MINISTRY OF AVIATION

D.T.D. 5035

December, 1959

Aircraft Material Specification

MAGNESIUM - SILVER - NEODYMIUM - ZIRCONIUM ALLOY INGOTS AND CASTINGS (Heat treated)

(Silver 2·5, rare earth metals 2·5, zirconium 0·6)

NOTE.—This specification is one of a series issued by the Ministry of Aviation, either to meet a limited requirement not covered by any existing British Standard for aircraft material or to serve as a basis for inspection of materials the properties and uses of which are not sufficiently developed to warrant submission to the British Standards Institution for standardisation.

1. Inspection and testing procedure

The ingots and castings shall be inspected and tested in accordance with the relevant requirements of British Standard L.101 as follows :

Ingots Section One and Section Two.
Castings Section One and Section Three.

2. Quality of material

2.1. *Ingots*. Scrap or secondary material may be used at the discretion of the ingot maker.

2.2. *Castings*. The castings shall be made from approved ingots with or without approved scrap therefrom.

3. Chemical composition

3.1. The chemical composition of the ingots shall be :

Element	Per cent	
	min.	max.
Silver	**2·0**	**3·0**
Total rare earth metals	**2·0**	**3·0**
Zirconium 'available'	**0·1**	**1·0**
Zinc	—	0·2
Manganese	—	0·15
Copper	—	0·03
Silicon	—	0·01
Iron	—	0·01
Nickel	—	0·005
Magnesium	—	**The remainder**

3.2. The chemical composition of the castings shall be :

Element	Per cent	
	min.	max.
Silver	**2·0**	**3·0**
Total rare earth metals	**2·0**	**3·0**
Zirconium 'available'	**0·4**	**1·0**
Zinc	—	0·2
*Manganese	—	0·15
Copper	—	0·03
*Silicon	—	0·01
*Iron	—	0·01
Nickel	—	0·005
Magnesium	—	**The remainder**

*Subject to the discretion of the Inspecting Authority, determination of these elements need be made on a small proportion only of the samples analysed.

3.3. The 'available' zirconium is defined as that portion of the zirconium which is dissolved in dilute hydrochloric acid when the method of determination given in the Appendix is used ; any alternative method of determination shall be approved by the Inspecting Authority.

4. Heat treatment

The castings and test samples shall be heated together at a temperature of not less than 510°C nor more than 545°C for not less than two hours, and quenched in water or oil at the option of the manufacturer. They shall then be re-heated at a temperature not exceeding 250°C for not less than two hours and cooled in air or quenched in water or oil at the option of the manufacturer.

5. Mechanical properties

NOTE.—The tensile values specified for test pieces from separately cast test samples may not always be realized in certain portions of castings.

The mechanical properties obtained from test samples selected and prepared in accordance with the relevant requirements of British Standard L.101 shall be not less than the following values :

	Tensile strength	0·1 per cent proof stress	Elongation per cent
	tons/in²	tons/in²	
Sand cast test samples (Form A or B) ..	15·5	11·0	2
Chill cast test samples (Form A, B, C or D)	15·5	11·0	2

(References to test sample forms are to those in British Standard L.101.)

6. Protection against corrosion

Unless otherwise specified by the purchaser, the castings shall, before delivery, be protected against corrosion by chromate treatment in accordance with one of the methods given in Ministry of Aviation aircraft process specification D.T.D.911.

APPENDIX

Method of determination of 'available' zirconium

Reagents

Hydrochloric acid A.R.	concentrated (sp. gr. 1·18).
Ammonia	'25 per cent' solution (1 vol. ammonia sp. gr. 0·880 to 3 vol. water).
Ammonium chloride A.R.	
Hexamine	20 per cent solution.
Ammonium arsenate ..	10 per cent solution (100g/litre ; filter before use).
Ammonium arsenate ..	1 per cent solution (10g/litre ; filter before use).
Hydrochloric acid	'10 per cent' solution (1 vol. acid sp. gr. 1·18 to 9 vol. water).
Sugar charcoal	prepared from pure cane sugar (less than 0·02 per cent ash content).

Method

1. Weigh out accurately 5-15g of sample into an 800 ml beaker, cover with 20 ml of water for every gramme of sample, and dissolve by the gradual addition of 10 ml of concentrated hydrochloric acid for each gramme of sample. When all the metal has dissolved, boil for 5 minutes, filter the solution through a thin pulp pad, and wash precipitate three times with hot water.

2. To the filtrate add '25 per cent' ammonia, while stirring, until a faint permanent precipitate appears. Just clear by adding drops of concentrated acid, and add about 10g of ammonium chloride. Add about 40 ml of 20 per cent hexamine solution, and allow the precipitate to coagulate by standing in a warm place.

3. Filter off the zirconium hydroxide on a No. 541 Whatman filter paper, and wash a few times with warm water. Wash the precipitate from the paper into the original beaker, and dissolve in 85 ml of hot concentrated hydrochloric acid. Dilute the solution with cold distilled water to a volume of about 350 ml.

4. To the diluted solution add slowly and with constant stirring 50 ml of 1 per cent ammonium arsenate solution, and then bring to the boil. Add 15 ml of 10 per cent ammonium arsenate solution, and boil for 20 minutes. Allow the precipitate to settle and filter through a No. 40 Whatman filter paper. Remove the adherent precipitate from the beaker by means of a rubber-tipped rod, using warm '10 per cent' hydrochloric acid. Wash the precipitate five times with hot water, dry, and transfer to a weighed silica crucible. Ignite at a dull-red heat. Cover the residue with sugar charcoal, and ignite at 900-1000°C to constant weight (for about one hour). Add a little charcoal and again ignite to constant weight ; if the loss exceeds 0·001g a further treatment with charcoal is necessary.

$$\text{per cent Zr} = \frac{100 \times \text{weight of precipitate} \times 0{\cdot}7403}{\text{weight of sample}}$$

NOTE.—A platinum crucible must not be used for ignition.

Approved for issue,
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Director of Materials Research and Development (Air).

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