analysis shall be the arithmetic mean of the values obtained from the sparked samples.

Each sample shall meet the specified composition limits. The analysis of the melt shall be the arithmetic mean of the results of the analysis of all the samples taken from this melt.

The manufacturer shall determine and periodically check the analytical accuracy of each element analysed. The manufacturer shall be able to demonstrate the validity of the whole test procedure, including sampling, sample preparation and measurement.

Test reports shall be retained and retrievable for a minimum of three years.

The analytical method is at the discretion of the supplier, who shall use methods acceptable at international level.

### 4.2 Chemical analysis of main impurities

All analytical samples shall be analysed for the main impurities that are listed in Table 1 or Table 2. The analytical results shall be indicated on the analysis certificate.

### 4.3 Chemical analysis of trace impurities

The trace impurities are those impurities which are not listed in Table 1 and Table 2. For the grades where maximum values of trace impurities are specified by footnotes, e.g. Cd, Hg, Pb, As, the supplier shall establish and maintain a quality plan which specifies the frequency of tests and the analytical procedure.

Small traces of Na and Li impurities can cause severe problems during casting, and rolling and with the quality of some special products. Therefore, it is strongly recommended that the producer of the ingots analyse for these elements and indicate the results (in mass percent to four decimal places) on the analysis certificate. For these elements and for other impurities that can cause similar problems, closer limits than those in Table 2 may be specified by agreement between supplier and purchaser.

### 4.4 Sampling from ingots

Sampling from ingots is only appropriate when analytical data of samples from the melt, e.g., of trace impurities are not available. After agreement between supplier and purchaser, analytical data from samples taken from ingots may be used as an indication of the composition of the metal, provided that the data are averages from samples taken from different ingots of one melt at a large number of different positions within the ingots, according to a documented and justified sampling plan.

## 5 Inspection documents



The consignment shall be accompanied by an analysis certificate listing the results of the chemical analysis of the main impurities as specified in 4.2 and any other elements which have been requested in advance.



## 6 Marking of products

Each individual ingot shall be marked with the manufacturer's identity.

Unless otherwise indicated on the order, each bundle of ingots and each non-bundled ingot, such as a T-bar or sow, shall be marked with a) below, with the optional addition of b) and/or c):

a) the designation of the grade of unalloyed aluminium;

b) the melt number;

c) the unit mass.

The method of marking is left to the discretion of the supplier, but it shall be indelible and shall not be a source of contamination.

Each bundle of ingots or each non-bundled ingot, such as a T-bar or sow, shall carry a warning about the need for the purchaser to thoroughly dry and preheat the ingot before melting, as related to the need to remove entrapped water from shrinkage cracks and cavities.

## 7 Packaging

Small ingots shall be supplied in bundles suitable for stacking. The bundles shall be securely strapped in order to be handled without breakage.

If not otherwise agreed between supplier and purchaser, each bundle shall only consist of one melt.

## 8 Delivery documents

The delivery documents shall accompany the delivery and shall include:

a) the manufacturer's identity;

b) the order number;

c) the designation of the grade of unalloyed aluminium and of the form of the ingots;

d) the melt number(s);

e) the results of chemical analysis for all main impurities, i.e. those impurities for which specific limits are listed in Table 1 or Table 2, in the same sequence as given in the relevant tables, and other impurities as agreed between supplier and purchaser;

f) the unit and total mass.

## 9 Complaints

Chemical and physical anomalies may give rise to complaints if they affect the processing or the end use of the relevant finished products.

The purchaser shall enable the supplier to check the validity of the complaint. The purchaser shall provide one or more of the following:

— a piece of ingot showing the objectionable condition, with its complete identification;

— a specimen of the finished product, or an intermediate state, obtained from the metal in question, with all the details necessary for identification;

— an explanation of how or why the questioned condition is objectionable for the ingot or for the finished product;

— details of conditions of processing and inspection in the intermediate stages.



In case of dispute concerning conformity with the requirements of this International Standard or specification stated on the order, examinations and tests shall be performed by a referee laboratory chosen by mutual agreement between supplier and purchaser. The arbitrator's decision is final.