DRAFT INTERNATIONAL STANDARD

# ISO/DIS 16374

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# Evaluation method for cleanness of magnesium and magnesium alloy ingots

*Méthode d'évaluation de la propreté du magnésium et des lingots en magnésium allié*

ICS: 77.120.20





Reference number
ISO/DIS 16374:2014(E)

# Evaluation method for cleanness of magnesium and magnesium alloy ingots

## 1. Scope and field of application

This international standard describes a method to evaluate the quality of magnesium ingots that are required by industries due to their expanded applications. This standard describes specifications to evaluate the cleanliness and the quality of primary ingots of important magnesium alloys including Mg-3Al-1Zn, Mg-5Al-0.5Mn, Mg-6Al-0.5Mn, and Mg-9Al-1Zn alloys, using the naked eye inspection, the composition analysis and an ISO brightness measurement method established by the international Organization for Standardization.

## 2. Normative references

The following references 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 8287 : Magnesium and magnesium alloys -- Unalloyed magnesium -- Chemical composition
ISO 16220 : Magnesium and magnesium alloys -- Magnesium alloy ingots and castings
ISO 3116 : Magnesium and magnesium alloys -- Wrought magnesium alloys
ISO 2469 : Paper, board and pulps -- Measurement of diffuse radiance factor
ISO 2470-1 : Paper, board and pulps -- Measurement of diffuse blue reflectance factor -- Part 1: Indoor daylight conditions (ISO brightness) transmitting objects -
ISO 7724 : Paints and Varnishes - colorimetry part Ⅰ : principle CIE No. 15
ASTM E 1164 : Standard practice for obtaining spectrophotometric data for object - color Evaluation



## 3. Naked Eye Inspection

Identify any presence of significant contraction or impurities on the surface of magnesium ingots. The decision on the quality of ingots by naked eye inspection follows to an agreement between the supplier and the purchaser.

## 4. Chemical Composition Analysis

Analyze the content of alloying elements of ingots. The chemical composition evaluation method can be freely chosen under an agreement between the supplier and the purchaser. However, the test method should be specified in the final report. The standard for the chemical composition follows specifications of ISO 8287, ISO 16220 and ISO 3116. The range of the composition of unspecified alloys or alloying elements can be determined by an agreement between the supplier and the purchaser.

## 5. ISO Brightness Measurement

### 5.1 Principle of Brightness Measurement

The principle of the brightness measurement in this standard follows the specification in ISO 2470. Diffused light beams from a standard testing machine are shed on a specimen. Beams reflected from the specimen surface pass through a specified glass filter, and are subsequently measured by an optical cell or arranged diodes that respond to different effective wavelengths. The brightness can be measured directly from the output of the optical cell or obtained by evaluating the output from the diodes using an appropriate weight function.

### 5.2 Specimen Preparation

In principle, the test specimen should be obtained directly from ingots or molten metals in use. The shape and dimension of the test specimen are shown in Figure 1. The specimen is machined directly from the ingot in use. When the specimen is obtained from molten metals, it is prepared by a casting using a mold with a cavity of same dimensions as the specimen. The basic shape and dimension of the specimen for brightness tests are as follows. Here, the dimensions can be slightly modified except the dimension of the neck area, which should be strictly maintain 8mm diameter since it is the same as the evaluating area of the testing machine.




Figure 1. The shape and dimension of the test specimen obtained by machining from ingots

Figure 2. shows the shape and dimension of the mold to make the brightness testing specimen by casting. The dimension of the inside area is the same as that shown in Figure 1. The design of the mold can be modified freely; it can be designed as a separate type such that the specimen is easily released as shown below.

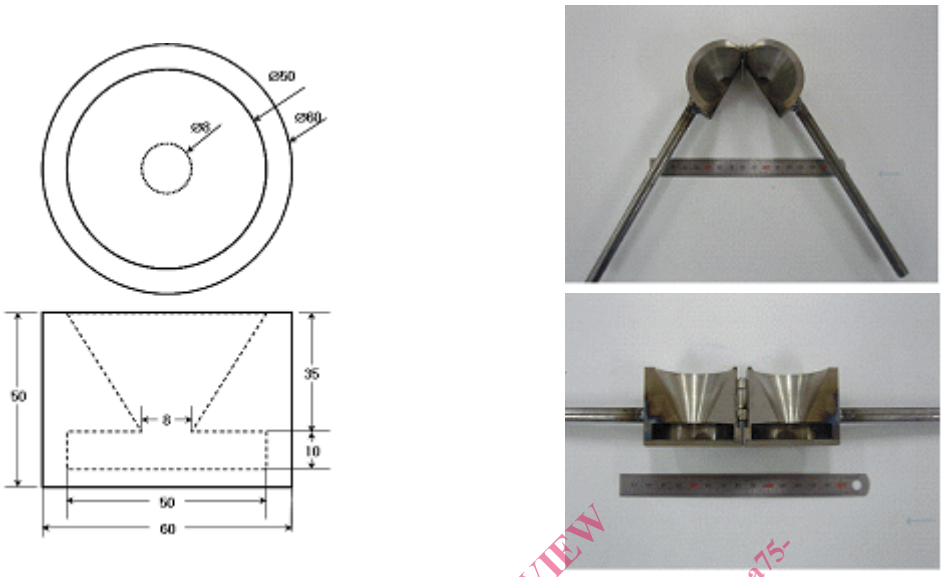


Figure 2. The shape and dimension of mold for brightness test specimen from molten metals.



## 5.3. Shape of Jig for Fracture Test

A jig is used to break the neck area for brightness tests. Such a jig can be prepared in various ways with freedom so that the neck area can be fractured by repeated impacts. The outline of the jig shape is shown in Figure 3.

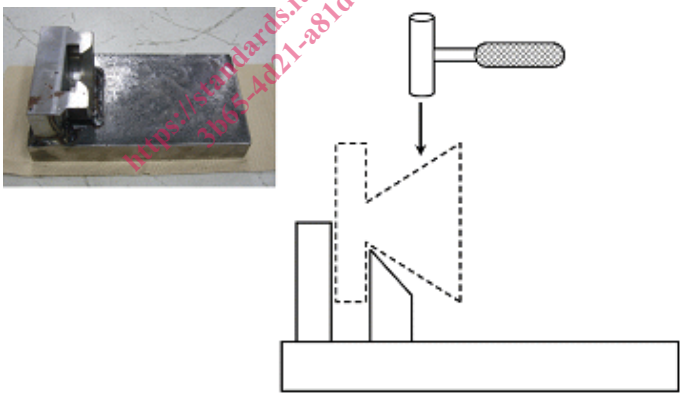

Figure 3. The shape of jig and setup for fracture tests.

## 5.4. Brightness Measurements for Fracture Surface

Immediately after the fracture of the test specimen, the brightness of the fracture surface is measured using a machine while rotating the specimen. The number of measurement depends on rotation angles as shown in Table 1. The final results are determined by the

average value of the test results obtained at each angle. The number of test specimen and measurement follows an agreement between the supplier and the purchaser.

Table 1. Conditions for the number of measurements and the rotation angles to evaluate brightness of fracture surface

| No. of Measurement | Rotation Angle for Each Measurement |
|---|---|
| 3 | 0°, 45°, 90° |
| 8 | 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315° |

The criteria to determine brightness for each alloy is shown in Table 2. The brightness data for alloys that are not shown in Table 2 can be deduced from the contents of major alloying elements and finally determined according to the agreements between the deliverer and the acceptor.

Table 2. Criteria to determine brightness for each alloy

| Materials | Criteria for Brightness | Major Alloying Element and Its Range | Responsible Notation | |
|---|---|---|---|---|
| | | | ISO | ASTM |
| Mg-9Al-1Zn | above 48 | Al, Zn, Mn<br>9.0~11.0 | MgAl9Zn1(B) | AZ91C |
| | | | MgAl9Zn1(A) | AZ91E |
| | | | | AZ91B |
| | | | | AZ91D |
| Mg-6Al-0.5Mn,<br>Mg-5Al-0.5Mn | above 50 | Al, Mn<br>5.0~7.5 | MgAl6Mn | AM60B |
| | | | MgAl5Mn | AM50A |
| Mg-3Al-1Zn | above 51 | Al, Zn, Mn<br>3.0~5.0 | MgAl3Zn1(A) | AZ31A |
| | | | MgAl3Zn1(B) | AZ31B |



## 5.5 Others

In the case that there is a difficulty to acquire the full-specimen dimension though machining or casting, the brightness can be measured by directly breaking the ingots or castings according to the agreement between the supplier and the purchaser. In this case, the diameter of the fractured surface should be at least 8mm and recorded in final report in detail.

## 6. Reporting Test Results

The following contents should be included in the report for test results.
a) Test date, place, and the name of the person
b) Specimen related things: manufacturer, alloy name, number of test specimens
c) Precise identification of the sample
d) Specimen preparation method: casting, machining

e) Criteria for naked eye inspection and results
f) Chemical composition analysis method and results
g) The type of instrument used : manufacturer, model
h) Conditions to evaluate the brightness of fractured surfaces
i) Results of measured brightness of fractured surfaces
j) Any departure from this standard or any circumstances or influences that may affect the results.