D.T.D. 5120B

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.

PROCUREMENT EXECUTIVE
MINISTRY OF DEFENCE

D.T.D. 5120B
June 1981

Aerospace Material Specification
PLATE
OF ALUMINIUM-ZINC-MAGNESIUM-COPPER-ZIRCONIUM ALLOY
(Solution treated, controlled stretched and artificially aged)

(Zn 6.2, Mg 2.4, Cu 1.7, Zr 0.13)
(7010-T7651)

NOTE 1: This specification is one of a series issued by the Procurement Executive, Ministry of Defence to meet a requirement not covered by an existing British Standard for aerospace material.

NOTE 2: This specification covers plate, including that which has been forged as an intermediate operation, which is finished by hot or cold rolling. It does not cover forged plate.

---

1. INSPECTION AND TESTING PROCEDURE

This specification shall be used in conjunction with Sections 1 and 14 of the latest issue of British Standard L100.

2. QUALITY OF MATERIAL

The material shall be made from aluminium and alloying constituents, with or without approved scrap, at the discretion of the manufacturer.

3. CHEMICAL COMPOSITION

The chemical composition of the material shall be as shown in Table A.

TABLE A

Element	Per cent	
	min	max
Silicon	—	0.12
Iron	—	0.15
Copper	1.5	2.0
*Manganese	—	0.10
Magnesium	2.1	2.6
*Chromium	—	0.05
*Nickel	—	0.05
Zinc	5.7	6.7
Zirconium	0.10	0.16
Titanium	—	0.06
Others -		
Each	—	0.05
Total	—	0.15
Aluminium	The remainder	

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

4. CONDITION

4.1 Except as is provided in 4.2 below, the material shall be supplied solution treated, controlled stretched to a permanent extension of not less than 1½ % nor more than 3 %, and artificially aged. (T—7651).

4.2 When agreed between the manufacturer and the purchaser and stated on the order, the manufacturer shall supply material solution treated and controlled stretched to a permanent extension of not less than 1½% nor more than 3% (W51). Unless otherwise agreed between the manufacturer and the purchaser, for this condition of supply the manufacturer shall demonstrate that the material conforms to the property requirements given in 6.1, 6.2 and 6.3 after heating representative test samples as set out in 5.2(b).below.

5. HEAT TREATMENT

Material shall be heat treated as follows:

5.1 Solution heat treat by heating at a temperature of 475 ± 10°C and quenching in water at a temperature not exceeding 40°C.

5.2 Artificial age by:

a. Heating to a temperature of 172 ± 3°C at a rate not exceeding 20°C per hour and soaking at this temperature for 6-15 hours followed by air cooling:

or

b. Heating at a temperature of 120 ± 3°C for 24 hours followed with or without cooling by further heating at a temperature of 172 ± 3°C for 6-15 hours followed by air cooling:

or

c. Material found not to conform to the requirements of 6.2.1 after ageing to treatments (a) or (b) above may be heated at 172 ± 3°C for an additional time to be agreed between the manufacturer and purchaser.

NOTE: In the majority of cases, the required property levels (given in 6.1, 6.2 and 6.3) are achieved after ageing for 10 hours at 172 ± 3°C. The range of times (6-15 hours) in the second stage ageing treatment allows the manufacturer to recommend, where necessary, the use of ageing times other than 10 hours.

5.3 Material aged by heating according to treatments (a), (b) or (c) above may be converted to DTD 5130A by further heating at 172 ± 3°C. Confirmation that DTD 5130A properties have been achieved shall be demonstrated by completion of the tests in DTD 5130A, paragraphs 6.1, 6.2 and 6.3.

6. PROPERTIES

Material manufactured in accordance with the requirement of 4.1 above, or test samples taken from material manufactured in accordance with the requirements of 4.2 above, and artifically aged in accordance with the requirements of 5.2(a), (b) or (c) above as appropriate, shall conform to the property requirements given in 6.1, 6.2 and 6.3 below.

6.1 TensileProperties

Tensileproperties obtained from test pieces selected and prepared in accordance with the requirements of the latest issue of British Standard Ll00 shall be not less than the values shown in Table B.

6.2 Resistance to Stress Corrosion Cracking

Test pieces from representative samples of plate of nominal thickness over 25 mm, selected, prepared and tested in accordance with the procedure set out in Appendix A, shall be capable of withstanding a stress of 175 MPa for 20 days without evidence of cracking. The test frequency shall be not less than one specimen per plate thickness range produced per month.

6.2.1 Resistance to stress corrosion cracking shall be demonstrated on a routine basis for all plates by the following control test. The electrical conductivity of representative samples taken from each piece of parent plate in each batch shall be determined by a method approved by the Quality Assurance Authority. Material shall be considered to have acceptable stress corrosion resistance provided that the conductivity is not less than 22 . 5 MS/m and the long-transverse 0 . 2 % proof stress as defined in 6.1 above is not greater than 500 MPa.

TABLE B

Nominal Thickness	Test Direction	0.2% Proof Stress	Tensile Strength	Elongation on gauge length of	
				50 mm	5D
mm		MPa	MPa	%	%
6 up to and including 10	Longitudinal Long transverse	450 450	520 520	8 8	— —
Over 10 up to and including 25	Longitudinal Long transverse	450 450	520 520	— —	7 5
Over 25 up to and including 40	Longitudinal Long transverse Short transverse	450 450 415	515 515 490	— — —	7 5 2.5
Over 40 up to and including 60	Longitudinal Long transverse Short transverse	450 445 405	515 515 485	— — —	7 5 2.5
Over 60 up to and including 80	Longitudinal Long transverse Short transverse	445 440 395	505 510 480	— — —	6 5 2
Over 80 up to and including 100	Longitudinal Long transverse Short transverse	440 435 390	500 505 475	— — —	6 5 2
Over 100 up to and including 120	Longitudinal Long transverse Short transverse	435 430 380	495 500 470	— — —	6 5 2
Over 120 up to and including 140	Longitudinal Long transverse Short transverse	430 425 370	490 495 460	— — —	5 4 2

NOTE: 1 MPa = lN/mm² = 0.102 Kgf/mm² = 0.065 tonf/in²
Information on SI units is given in BS 3763 “The International System of Units (SI)” and BS 350 “Conversion Factors and TabIes”.

6.2.2 When material does not meet the requirements of 6.2.1 above it may be given additional artificial ageing as defined in 5.2(c) above. The material shall he considered to have acceptable stress corrosion resistance provided that, upon completion of this additional ageing, it conforms to the requirements of 6.2.1

or

6.2.3 When material does not meet the requirements of 6.2.1, it may be tested in accordance with Appendix A. The material shall be capable of withstanding a stress of 175 MPa for 20 days without evidence of cracking.

6.3 Plane Strain Fracture Toughness

Test pieces from representative samples of plate of nominal thickness over 25 mm, selected, prepared and tested in accordance with the procedure set out in Appendix B shall be capable of achieving plane-strain fracture toughness not less than the values shown in Table C. The test frequency shall be not less than one specimen per plate thickness range produced per month.

6.3.1 Plane-strain fracture toughness shall be demonstrated on a routine basis for all plates of nominal thickness over 25 mm by the following control test. The notch tensile strength/0.2 % proof stress ratio of each piece of parent plate in each batch shall be determined by the method specified in Appendix C. Material shall be considered to have acceptable plane-strain fracture toughness provided the notch tensile strength/0.2% proof stress ratio is not less than the values shown in Table D.

6.3.2 When material does not meet the requirements of 6.3.1 above it may be given additional artificial ageing as defined in 5.2(c) above. The material shall be considered to have acceptable plane-strain fracture toughness provided that, upon completion of this artificial ageing, it conforms to the requirements of 6.3.1

or

6.3.3 When material does not meet the requirements of 6.3.1 it may be tested in accordance with the procedure set out in Appendix B. The material shall be considered to have acceptable plane-strain fracture toughness provided that the results of the test are not less than the values shown in Table C.

TABLE C

Plate Thickness (mm)	Specimen Orientation	Facture Toughness (MPa m½)
> 25 ⩽ 40	L-T T-L	28.0 25.0
> 40 ⩽ 60	L-T T-L	27.0 25.0
> 60 ⩽ 80	L-T T-L	26.0 24.0
> 80 ⩽ 120	L-T T-L	24.0 22.0
> 120 ⩽ 140	L-T T-L	22.0 20.0

TABLE D

Plate Thickness (mm)	Specimen Orientation	NTS/0.2% PS	
		(1)	(2)
> 25 ⩽ 40	Longitudinal Long trans.	1.42 1.30	1.10 0.96
> 40 ⩽ 60	Longitudinal Long trans.	- -	1.05 0.96
> 60 ⩽ 80	Longitudinal Long trans.	- -	1.01 0.92
> 80 ⩽ 120	Longitudinal Long trans.	- -	0.92 0.83
> 120 ⩽ 140	Longitudial Long trans.	- -	0.83 0.74

NOTE: 1 Notch tensile strength to be obtained using 12.7 mm diameter specimen specified in ASTM E602/78.
2 Notch tensile strength to be obtained using 26.9 mm diameter specimen specified in ASTM E602/78.

APPENDIX A

TEST FOR THE DETERMINATION OF RESISTANCE TO STRESS CORROSION CRACKING

A1 *Test Sample Selection*

A1.1 The test sample shall be selected from an individually fabricated plate at middle width at a position clear of the stretcher jaw markings.

A2 *Test Piece Preparation*

A2.1 Plate over 25 mm thick and up to and including 50 mm thick.

A2.1.1 Three adjacent C-ring test pieces shall be machined from the test sample so that the stress applied during the test will be in the short transverse direction in relation to the plate.

A2.1.2 The test piece shall be machined to the dimensions specified in American Society for Testing Materials standard ASTM G47/79, "Recommended Procedure for Determining Susceptibility to Stress-Corrosion-Cracking of High Strength Aluminium Alloy Products".

A2.2 Plate over 50 mm thick.

A2.2.1 Three adjacent tensile bar test pieces shall be machined from the test sample in the short transverse direction in relation to the plate.

A2.2.2 The tensile bar test piece shall be machined to the dimensions specified in ASTM G47/79.

A2.3 Test Piece Location

A2.3.1 Test pieces shall be located so that the region of maximum stress applied during testing will be centred on the mid-plane of the plate thickness.

A2.4 Identification

A2.4.1 Test pieces shall be identifiable to the product(s) under test.

A3 *Test Procedure*

A3.1 Test pieces shall be exposed to an alternate immersion stress corrosion test conducted in accordance with the procedure specified in ASTM G47/79 and its associated documents.

A3.2 Three test pieces shall be tested per test sample.

A4 *Interpretation of Results*

A4.1 Criterion of Failure

A4.1.1 A sample shall be considered to have failed the test if one or more of the specimens fail (see retest procedure A5).

A4.1.2 A specimen that has fractured or which exhibits cracking shall be considered as a stress corrosion failure unless, (a) it is proved otherwise by the provision of A4.2 and A4.3, or (b) failure was due to improper test piece preparation or testing technique.

A4.2 Macroscopic Examination

A4.2.1 Cracking should be clearly differentiated from lined-up pitting. If the presence of SCC is questionable, metallographic examinations should be performed to determine whether or not SCC is present.

A4.3 Metallographic Examination

A4.3.1 Test pieces revealing intergranular cracking, even if accompanied by transgranular cracking shall be a test failure.

A4.3.2 Localised intergranular attack of the surface of test pieces that is no deeper than the width of the attack or not deeper than localised attack on an unstressed or compressively stressed region of those test pieces or separate unstressed test pieces shall not be considered a test failure.

A4.3.3 Pitting corrosion without intergranular attack even if accompanied by transgranular cracking shall not be a test failure

A5 *Re-test procedure*

A5.1 If only one test piece fails the test requirements, or incorrect testing technique has been proven a re-test is permitted.

Replacement of a test piece shall be permitted if test piece preparation has been proved incorrect.

A5.2 Re-testing shall be carried out on a further 3 test pieces from the original sample whenever possible or from another sample of the same plate in accordance with Al.

A5.3 If any test piece fails the sample shall have failed the test.

A6 *Test Records*

A6.1 Test records shall include:
Plate identification and thickness
Alloy and temper designation
The results of all interim and final inspections carried out
Orientation, size, type and number of test pieces
Stress level applied
Time to failure when applicable

APPENDIX B

TEST FOR THE DETERMINATION OF PLANE STRAIN FRACTURE TOUGHNESS

B1 *Test Sample Selection*

Bl.1 The test sample shall be selected from an individually fabricated plate at middle width at a position clear of the stretcher jaw markings.

B2 *Test Piece Location*

B2.1 For plate thicknesses up to and including 40 mm, test pieces shall be taken from the test sample such that the centre-line of the test piece corresponds with the mid-plane of the plate thickness.

B2.2 For plate thicknesses over 40 mm and up to and including 54 mm, test pieces shall be taken from the test sample such that the centre-line of the test piece is as near as possible to the the rolled surface.

B2.3 For plate thicknesses over 54 mm, test pieces shall be taken from the test sample such that the centre-line of the test piece corresponds with the ¼- thickness plane of the plate.

B3 *Test Piece Preparation*

B3.1 A standard fracture toughness test piece shall be machined from the test sample in each of the orientations (L-T) and (T-L) specified in British Standard BS 5447, except that in the crack plane identification of Appendix D of the Standard, (X-Y) shall be represented by (L-T) and (Y-X) shall be represented by (T-L) designations.

B3.2 The standard fracture toughness test pieces shall be machined to the dimensions specified in British Standard BS 5447.

B4 *Test Procedure*

B4.1 Plane strain fracture toughness (K_{Ic}) tests shall be conducted in accordance with the procedure specified in British Standard BS 5447.

B4.2 One test piece taken in each of the orientations (L-T) and (T-L) shall be tested per test sample.

B5 *Test Records*

B5.l Test records shall include
Plate identification and thickness
Alloy and temper designation
Orientation, size, type and number of test pieces
Test data validity criteria according to BS 5447.

APPENDIX C

TEST FOR THE DETERMINATION OF NOTCH TENSILE STRENGTH/0.2% PROOF STRESS RATIO

C1 *Test Sample Selection*

Test samples shall be selected from each parent plate in the longitudinal and long-transverse directions.

C1.2 The test samples shall not be taken from the plate ends that have been contained within the stretcher grips.

C1.3 The test samples shall be such that both the standard tensile and the notched tensile test pieces can be prepared from it.

C2 *Position of Test*

C2.1 For plate thickness up to and including 40 mm the test sample shall be selected so as to produce test pieces which will have a centre line corresponding to the centre line of the plate thickness.

C2.2 For plate thicknesses over 40 mm and up to and including 54 mm test samples shall be selected so as to produce test pieces which will have a centre line as near the rolled surface as possible.

C2.3 For plate thicknesses over 54 mm test samples shall be selected so as to produce test pieces with a centre line that corresponds to the ¼- thickness plane of the plate.

C3 *Test Piece Preparation*

C3.1 A standard tensile test piece and a notched tensile test piece shall be machined from the test samples as close to each other as is practical.

C3.2 The standard test piece shall conform to British Standard BS4A4 requirements.

C3.3 The notched test sample shall be machined to the dimensions specified in American Society for Testing and Materials Standard ASTM E602/78 "Sharp Notch Tension Testing with Cylindrical Specimens".

C3.4 The machining procedure for the preparation of the notch shall be as specified in ASTM E602/78.

C4 *Verification of Testing Equipment for Notched Tensile Test*

Verification that the procedure adopted for the notched tensile test is acceptable shall be conducted according to the requirements of ASTM E602/78.

C5 *Inspection of Notched Tensile Test Pieces*

C5.1 The notched tensile test pieces shall be inspected in accordance with, and shall conform to the requirements of, ASTM E602/78.

C6 *Test Procedure*

C6.1 The standard and notched tensile test pieces shall be tested in accordance with the procedure specified in ASTM E602/78.

C7 *Test Records*

C7.1 Test records shall include:

Plate identification and thickness
Test section length
Major diameter
Notch diameter
Notch root radius
Maximum load for notch test
0.2% proof stress for standard test
Notch tensile strength/0 .2 % proof stress ratio

Approved for issue:

Dr D K Thomas
Head of Materials Department
Royal Aircraft Establishment
Farnborough
Hampshire

Printed in England by Albert Gait Ltd., Grimsby
and published by Her Majesty's Stationery Office
D/d 718055 C9 5/82 (12/51535)

First published 1982

HER MAJESTY'S STATIONERY OFFICE

Government Bookshops

49 High Holborn, London WCIV 6HB
13a Castle Street, Edinburgh EH2 3AR
41The Hayes, Cardiff CF1 1JW
Brazennose Street, Manchester M60 8AS
Southey House, Wine Street, Bristol BS1 2BQ
258 Broad Street, Birmingham B12HE
80 Chichester Street, Belfast BT1 4JY

Government Publications are also available through booksellers

£l.35 net

ISBN 0 l1 772440 8