

**Ministry of Defence  
Defence Procurement Agency, ADRP2  
Abbey Wood  
Bristol  
BS34 8JH**

## **OBSOLESCENCE NOTICE**

All DTD specifications were declared obsolescent from 1<sup>st</sup> April 1999. All DTD 900 series approvals also lapsed at that time. The standards will no longer be updated but will be retained as obsolescent documents to provide for the servicing of existing equipment.

### **Further Guidance**

The aim in declaring the specifications obsolescent is to recognise that the documents are not being updated and thus should be used with care by both purchaser and supplier. For example, a specification could contain valid technical information but may also contain type approval clauses that contradict procurement policy and/or use materials that do not comply with environmental legislation. The obsolescent specification can still be used as a basis for a purchase provided that the supplier and purchaser agree suitable changes to the specification within the purchase order/contract.

For the DTD 900 system, each specification has provided an MoD approved material and process. For these items, the declaration of obsolescence will constitute the termination of both the extant MoD approval and the continuing MoD assessment that had underpinned those approvals. Again, the technical content of the document remains valid and can be used by both purchaser and supplier as a basis for a contract but an acceptable (to the parties) approval/assessment procedure would be required.

**Material Specification**

**LIGHT ALLOY AIRSCREW FORGINGS  
(Detachable blades)**

*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 material the properties and uses of which are not sufficiently developed to warrant submission to the British Standards Institution for standardisation.*

*The term "forging" in this specification includes forgings, stampings, and pressings.*

Section I.-Provisions applicable to all sections of this specification.

Section II.-Forgings supplied in the softened condition.

Section III.-Forgings supplied in the heat treated condition.

SECTION I

Provisions applicable to all sections of this Specification

**1. Quality of material**

(a) The aluminium used for making this alloy shall be in accordance with the latest issue of British Standard Specification No. L.31.

(b) The copper used for making this alloy shall assay not less than 99.8 per cent.

(c) No scrap shall be used other than that derived from the maker's own manufacture.

**2. Chemical composition**

(a) The chemical composition of the alloy shall be:

Copper	.....	.....	.....	.....	not less than 3.5 nor more than 4.5 per cent.
Manganese	.....	.....	.....	.....	not less than 0.4 nor more than 0.7 per cent.
Magnesium	.....	.....	.....	.....	not less than 0.4 nor more than 0.9 per cent.
Silicon	.....	.....	.....	.....	not more than 0.7 per cent.
Iron	.....	.....	.....	.....	not more than 0.7 per cent.
Titanium (if present)	.....	.....	.....	.....	not more than 0.3 per cent.
Aluminium	.....	.....	.....	.....	the remainder.

(b) The manufacturer shall supply the complete analysis of each cast to the inspector.

(c) A cast shall be defined as:

(i) The product of one furnace melt.

(ii) The product of one crucible melt.

(iii) The product of a number of crucible or furnace melts where such are aggregated and mixed prior to casting.

(iii) Where a continuous melting process is employed, a cast shall be taken as the amount of metal tapped from the furnace without any further additions of metal having been made to the charge.

(v) Or as otherwise defined from time to time.

**3. Mechanical tests**

(a) All tests shall be carried out to the satisfaction of the inspector.

(b) *Tensile test.*

0.1 per cent proof stress ..... not less than 13.5 tonf/in<sup>2</sup>.

Tensile strength ..... not less than 24.0 tonf/in<sup>2</sup>.

Elongation ..... not less than 15 per cent.

From the test samples, test pieces shall be turned to the dimensions of the British Standard test piece C or if the samples are too small, the test pieces shall be in accordance with the largest possible size of those shown in Figs. 2 and 3 of B.S. A4.

The parallel portion of any test piece may be increased in length to accommodate the extensometer employed.

The load shall be applied axially. Should a tensile test piece break outside the middle half of its gauge length the test may be discarded and another test made.

(c) *Nicked fracture test.* The test piece shall be a disc not less than 1/4 inch thick cut from the root test sample of each blade and the disc shall be nicked and fractured on a diameter by a minimum number of blows. The fractures must show freedom from defects.

#### 4. Microscopical examination

A small sample shall be taken, on the scale shown below, from the root portion of blades which have been upset at works other than those of the aluminium alloy manufacturer's own forging plant. The sample shall be taken following the upsetting operation and after suitable preparation shall be examined microscopically. The microstructure must show no evidence of the alloy having been overheated.

Where blades are heated in a salt bath for upsetting 5 per cent shall be examined microscopically. Where blades are heated by other means each blade shall be microscopically examined (see footnote).

#### 5. Freedom from defects

(a) The forgings shall be sound and free from defects. They shall admit of being machined to the required dimensions without leaving evidence of the original forged surface.

(b) Any forging may be rejected for faults in manufacture, notwithstanding that it has been passed previously on chemical composition and mechanical tests.

#### 6. Identification

All forgings passed by the inspector shall be stamped with the mark of the inspector and such other marking as shall ensure full identification of the material. All such stamping shall be done where it is least liable to be detrimental to the forging.

### SECTION II

#### Forgings supplied in the softened condition

*NOTE.* Where two forgings are provided from one piece of stock material, one set only of root test pieces shall be required to represent two forgings, providing that the root portion of each forging is adjacent to the material from which the test samples are taken.

Where more than two forgings are provided from one piece of stock material, unless otherwise agreed between the manufacturer, purchaser and inspector, two sets only of root test pieces shall be required. Each set of test pieces shall be taken from a position adjacent to the root of the forging manufactured from each end of the stock material.

#### 7. Heat treatment

(a) The tensile test samples selected as specified in Clause 8 shall be finally heat treated by being heated uniformly at a temperature of  $495^{\circ} \pm 10^{\circ}\text{C}$  and quenched in oil or water; they shall then be aged at room temperature for five days.

(b) The tensile test samples shall not be further heat treated or mechanically worked before testing.

#### 8. Selection and preparation of mechanical test samples

Either of the following procedures may be adopted as agreed between the manufacturer and the purchaser.

##### *Procedure A.*

(a) All test samples shall be marked as directed by the inspector before being cut from the forgings.

(b) (i) *Tip.* Unless otherwise agreed by the purchaser, manufacturer and inspector a test sample shall be forged integral with each blank as an extension on the end of the tip, approximately 6 in square and of a thickness equal to the ruling thickness approximately twelve inches from the tip.

A portion of each test sample shall be cut off and, after heat treatment and ageing as specified in Clause 7 (a), shall be used for the longitudinal tensile test specified in Clause 3 (b). The remaining portion of the test sample shall be used for test purposes after the forging is finally heat treated.

(ii) *Root.* A test sample from each blank may be cut at any stage during manufacture, or the sample may be taken from the stock used in the preparation of the blank. This test sample shall be of a diameter equal to the diameter of the finished forged blade root and shall not be further mechanically worked or heated, except for final heat treatment, before testing. The test sample shall be of sufficient size to permit of the transverse nicked fracture test piece and the longitudinal tensile test piece being prepared.

One portion of the test sample shall be heat treated and aged as specified in Clause 7 (a) and a tensile test piece shall be machined from this portion for the longitudinal tensile test specified in Clause 3 (b).

A portion of the test sample shall be used for the transverse nicked fracture test specified in Clause 3 (c). The remainder of the test sample shall be retained for placing adjacent to the root portion during final heat treatment of the forging. After the forging and test sample have been heat treated, test pieces shall be machined from the test sample for the longitudinal tensile test specified in Clause 3 (b).

##### *Procedure B.*

(c) All test samples shall be marked as directed by the inspector before being cut from the forgings.

(d) (i) *Tip.* Unless otherwise agreed by the purchaser, manufacturer and inspector, a test sample from the same stock as that from which the blade was made shall be forged to a thickness equal to that of the finished blade forging approximately 12 inches from the tip.

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*NOTE.* When the heat treatment is carried out other than in a salt bath and the method is shown to be consistently satisfactory the number of blades microscopically examined may be reduced when agreed between the manufacturer, purchaser and inspector.

One portion of the test sample shall be heat treated as specified in Clause 7 (a) and a tensile test piece shall be machined from this portion for the longitudinal tensile test specified in Clause 3 (b).

The remainder of the test sample shall be retained for placing adjacent to the tip portion during final heat treatment of the forging. After the forging and test sample have been finally heat treated, a test piece shall be machined from the test sample for the longitudinal tensile test specified in Clause 3 (b).

(ii) *Root.* A test sample may be cut from each blank at any stage during manufacture, or the sample may be taken from the stock used in the preparation of the blank. This test sample shall be of a diameter equal to the diameter of the finished forged blade root and shall not be further mechanically worked or heated, except for final heat treatment, before testing. The test sample shall be of sufficient size to permit of the transverse nicked fracture test piece and the longitudinal tensile test piece being prepared.

One portion of the test sample shall be heat treated and aged as specified in Clause 7 (a) and a tensile test piece shall be machined from this portion for the longitudinal tensile test specified in Clause 3 (b).

A portion of the test sample shall be used for the transverse nicked fracture test specified in Clause 3 (c). The remainder of the test sample shall be retained for placing adjacent to the root portion during final heat treatment of the forging. After the forging and test sample have been heat treated, a test piece shall be machined from the test sample for the longitudinal tensile test specified in Clause 3 (b).

## 9. Mechanical tests

The mechanical properties of the test pieces machined from the samples selected and prepared as specified in Clause 8 must comply with the tests specified in Clause 3.

## 10. Re-tests

If any test piece fails to comply with the tensile test specified in Clause 3, the inspector may reject the forging or forgings represented by that test piece or, at the request of the manufacturer, adopt either of the following procedures:

(a) Prepare a further test piece from the test sample which failed. The test piece must comply with the tensile test specified in Clause 3.

(6) Allow the test sample to be re-heat treated in accordance with Clause 7 (a) and be re-tested in accordance with Clauses 8 and 9.

## SECTION III

### Forgings supplied in the finally heat treated condition

*NOTE.* Where two forgings are provided from one piece of stock material, one set only of root test pieces shall be required to represent two forgings, provided that the root portion of each forging is adjacent to the material from which the test samples are taken.

Where more than two forgings are provided from one piece of stock material, unless otherwise agreed between the manufacturer, purchaser and inspector, two sets only of root test pieces shall be required. Each set of test pieces shall be taken from a position adjacent to the root of the forging manufactured from each end of the stock material.

## 11. Heat treatment

(a) The forgings shall be finally heat treated by being heated uniformly at a temperature of  $495^{\circ} \pm 10^{\circ}\text{C}$  and quenched in oil or water; they shall then be aged at room temperature for five days.

(b) The forgings and the test samples shall not be further heat treated or mechanically worked before testing.

## 12. Provision and preparation of mechanical test samples

Either of the following procedures may be adopted as agreed between the manufacturer and the purchaser:

### *Procedure A.*

(a) All test samples shall be marked as directed by the inspector before being cut off from the forgings.

(b) (i) *Tip.* Unless otherwise agreed by the purchaser, manufacturer and inspector a test sample shall be forged integral with each blank as an extension on the end of the tip approximately 6 in long by 3 in wide and of thickness equal to the ruling thickness approximately twelve inches from the tip. The test sample shall not be removed from the blade until after final heat treatment.

The longitudinal tensile test specified in Clause 3 (b) shall be carried out on test pieces prepared from this test sample.

(ii) *Root.* A test sample from each blank may be cut at any stage during manufacture, or the sample may be taken from the stock used in the preparation of the blank. This test sample shall be of a diameter equal to the diameter of the finished forged blade root and shall not be further mechanically worked or heated, except for final heat treatment, before testing. The test sample shall be of sufficient size to permit of the transverse nicked fracture test piece and the longitudinal tensile test piece being prepared.

During final heat treatment the test sample shall be placed adjacent to the root portion of the forging.

The transverse nicked fracture test specified in Clause 3 (c) and the longitudinal tensile test specified in Clause 3 (b) shall be carried out on test pieces prepared from this test sample.

*Procedure B.*

(c) All test samples shall be marked as directed by the inspector before being cut off from the forgings.

(d) (i) *Tip.* Unless otherwise agreed by the purchaser, manufacturer and inspector, a test sample from the same stock as that from which the blade was made shall be forged to a thickness equal to that of the finished blade forging approximately 12 inches from the tip.

During final heat treatment the test sample shall be placed adjacent to the tip portion of the forging.

The longitudinal tensile test specified in Clause 3 (b) shall be carried out on test pieces prepared from this test sample.

(ii) *Root.* A test sample may be cut from each blank at any stage during manufacture, or the sample may be taken from the stock used in the preparation of the blank. This test sample shall be of a diameter equal to the diameter of the finished forged blade root and shall not be further mechanically worked or heated, except for final heat treatment, before testing. The test sample shall be of sufficient size to permit of the transverse nicked fracture test piece and the longitudinal tensile test piece being prepared.

During final heat treatment the test sample shall be placed adjacent to the root portion of the forging.

The transverse nicked fracture test specified in Clause 3 (c) and the longitudinal tensile test specified in Clause 3 (b) shall be carried out on test pieces prepared from this test sample.

### 13. Mechanical tests

The mechanical properties of the test pieces machined from the samples selected and prepared as specified in Clause 12 must comply with the tests specified in Clause 3.

### 14. Re-tests

If any test piece fails to comply with the tensile test specified in Clause 3, the Inspector may reject the forging represented by that test piece or, at the request of the manufacturer, adopt either of the following procedures:

(a) Prepare a further test piece from the test sample which failed. This test piece must comply with the tensile test specified in Clause 3.

(b) Allow the forging to be reheat treated in accordance with Clause 11 (a) and be re-tested in accordance with Clauses 12 and 13.

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Approved for issue,

E. W. RUSSELL,

Director of Materials Research and Development.

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