

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

OBSOLESCENCE NOTICE

All DTD specifications were declared obsolescent from 1st 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.

Process Specification**ULTRASONIC INSPECTION OF ALUMINIUM ALLOY****EXTRUSIONS AND HAND FORGINGS**

1. Scope (*See also Appendix I*).

1.1 The provisions of this specification shall apply to extruded or hand forged material as supplied, and which is characterised by a uniform square or rectangular cross section having both:

- (a) an area of not less than 1 square inch.
- (b) a minor dimension of not less than ½ inch.

1.2 Any extrusion or hand forging not covered by Clause 1.1 above, but having a cross section the major opposing faces of which are substantially flat and parallel and which complies as regards area and dimensions with requirements (a) and (b) of Clause 1.1. may be inspected subject to prior agreement between the supplier and the purchaser.

1.3 Certification by the supplier in compliance with this specification applies to the material in whatever condition it is supplied. The certification remains valid if the material is precipitation heat treated by the purchaser but not if the material is solution treated after delivery, as no guarantee can be given by the supplier that subsequently the material will meet the requirements of this specification.

1.4 Extrusions and hand forgings shall be ultrasonically inspected after the final solution heat treatment whether or not they have been previously heat treated and/or ultrasonically inspected. They shall meet all the requirements of this specification.

2. Limits of inspection

It is intended that inspection shall reveal defects lying between a plane ¼ inch distant from the face being scanned and ⅛ inch or 2½ per cent of the total thickness, whichever is the greater, from the opposite face. (*See also Appendix I*).

3. Objective

3.1 This specification sets out a calibration procedure for longitudinal wave ultrasonic flaw detection equipment, based on the amplitudes of the indications obtained from the ends of flat-ended drilled holes of prescribed diameters contained in a standard test block, the design of which shall comply with that set out in Appendix II to this specification.

3.2 For the purpose of this specification, the size of a defect shall be taken to be the diameter of that hole in a standard test block of which the end gives an amplitude of indication equal to that given by the defect, when both are at substantially the same distance from the surface to which the probes are applied.

NOTE. The true defect size corresponding to a given indication will vary with the nature and orientation of the defect, and may in fact be considerably greater than the indicated size as defined above. (*See also Appendix I*).

4. Provision and calibration of test blocks

4.1 A set of Master Reference Blocks is retained in the Laboratories of the Aeronautical Inspection Directorate (for details see Appendix II).

4.2 Standard test blocks, as referred to in Clause 3.1 above, will be supplied by the Aluminium Federation (for details see Appendix II). They shall have been calibrated against the Master Reference Blocks.

4.3 For routine inspection, instrument adjustment and classification of defect size, working test blocks which have been compared with standard test blocks may be used. (*See Appendix I*).

4.4 In any case of disagreement standard test blocks shall be employed.

5. Adjustment and setting up of instrument

5.1 The instrument setting shall be such that appropriate artificial defects in the test blocks can be detected and discrimination obtained between them.

5.2 The probe or probes shall be so arranged that defects are satisfactorily detected and can be classified for size by comparison with test blocks.

5.3 The acoustical coupling and method of application of the medium employed shall be such that consistent and equivalent coupling is obtained and maintained between probe and test block and between probe and material under test. (*See Appendix I*).

6. Inspection procedure

6.1 Each piece of material shall be scanned over two major or two adjacent faces unless agreed otherwise between supplier and purchaser. The faces scanned shall be marked.

6.2 The probe or probes shall be moved over the surface of the material in such a way as to explore reasonably fully the volume to be examined, using an instrument setting which will reveal a defect, having an indicated size (as defined in Clause 3.2) of 3/64 inch, in any part of the volume defined in Clause 2.

6.3 After a defect has been located, its indicated size shall be classified by a direct comparison of the amplitudes of indication received from it and from the appropriate holes in a test block. While classifying any one defect in this way by a contact technique, the probe arrangement, testing frequency and instrument settings shall remain the same throughout, and the coupling between probe or probes and material shall be maintained uniform and as nearly equivalent as possible to that between the probe or probes and test block.

6.4 While classifying the size of a defect the sensitivity of the instrument shall be so adjusted that the indications are easily compared without approaching overload indication.

7. Acceptance of material

7.1 A piece of material shall be deemed acceptable:

- (i) if it is free from defects having an indicated size greater than 5/64 inch, if any defects of an indicated size exceeding 3/64 inch which it contains are not less than 2 inches apart, and if any stringer-like defects of an indicated size exceeding 3/64 inch are not more than 1 inch long in material not less than 1/2 inch and not more than 1 inch thick, or not more than 1/2 inch long in material over 1 inch thick; or
- (ii) subject to the purchaser's specific agreement, if it contains one or more defects of an indicated size greater than 5/64 inch but not exceeding 8/64 inch, and if any stringer-like defects are not more than 1 inch long in material not less than 1/2 inch and not more than 1 inch thick or not more than 1/2 inch long in material over 1 inch thick.

7.2 When a piece of material is found to contain one or more defects of indicated size exceeding 3/64 inch but not exceeding 8/64 inch, the supplier shall mark the surface of the material to show the location of each defect, its estimated size and its distance from the surface. The marking shall not impair the efficiency of any subsequent ultrasonic examination. (*See Appendix I*).

7.3 In the event of a dispute between the supplier and the purchaser as to the existence and/or apparent size of a defect, the Aeronautical Inspection Directorate, on receipt of a joint request, will carry out a comparative ultrasonic test using the Master Reference Blocks in their custody. The results of the comparative test will be made available to the purchaser and supplier.

APPENDIX I

Explanatory notes

- | | |
|-------------------|---|
| <i>Clause 1.</i> | This specification applies to material in whatever condition it is supplied, and also to material which is subsequently given a heat treatment by the purchaser. |
| <i>Clause 2.</i> | It is expected that the limits of inspection quoted can be obtained with the standard equipment at present available, although some difficulty may be encountered in the classification of the acoustical size of defects as these limits are approached. |
| <i>Clause 3.2</i> | At the present time it is not possible to give a quantitative figure for the probable accuracy measurements of the cross section of any defect by ultrasonic examination as called for in this specification; initial work, however, has shown that a reasonable correlation exists between defect-indications and the true size of defects which are orientated normally to the direction of propagation of the ultrasonic beams. If defects are not orientated normally to the direction of propagation of the ultrasonic beam, the correlation obtained may not be so consistent and variable results may be obtained for the classification of defect size. Improved correlation can frequently be obtained by inspection from two or more faces. |
| <i>Clause 4.3</i> | The working test blocks shall be fabricated from material of similar ultrasonic characteristics to that under examination. The design of the test blocks employed is left to the discretion of the user. It is suggested that to facilitate the interpretation of indications, further series of holes, of diameters additional to those required by this specification, should be provided. Experience has shown that, to obtain standard holes having the desired form, it is necessary to exercise the greatest care in the selection of drills. |
| <i>Clause 5.3</i> | Acoustical coupling between the inspection probe and test surface is influenced by the following factors:
(a) Surface finish.
(b) Nature of coupling medium. |

The surface finish of extrusions should not cause any difficulty in obtaining consistent acoustical coupling, but in the examination of forgings errors may arise due to the surface condition, in which case the indicated size of defect will be reduced. For extrusions, lanolin in white spirit or an oil of similar viscosity has given consistent and satisfactory acoustical coupling between the probe and the surface being scanned. Forgings with a surface roughness approximating to 1/64 inch may require an oil of greater viscosity to effect satisfactory coupling. Where immersion technique is used inhibited water is a satisfactory medium.

Clause 7.2

Normally the system of marking should consist of three characters giving the size of the defect in 64th inch, an 'X' marking the location of the defect, followed by the depth of the defect from the marked surface approximately in tenths of an inch, e.g. 6 x 15 indicates that there is a 6/64th inch diameter defect 1.5 inches below the surface at the location X.

APPENDIX II**Test blocks**

- (i) The standard test blocks and Master Reference Blocks are machined from extruded hexagonal bar to specification D.T.D. 683, to have smooth plane surfaces. The scanning face, to which the probes are applied, is perpendicular to the extrusion direction, and is flat within 0.0001 inch of a mean true plane. It has a surface texture value better than 32 micro-inches (C.L.A.).

From, and perpendicular to, the face of each block which is opposite and accurately parallel to the scanning face, a hole of $\frac{3}{4}$ inch depth is drilled, having its axis on the centre line of the block. The hole is drilled to have a diameter accurate to ± 0.0005 inch, with care being taken to obtain flatness of the bottom of the hole

Blocks are provided in a series of depths, such that the holes terminate at distances of $\frac{1}{4}$ inch, $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, 1 inch, $1\frac{1}{4}$ inches, $1\frac{1}{2}$ inches, $1\frac{3}{4}$ inches, 2 inches, $2\frac{1}{4}$ inches, $2\frac{1}{2}$ inches, $2\frac{3}{4}$ inches, 3 inches, $3\frac{1}{2}$ inches, 4 inches, 5 inches, 6 inches, and 7 inches below the scanning face. These depths are accurate to $+ 0.01$ inch. At each depth there are blocks having holes of the standard diameters $\frac{3}{64}$ inch, $\frac{5}{64}$ inch and $\frac{8}{64}$ inch.

- (ii) For access to the Master Reference Blocks, application should be made to:

Assistant Director, A.I.D. Laboratories,
Harefield, Uxbridge, Middlesex.

- (iii) For Standard Test Blocks, application should be made to:

Aluminium Federation,
60, Calthorpe Road,
Five Ways,
Birmingham 15.

Approved for issue,

E. W. RUSSELL,

Director of Materials Research and Development.
