

STANDARDS ASSOCIATION OF AUSTRALIA.

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

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL
(Emergency Series).

SILVER QUANDONG

(*Elaeocarpus grandis* F. v. M., or *Elaeocarpus kirtonii* F. v. M.)

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.

INTRODUCTION.

This specification applies to the selection of timber for aircraft construction and is divided into three sections :

(a) Section I applies to the requirements for the purchase of raw material which can subsequently be graded for use under Sections II and III.

(b) Section II applies to material for parts the strength and stiffness of which do not affect the safety of the aircraft.

(c) Section III applies to material for those portions of the aircraft structure the loads of which are laid down in the airworthiness requirements or the failure of which would endanger the safety of the aircraft.

The tests specified shall be carried out in the manner described in the appendices.

Unseasoned timber may be submitted for testing. Under these circumstances, the procedure for testing and acceptance shall be in accordance with Appendix F. The visual inspection required under Section I shall, however, be made after seasoning.

The terms and trade and botanical names used in this specification shall be interpreted in accordance with A.S. No. O.1 "Terms and Definitions used in Timber Grading Rules" and A.S. No. O.2 "Nomenclature of Australian Timbers."

SECTION I. ROUGH TIMBER.

1. Timber accepted under this section will require further grading to select pieces which will comply with Sections II and III of this specification.

2. **Dimensions.** The timber shall be in the form of selected planks 2 in. or less in thickness.

3. **Quality.**

(a) The timber shall be free from obvious and incipient decay, knots, splits, shakes, seasoning checks, brittle heart, figured grain, gum veins, compression failures, insect attack, internal checks, want, blemishes due to handling and other injuries. The following imperfections will be permitted in sawn timber, but their presence in finished parts will be at the discretion of the inspector :

(i) pin-knots : not exceeding $\frac{1}{8}$ in. dia., and not closer than 2 in., nor more than 6 in any 1 sq. ft. of face area,

(ii) pin-holes : not exceeding $\frac{1}{16}$ in. dia., and not closer than 2 in., nor more than 6 in any 1 sq. ft. of face area,

(iii) sloping grain as determined by the splitting test described in Appendix B: not exceeding 1 in 15,

(iv) spring : not exceeding 1 in 576 ($\frac{1}{4}$ in. in 12 ft.),

(v) bow : not exceeding 1 in 288 ($\frac{1}{2}$ in. in 12 ft.),

(vi) twist : not exceeding $\frac{1}{4}$ in. in 10 sq. ft. of face area.

(b) The timber shall be immune from attack by the powder post borer (*Lyctus brunneus*) as the result of :

- (i) the complete absence of starch, or
- (ii) satisfactory treatment under approved supervision with boric acid (H_3BO_3) in accordance with the procedure described in Appendix K.

Every plank shall be clearly marked showing whether it is :

- (i) starch-free, or
- (ii) treated with boric acid, giving the treatment batch number.

All planks stated as being starch-free shall be tested for the presence of starch by the method described in Appendix H, and any plank in which starch is present shall be rejected.

The boric acid content of treated timber, as determined by the method described in Appendix J, shall be not less 0.2%, the individual determinations in no instance being less than 0.18%. Should any sample plank fail to meet these requirements, all of the planks in the treatment batch represented by that sample shall be rejected.

4. Seasoning. The timber shall be either air-dried or kiln-dried to the moisture content specified. If kiln-dried, the operation shall be carried out under approved supervision in accordance with the appropriate schedule in Appendix G.¹

5. Moisture Content. The moisture content as determined by an approved electrical moisture meter shall not exceed 17%.

NOTE.—In case of dispute, the moisture content as determined by the electrical moisture meter may be checked by the oven-drying method described in Appendix A, and the value so obtained shall be adopted.

6. Density. Although no tests are required on timber selected to this section, it is desirable that the timber shall weigh less than 35 lb. per cu. ft.

7. Marking. Each plank accepted under this section shall be stamped with the following particulars :

- (a) the supplier's name or distinguishing mark,
- (b) the number of this specification,
- (c) whether the timber is starch-free or treated, giving the treatment batch number.
- (d) the inspector's stamp.

SECTION II. GRADE B TIMBER.

8. Timber which complies with the provisions of Section I shall fulfil the further provisions of this section before being released as Grade B timber.

9. Moisture Content. The moisture content of every plank shall be determined by an approved electrical moisture meter. Tests shall be made at points approximately 18 in. from each end, and at the mid-length. The three readings shall be between 15% and 10% and the individual readings shall not vary by more than 2% in any one plank.

NOTE.—In case of dispute, the moisture content as determined by the electrical moisture meter may be checked by the oven-drying method described in Appendix A, and the value so obtained shall be adopted.

10. Density. The density of every plank shall be determined, as described in Appendix C, from two specimens, one from each edge of each plank. The density shall be between 24 and 34 lb. per cu. ft.

11. Brittleness Test. A determination of brittleness shall be carried out on specimens from each plank by the method described in Appendix D. For planks 20 ft. and longer four specimens shall be cut from the diagonally opposite corners ; for planks less than 20 ft. long not less than two specimens shall be cut from diagonally opposite edges, from one end of the plank ; one specimen shall include the corner nearest the pith. Where sloping grain is present, the specimens shall be cut from the end of the plank nearest the pith. No specimen shall have an Izod value less than 4 ft. lb.

12. Re-test. A plank which does not comply with the requirements of Clauses 9 to 11 above may be sawn down the wide face. If on re-test one part then complies with these requirements that part may be released.

¹If, however, in the opinion of the inspector, the quality of the timber in a charge would be improved by the use of a milder schedule, lower temperature and/or smaller wet bulb depressions may be used until the moisture content of the wettest sample plank reaches 30%.

13. Marking. Each plank accepted under this section shall be stamped with the following particulars :

- (a) the supplier's name or distinguishing mark.
- (b) the number of this specification,
- (c) the grade of timber,
- (d) whether the timber is starch-free or treated, giving the treatment batch number,
- (e) the inspector's stamp.

SECTION III. GRADE A TIMBER.

14. Timber which complies with the provisions of Sections I and II shall fulfil the further provisions of this section before being released as Grade A timber.

15. Brittleness Test. The Izod value of the timber, determined by the brittleness test described in Clause 11 above, shall be not less than 5 ft. lb.

16. Compression Strength Parallel to Grain. The compression strength parallel to the grain shall be determined for every plank by the method described in Appendix E. The determination shall be made on specimens cut from each of the specimens used for the brittleness test described in Clause 11 above or end matched therewith. The ultimate compression strength of the timber shall be not less than the value specified in Table I for the appropriate moisture content.

TABLE I.

Moisture Content ²	Compression Strength Parallel to Grain.
%	lb. per cu. ft.
10	6,100
11	5,800
12	5,600
13	5,400
14	5,200
15	5,000
16	4,800
17	4,600
18	4,400
19	4,300
20	4,100

17. Re-test. A plank which does not comply with the requirements of Clauses 15 and 16 above may be sawn down the wide face. If on re-test one part then complies with these requirements that part may be released.

18. Marking. Each plank selected to this section shall be stamped with the following particulars :

- (a) the supplier's name or distinguishing mark,
- (b) the number of this specification,
- (c) the grade of timber,
- (d) whether the timber is starch-free or treated, giving the treatment batch number,
- (e) the inspector's stamp.

APPENDIX A.

Method of Determination of Moisture Content. (Oven-Drying Test).

Each specimen shall be weighed on a balance, the sensitivity of which is not less than 1 in 500, immediately after cutting, and shall then be dried in an oven at a temperature of 212° to 221° F. (100° to 105° C.) until the weight is constant, and weighed immediately after removal from the drying oven.

The percentage moisture content shall be determined using the formula :

$$\text{M.C.} = \frac{W_i - W_o}{W_o} \times 100$$

M.C. = percentage moisture content.

W_i = initial weight of specimen.

W_o = oven-dry weight of specimen.

²Moisture content as determined by the method described in Appendix A.

APPENDIX B.

Splitting Test.

Short specimens, say 4 in. to 6 in. long, shall be split in two planes, one tangential and one radial.

APPENDIX C.

Method of Determination of Density.

The determination of weight shall be correct to within $\pm 1\%$ and of volume to within $\pm 3\%$.

The density in lb. per cu. ft. may be calculated by one of the following formulae :

$$\frac{\text{Wt. in pounds} \times 1728}{\text{Vol. in cu. in.}}$$

or

$$\frac{\text{Wt. in grammes} \times 3.81}{\text{Vol. in cu. in.}}$$

or

$$\frac{\text{Wt. in grammes} \times 62.4}{\text{Vol. in cu. cm.}}$$

The density of the timber shall be taken as the average of the two tests, and shall be stated to the nearest lb. per cu. ft.

APPENDIX D.

Method of Determination of Brittleness.

(Izod Test).

A notched specimen, the sides of which are cut radially and tangentially, of the dimensions shown in Fig. D. 1 shall be broken in an approved impact testing machine, the blow being applied in the tangential direction. The testing machine shall be of a type which will permit of the test results being determined to within $\frac{1}{4}$ ft. lb.

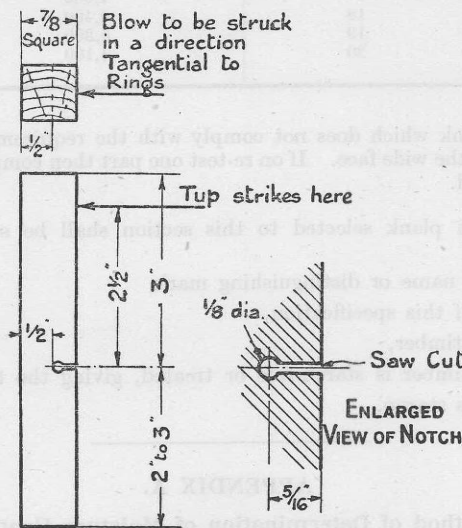


FIG. D. 1. Standard Impact Test Specimen.

(NOTE.—An approved type of impact testing machine is shown in Figs. 5 and 6 in B.S. Specification 3 V.4.)

APPENDIX E.

Method of Determination of Compression Strength Parallel to Grain.

The specimens shall be not less than $\frac{7}{8}$ in. square and having a length from two to four times the width.

The test shall be carried out in an approved testing machine and the load shall be so applied that the stress in the specimen increases at a rate of from 3,000 to 6,000 lb. per sq. in. per minute.

The ultimate compression strength of the timber shall be taken as the average of the tests, the corresponding moisture content being taken as the average of the moisture contents of the specimens.

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ADDENDUM.

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APPENDIX G.

Kiln-Drying Schedules for Silver Quandong.

Delete note “ (Not available at present) ” and insert the following :

(a) Up to 1 in.—Back Sawn.

Moisture Content Change-points (moisture content of wettest sample plank).	Dry Bulb Temperature.	Wet Bulb Depression.	Remarks.
	° F.	° F.	
Green	130	7	Maintain this High Humidity Treatment for 24 hours.
50%	130	10	
40%	130	15	
30%	140	20	
20%	160	20	
12%	160	12	

(b) Up to 1 in.—Quarter Sawn.

Moisture Content Change-points (moisture content of wettest sample plank).	Dry Bulb Temperature.	Wet Bulb Depression.	Remarks.
	° F.	° F.	
Green	140	15	Maintain this High Humidity Treatment for 24 hours.
40%	140	20	
20%	160	20	
12%	160	12	

(c) Over 1 in. and up to 2 in.—Back Sawn.

Moisture Content Change-points (moisture content of wettest sample plank).	Dry Bulb Temperature.	Wet Bulb Depression.	Remarks.
	° F.	° F.	
Green	110	5	Maintain this High Humidity Treatment for 24 hours. For 48 hours.
40%	120	7	
30%	120	10	
25%	130	15	
20%	140	20	
17%	160	3	
After H.H.T.	140	20	
12%	160	12	

(d) Over 1 in. and up to 2 in.—Quarter Sawn.

Moisture Content Change-points (moisture content of wettest sample plank).	Dry Bulb Temperature.	Wet Bulb Depression.	Remarks.
	° F.	° F.	
Green	120	7	Maintain this High Humidity Treatment for 24 hours. For 48 hours.
40%	130	10	
30%	130	15	
20%	140	20	
17%	160	3	
After H.H.T.	140	20	
12%	160	12	

APPENDIX F.

A Permissible Method of Testing Unseasoned Timber.

When unseasoned timber is submitted for testing, it shall be permissible to cut samples at least 6 in. long from the end of the plank (in accordance with Clause 11) which shall then be end-coated to the approval of the inspector. These samples shall be kiln-dried to between 10 and 15% moisture content, in accordance with the schedule given in Appendix G., and then tested. Acceptable planks shall be kiln-dried to the same schedule and not less than 5% of the planks, well distributed throughout the charge, shall be re-tested after drying. The re-tests shall be taken from the same ends of the planks as the original samples, and the averages shall be taken of the results of each of the two series of tests on the same planks. If the average of the re-tests indicates any reduction, the test values on all planks in the kiln charge shall be reduced by the difference between the averages of the two series of tests. If the adjusted test results of any plank then fail to comply with the requirements of this specification, that plank shall be re-tested.

APPENDIX G.

Kiln-Drying Schedules for Silver Quandong.

(Not available at present)

APPENDIX H.

Method of Testing for the Presence of Starch.

Both ends of the plank shall be docked and the whole cross section of each of the freshly cut surfaces shall be painted with a 0.05N solution of iodine in potassium iodide solution.

Where the grain is deflected so that the sapwood may occur other than at the ends of the plank, the point of maximum deflection on the edge furthest from the pith shall also be tested. Except on freshly sawn planks, the surface shall be freshened by planing before being painted with the solution.

Any trace of grey or blue colouration on the timber after painting with the solution indicates the presence of starch.

APPENDIX J.

Method of Determination of Boric Acid Content of Treated Timber.

(i) Selection and Preparation of Test Specimens.

The inspector shall select for testing at least 1% of the planks in each treatment batch of treated timber.

A section 12 in. long shall be cut at least 3 ft. from the end of each selected plank, and from the centre of each section a test specimen shall be cut in accordance with Fig. J. 1.

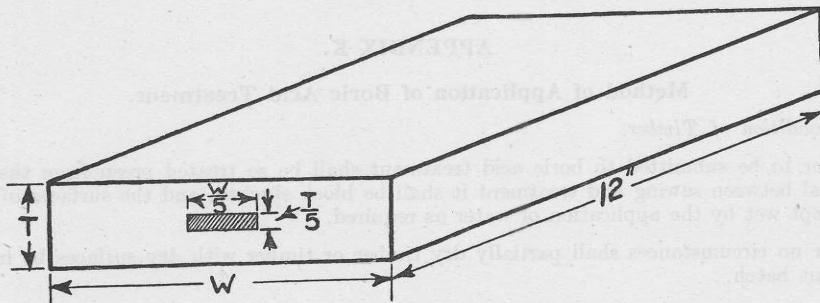


Fig. J. 1. Test Specimen for Determination of Boric Acid Content.

(ii) Method of Test.

The test specimen shall be brushed clean to remove any traces of chemical that may have adhered to it during the cutting process. It shall then be cut into small pieces to pass a $\frac{1}{4}$ in. mesh.

A representative sample shall be placed in a weighing bottle and the moisture content determined by the method described in Appendix A. (This moisture content sample shall not be used in the determination of the boric acid content.)

The boric acid analysis shall be made in duplicate as follows :

Mix a 5 g. sample of ground-up wood with 2.5 g. of lime-eschka mixture³ and place in a platinum dish. Cover the sample evenly with a further 3 g. of lime-eschka mixture and ignite gently over a medium burner flame until the sample ceases to emit flame spontaneously. Continue the ignition over a Meker burner until most of the carbon has been removed and the mixture is a light grey colour, care being taken to prevent fusion. The ignition should not take longer than 20 to 25 minutes.

Grind the mixture to a fine powder in the dish, using a small pestle, and transfer the powder to a 400 ml. beaker. (If the ignition has been carried out correctly the mixture will come away cleanly from the platinum dish and no lumps of carbon or fused mixture will remain.) Wash out the dish with a few ml. of dilute hydrochloric acid and add the washings to the beaker, followed by about 10 ml. of water and then concentrated hydrochloric acid slightly in excess of the amount required to dissolve the mixture (from 15 to 20 ml. should be sufficient). The beaker should be covered with a watch glass during this operation to prevent loss by spattering.

To the solution in the beaker add a few drops of phenolphthalein, followed by sufficient 15% caustic soda solution, added dropwise, to make the solution just alkaline. Make up to 100 ml. with water and filter the solution through a dry paper into a dry beaker.

Take a 25 ml. portion contained in a 250 ml. conical flask for each titration and, using phenolphthalein as an indicator, add 10% hydrochloric acid solution dropwise until the colour is discharged. Then add a few drops of methyl orange and continue the addition of acid until the solution is just acid to this indicator. Boil the solution gently under a reflux condenser for about 10 minutes to remove the carbon dioxide from the solution, but taking care that no large amount of steam issues from the top of the condenser. When the solution is cool adjust it to the methyl orange end point by means of 0.05N caustic soda solution, add glycerol in excess (about 40 ml.) and 1 ml. of phenolphthalein and titrate to the phenolphthalein end point with standard 0.05N carbonate-free caustic soda solution. The end point is different from the usual phenolphthalein end point in that it occurs only as a faint orange colour, which is easily missed if care is not taken. At the end point the solution changes in colour from the yellow of the alkaline methyl orange to a colour closely resembling the neutral orange colour of this indicator. The addition of a further drop of caustic soda solution produces a very faint pink colour. The occurrence of the orange colour indicates the true end point of the reaction and its detection may give difficulty, but a reliable verification may be obtained by reading the burette at the supposed end point and then adding one drop more of the caustic soda solution, when the further colour change mentioned above should take place.

Determine the acidity of the glycerol by taking a measured quantity, mixing it with an equal quantity of water and titrating with 0.05N caustic soda solution using phenolphthalein as an indicator and adjust the result of the main titration accordingly.

Titration reaction.



The boric acid acts as a monobasic acid in the presence of glycerol.

Therefore 1 ml. 0.1N NaOH = 0.00618 g. H_3BO_3 .

The boric acid content of the timber shall be the average of the duplicate determinations and shall be expressed as a percentage of the oven-dry weight of the timber.

The duplicate determinations shall agree to within 20% of each other, otherwise they shall be disregarded and fresh determinations made.

APPENDIX K.

Method of Application of Boric Acid Treatment.

(a) Condition of Timber.

Timber to be submitted to boric acid treatment shall be so treated green from the saw. In the interval between sawing and treatment it shall be block stacked, and the surfaces of the stack shall be kept wet by the application of water as required.

Under no circumstances shall partially dry timber or timber with dry surfaces be included in a treatment batch.

(b) Treatment Procedure.

Planks of the same thickness shall be stacked in a suitable bath, the planks being separated on faces and edges by at least $\frac{1}{4}$ in. The timber shall be completely covered with boric acid solution which shall be heated to and maintained at a temperature of not less than 200° F. for the appropriate period specified below. To ensure satisfactory treatment, the volume of solution in the bath shall be not less than eight times the volume of the timber.

³Lime-eschka mixture consists of a mixture of three parts of calcium oxide and one part of anhydrous sodium carbonate ground finely.

Throughout the treatment the level of the solution shall be maintained to cover the timber completely and the concentration of the solution shall not fall below 8%.

Thickness of planks.	Minimum concentration of boric acid solution.	Min. temperature of solution during treatment.	Period of immersion of timber in hot solution.
	%	° F.	hours
Up to 1 in.	8	200	10
Over 1 in. up to 1½ in.	8	200	14
Over 1½ in. up to 2 in.	8	200	18
Over 2 in. up to 2½ in.	8	200	22
Over 2½ in. up to 3 in.	8	200	26

NOTE.—Full information regarding the boric acid treatment of timber may be obtained from the Council of Scientific & Industrial Research, Division of Forest Products, or the Forestry Commission of N.S.W., Division of Wood Technology.

For the purposes of this specification 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 1st June, 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.