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EMERGENCY STANDARD
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(Superseding No. (E)D. 501—1940)
Being British Standards Institution
Specification for Aircraft Material
No. 3 S. 3 *
endorsed with amendment

STANDARDS ASSOCIATION OF AUSTRALIA.

Headquarters :
Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL
(Emergency Series)

MILD STEEL SHEETS AND STRIPS
(SUITABLE FOR WELDING)

This standard forms one of a series prepared by the Standards Association of Australia at the request of Departments of the Commonwealth Government for use in relation to the supply of materials required for defence purposes. In appropriate cases these specifications will be reviewed for inclusion in the normal series of Australian Standards.

First Issued - - - - April, 1940
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1. **Chemical Composition.** (a) The chemical composition of the sheets and strips shall be :—

Carbon	-	-	-	Not less than 0.20 nor more than 0.27 per cent.
Silicon	-	-	-	Not more than 0.30 per cent.
Manganese	-	-	-	Not more than 0.60 per cent.
Sulphur	-	-	-	Not more than 0.05 per cent.
Phosphorus	-	-	-	Not more than 0.05 per cent.
Nickel (if present)	-	-	-	Not more than 0.30 per cent.

(b) The complete analysis of every cast shall be supplied to the Inspector.

2. **Condition.** The sheets and strips shall be supplied in the rolled and reheated condition. The reheating shall be carried out after rolling.

3. **Methods of Testing.** (a) All tests shall be carried out to the satisfaction of the Inspector.

(b) *Tensile Test.* 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.

Proof stress determinations shall be carried out as follows :—

(i) One test sample shall be taken from a sheet or strip from each cast of steel, the test sample shall be normalised and the proof stress shall be obtained from an accurately determined load-elongation diagram. The proof stress is defined as that stress at which the stress strain curve departs by 0.1 per cent of the gauge length from the line of proportionality.

This sample shall be broken in tension and the ultimate tensile stress recorded on the diagram.

(ii) On all remaining tensile test samples proof stress determinations shall be carried out by an approved method.

All tensile test samples shall be cut from the selected sheets so that the longitudinal axis of the test piece is at right angles to the direction of final rolling. All tensile test samples from strips shall be cut from the selected strip so that the longitudinal axis of the test piece is in a direction parallel to the length of the strip. The tensile test pieces shall have a width of 0.5 inch in the parallel test portion and the elongation shall be measured on a gauge length of 2 inches.

(c) *Single Bend Test* (12 S.W.G. (0.104 in.) and thinner). The test piece shall be bent through 180° by steadily applied pressure round the end of a former of the specified radius. Bending may be effected by pressing the test piece into lead by means of an appropriate former, and in cases of dispute this method shall be used.

Where the specified radius is less than 0.012 inch the test piece shall first be bent round a radius of 0.012 inch and the U piece thus formed shall be subsequently closed in a vice until the inner surfaces of the bend are twice the specified radius apart.

(d) *Reverse Bend Test* (12 S.W.G. (0.104 in.) and thinner). One end of each test piece shall be fixed in a vice between suitable formers, the inner edges of which are rounded to a radius equal to

* This specification is B.S. No. 3 S. 3 with amendments regarding chemical composition, and margins of manufacture for hot rolled sheets and strips. For reference to the specification in its amended form it is essential that the Australian classification number (E)2D. 501 be used.

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three times the nominal thickness of the sheet or strip. The projecting length of the test piece shall then be bent at right angles to the fixed end, first to one side and then to the other until the test piece breaks. Each test piece must withstand without cracking the specified number of bends through 180° , the first bend through 90° not being counted.

The fractured surfaces must show freedom from pipe or other defect.

(e) All single bend and reverse bend test pieces shall be 0.5 inch wide and shall be cut from each selected sheet or strip so that the longitudinal axis of the test piece is in a direction at right angles to the direction of final rolling. The longer edges shall be carefully smoothed and chamfered so that the cross section has approximately semi-circular ends.

The test pieces shall be bent in such a manner that the axis of the bend lies in a direction parallel to the direction of final rolling. Where the width of the strip does not permit of the above procedure the test pieces shall be cut and bent in such a manner that the axis of the bend is in a direction at right angles to the direction of rolling.

(f) All test samples shall be marked as directed by the Inspector before they are cut from the sheets or strips.

4. Freedom from Defects. (a) The sheets and strips shall be free from defects.

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

(c) The sheets shall be so free from curvature that when laid out flat no part of their edges shall be distant from a 6 foot chord by more than $\frac{1}{16}$ inch.

(d) The strips shall be so free from lateral curvature that when laid out flat no part of their edges shall be distant from a 10 foot chord by more than $\frac{1}{4}$ inch.

5. Margins of Manufacture. (a) The margins of manufacture for hot rolled sheets and strips shall not exceed those given in Table 1 and for cold rolled sheets and strips those given in Table 2.

(b) For sheets and strips thicker than 0.232 inch the tolerance on thickness shall be specified on the order.

6. Heat Treatment. The sheets and strips after rolling shall be re-heated at a uniform temperature of not less than 500°C . and then allowed to cool freely in still air.

7. Selection and Preparation of Mechanical Test Samples. (a) Sheets or strips from the same cast and re-heated together shall be grouped in parcels.

(b) *Sheets or strips (12 S.W.G. (0.104 in.) and thinner).* Each sheet or strip 12 S.W.G. and thinner shall be subjected to a single bend test on a corner as specified in Clause 8 (d) and the Inspector shall select from each parcel one sheet or strip of the thickest gauge from which test samples shall be cut for a tensile test, a single bend test and a reverse bend test as specified in Clause 8. These test samples shall not be further heat-treated or mechanically worked before testing.

(c) *Sheets or strips thicker than 12 S.W.G. (0.104 in.).* Each sheet or strip thicker than 12 S.W.G. shall be submitted to the Brinell (or other approved) hardness test. The Inspector shall then select from each parcel two sheets or strips, one giving the highest and the other the lowest hardness number; test samples shall be cut from these sheets for the tensile test specified in Clause 8 (a).

8. Mechanical Tests. The mechanical properties of the test pieces machined from the samples selected and prepared as specified in Clauses 7 and 3, must comply with the following tests:—

(a) *Tensile Test:—*

0.1 per cent Proof Stress (All thicknesses) Not less than 16 tons per sq. in.
Ultimate Tensile Stress (All thicknesses) Not less than 28 tons per sq. in.

For sheets and strips thicker than 12 S.W.G. (0.104 in.):—

Elongation on 2 inches Not less than 20 per cent.

(b) *Single Bend Test. (12 S.W.G. (0.104 in.) and thinner).* The test pieces must withstand without cracking being bent as specified in Clause 3 (c) over a radius equal to half the nominal thickness of the sheet or strip.

(c) *Reverse Bend Test (12 S.W.G. (0.104 in.) and thinner).* The test pieces must withstand without cracking three bends in the manner specified in Clause 3 (d).

(d) *Single Bend Test on the Corner of each Sheet or Strip (12 S.W.G. (0.104 in.) and thinner).* Each sheet or strip 12 S.W.G. and thinner shall be subjected to a single bend test at one corner. The material must withstand without cracking being bent through 180° over a radius equal to half the nominal thickness of the sheet or strip.

All sheets or strips failing in this test will be rejected.

9. Re-tests. If any test piece fails to comply with the mechanical tests specified in Clause 8, the Inspector may reject the parcel represented by that test piece, or at the request of the Manufacturer adopt either of the following procedures:—

(i) Select for test from the same parcel two other samples, one of which must be from the sheet or strip from which the original test sample was taken unless that sheet or strip has been withdrawn by the Manufacturer. Test pieces prepared from these two further samples as specified in Clauses 7 and 3 must comply with the mechanical tests specified in Clause 8.

(ii) Allow the parcel of sheets or strips to be re-heated and re-tested in accordance with Clauses 3, 7 and 8.

10. Identification. All sheets and strips 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.

501

MARGINS OF MANUFACTURE.
TABLE 1. HOT ROLLED SHEETS AND STRIPS.

Nominal Thickness.	Tolerance
Inch	Inch
0.250 to 0.220	+0.016 -0
0.219 to 0.190	+0.016 -0
0.189 to 0.160	+0.016 -0
0.159 to 0.140	+0.016 -0
0.139 to 0.120	+0.016 -0
0.119 to 0.100	+0.016 -0
0.099 to 0.080	+0.016 -0
0.079 to 0.070	+0.012 -0
0.069 to 0.060	+0.012 -0
0.059 to 0.050	+0.008 -0
0.049 to 0.040	+0.008 -0
0.039 to 0.030	+0.006 -0
0.029 to 0.020	+0.004 -0
0.019 and thinner	+0.004 -0



TABLE 2. COLD ROLLED SHEETS AND STRIPS.

1 Nominal Width	2 Tolerance on Sheared Width	3 Nominal Thickness	4 Tolerance on Thickness	
			Centre portion	Edges (12½ per cent of the total width on each side after shearing)
Inch	inch	inch	inch	inch
Under 4	+0 —·010	Under 0·020	+·0010 —0	+·0010 —·0005
	+0 —·010	0·020 to 0·031	+·0015 —0	+·0015 —·0005
	+0 —·015	0·032 to 0·047	+·0020 —0	+·0020 —·0005
	+0 —·015	0·048 to 0·063	+·0025 —0	+·0025 —·0010
	+0 —·020	0·064 to 0·091	+·0030 —0	+·0030 —·0010
	+0 —·020	0·092 to 0·127	+·0035 —0	+·0035 —·0015
	+0 —·025	0·128 to 0·159	+·0040 —0	+·0040 —·0015
	+0 —·025	0·160 to 0·191	+·0045 —0	+·0045 —·0015
	+0 —·030	0·192 to 0·232	+·0050 —0	+·0050 —·0020
4 and under 6	+0 —·010	Under 0·020	+·0010 —0	+·0010 —·0005
	+0 —·015	0·020 to 0·031	+·0015 —0	+·0015 —·0010
	+0 —·020	0·032 to 0·047	+·0020 —0	+·0020 —·0010
	+0 —·020	0·048 to 0·063	+·0025 —0	+·0025 —·0015
	+0 —·025	0·064 to 0·091	+·0030 —0	+·0030 —·0015
	+0 —·025	0·092 to 0·127	+·0035 —0	+·0035 —·0020
	+0 —·030	0·128 to 0·159	+·0040 —0	+·0040 —·0020
	+0 —·030	0·160 to 0·191	+·0045 —0	+·0045 —·0020
	+0 —·035	0·192 to 0·232	+·0050 —0	+·0050 —·0025
6 and under 10	+0 —·015	Under 0·020	+·0015 —0	+·0015 —·0010
	+0 —·020	0·020 to 0·031	+·0020 —0	+·0020 —·0010
	+0 —·025	0·032 to 0·047	+·0020 —0	+·0020 —·0015
	+0 —·025	0·048 to 0·063	+·0030 —0	+·0030 —·0015
	+0 —·030	0·064 to 0·091	+·0040 —0	+·0040 —·0020
	+0 —·030	0·092 to 0·127	+·0045 —0	+·0045 —·0025
	+0 —·035	0·128 to 0·159	+·0050 —0	+·0050 —·0025
	+0 —·035	0·160 to 0·191	+·0055 —0	+·0055 —·0030
	+0 —·040	0·192 to 0·232	+·0060 —0	+·0060 —·0030
10 and under 16	+0 —·020	Under 0·020	+·0015 —0	+·0015 —·0010
	+0 —·025	0·020 to 0·031	+·0025 —0	+·0025 —·0010
	+0 —·030	0·032 to 0·047	+·0025 —0	+·0025 —·0015
	+0 —·030	0·048 to 0·063	+·0035 —0	+·0035 —·0015
	+0 —·035	0·064 to 0·091	+·0045 —0	+·0045 —·0020
	+0 —·035	0·092 to 0·127	+·0050 —0	+·0050 —·0025
	+0 —·040	0·128 to 0·159	+·0055 —0	+·0055 —·0025
	+0 —·040	0·160 to 0·191	+·0060 —0	+·0060 —·0030
	+0 —·045	0·192 to 0·232	+·0065 —0	+·0065 —·0030
16 to 24 inclusive	+0 —·020	Under 0·020	+·0020 —0	+·0020 —·0015
	+0 —·025	0·020 to 0·031	+·0030 —0	+·0030 —·0015
	+0 —·030	0·032 to 0·047	+·0035 —0	+·0035 —·0015
	+0 —·035	0·048 to 0·063	+·0035 —0	+·0035 —·0015
	+0 —·040	0·064 to 0·091	+·0045 —0	+·0045 —·0020
	+0 —·040	0·092 to 0·127	+·0050 —0	+·0050 —·0025
	+0 —·045	0·128 to 0·159	+·0060 —0	+·0060 —·0025
	+0 —·045	0·160 to 0·191	+·0065 —0	+·0065 —·0030
	+0 —·050	0·192 to 0·232	+·0070 —0	+·0070 —·0030

For the purposes of this specification as an Australian standard the term "Inspector" shall be interpreted in the manner directed by the Australian Airworthiness Authority concerned.

This specification, prepared by the Special Committee on Aircraft Materials and Components, was approved on behalf of the Council of the Association on 21st July, 1942.

NOTE.

In order to keep abreast of progress in the industries concerned, Australian standards are subject to periodical review. Suggestions for improvement, addressed to the Headquarters of the Association, will be welcomed.