

FORESTS DEPARTMENT OF WESTERN
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FORESTERS' MANUAL

FOREST ENGINEERING

SECTION 4.—DEPARTMENTAL SAWMILLS

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FOREWORD

1. The attention of officers receiving this pamphlet is drawn to the introduction in Pamphlet No. 1 which is applicable to the Manual as a whole.

2. It is to be noted that each section as issued will override the instructions contained in circulars covered by the section and such circulars will automatically be cancelled.

3. This section is referred to in the foreword to Pamphlet No. 10 covering three sections, issued in 1961, in which it was stated that Section 4 would be published at a later date.

4. With reference to 2. above, the following circular appears as the Appendix in this pamphlet and is, therefore, to be cancelled:—

Circular No. 19/53—Notes on stain and mould fungi which may attack softwood.

The following circulars deal with sections of this pamphlet, but also refer to other matters and are, therefore, to be retained:—

Circular No. 6/53—Protection against insecticides and wood preservatives.

Circular No. 3/62—Use of chain saws in plantations.

INTRODUCTION

At present there are eight Departmental Sawmills in operation and others may be constructed if and when required. Those in operation are listed as follows:—

A. Hardwood Mills.

- (i) **Dwellingup.**—For experimental milling and the training of future timber inspection staff in the milling and properties of Jarrah.
- (ii) **Ludlow.**—For the conversion of silvicultural fellings in the TUART forest and the production of Tuart for Government requirements, mainly for the W.A.G.R.
- (iii) **Dryandra.**—For the conversion of Wandoo and Mallet.

B. **Softwood Mills.**—These mills operate primarily for the economic conversion of thinnings to sawn timber at the plantations more remote from markets, where at present there is no trade demand for such thinnings at an economic price. The mills are located at—

- (i) Grimwade Plantation.
- (ii) Harvey.
- (iii) Keenan Plantation.
- (iv) Ludlow Plantation.
- (v) Pimelia Plantation.

FELLING, LOGGING AND CARTING

1. Felling for departmental hardwood and pine mills is carried out on either a daywork, piecework or contract basis.

2. Where fellers are paid by daywork, the respective margins as provided by the Forestry Workers' Award for the time being in force, or such other rates as approved by the Conservator, must be paid.

Daywork felling rates.

3. Piecework rates and conditions are governed by paragraph 18 of the Award and in accordance with this paragraph, piecework felling rates are fixed from time to time by head office. These rates are adjusted with the automatic rise or fall of the basic wage and officers in charge of Divisions and Districts will be advised by head office of such alterations.

Piecework felling rates.

4. Special arrangements are made in some cases where both felling and hauling is done by the one pieceworker or team and such rates must not be varied without head office approval. Any officer recommending a variation, must supply all details relevant to the particular operation for consideration and decision by head office.

Rates for felling and hauling combined.

5. Officers charged with the administration of departmental sawmills must be thoroughly conversant with the provisions of the Forests Act and Regulations governing the procedure and method of measuring and recording the dimensions and volume of logs.

6. All log volumes are to be calculated in "True Volume" (50 cub. ft. = 1 load), but with pine logs, all volumes are recorded "over bark".

7. In pine mills cutting short length logs from first or second thinnings, the pay of piecework fellers and carters is assessed by the "bin load." This is a truckload of logs stacked to a previously fixed height and length, containing a constant volume of logs.

"Bin load."

In the case of logs over 9 in. crown diameter U.B., each log will be measured both for length and centre diameter O.B. from which details the log volume will be calculated.

Logs over 9 in. crown U.B. to be measured individually.

8. Officers in charge of sawmills must ensure that each bin load is checked before unloading. Where convenient, the Forest Assistant should do this.

Checking the
"bin load."

9. A string, run from end to end at the height of the mark will give a fair indication of the average height of the load. This will be recorded on a tabulated sheet as—

- (a) correct;
- (b) "X" inches over; or
- (c) "X" inches under the bin mark.

10. Check measurements of several complete bin loads, by measuring each log, must be carried out from time to time as the Officer-in-Charge thinks advisable, but not less than once a quarter and at irregular intervals.

11. Officers checking bin measure must also ensure that—

- (a) the length of logs is correct;
- (b) it does not contain logs of a smaller crown diameter than fixed from time to time by the Conservator;
- (c) no bent logs or forks which can not be economically utilised for milling are brought in.

Pine log records.

12. Each pine carter or team of carters must be issued with a "Pine Carter's Record Book," F.D. 240C, and therein must be recorded by each carter the required particulars regarding each load of logs carted.

13. This book should be checked periodically by an officer and handed in at the end of each pay period at the office.

Hardwood log
records and
larger pine logs.

14. Immediately on delivery at the mill yard, each log must be measured and marked with a distinguishing number in consecutive order and entered in the Mill Landing Book, F.D. 184, usually kept by the mill foreman. The attention of officers is drawn to the fact that this must be carried out in accordance with Regulations 58, 59 and 60 made under the Forests Act.

15. In cases where logs are received in bin loads, it is not necessary to number and measure each log. Each bin then is given a consecutive number and this is entered in the Mill Landing Book.

16. The details of all logs and/or bin measures entered in the Mill Landing Book must be transferred at least once every day to the Log Book, F.D. 183, which is kept at the office.

17. The volume of each log shall be entered in the Log Book from the current "Table of Cubic Contents" as issued by the Department, except that the volume will be calculated to the nearest cubic foot. Under 0.5 of a cubic foot will not be calculated, 0.5 and over will be taken to the next cubic foot.

MILLING

Log "Intake Book."

18. Each mill should keep an "Intake Book" (in the form of a ruled-off notebook), in which the daily intake of logs is recorded. In the case of hardwood mills, each log, showing the log number, should be entered. In pine mills, where small logs are brought in by the bin load, this is not practicable, and in order to arrive at the quantity of log timber cut during the period, it is easier to tally all logs (or in bin loads) left on the mill skids at the end of the period, and deduct this from the total of the previous balance plus logs delivered at the mill during the period. This record should be handed in at the office at the end of each fortnightly pay period.

19. Daily Cutting Sheets on Form F.D. 374 should be kept at each mill, on which mill tallyman will record details of all timber produced during the day.

Daily Cutting Sheets.

20. These sheets must be handed in at the office every morning, where details will be entered into the Daily Cutting Book.

Daily Cutting Book.

21. Depending on the species milled and the type of output produced, these Daily Cutting Books can vary from mill to mill and, therefore, should be set out in a manner to suit the particular requirements of each mill.

22. On the Friday of each week while the mill is operating, a Weekly Progress Return, F.D. 497, will be forwarded to head office. This form shows the progress made each week with the Sawn Pine Orders on hand. The form is of vital importance to those in head office concerned with the allocation of orders and enables them, where possible, to—

- (i) Allocate new orders to keep mills in production.
- (ii) Provide balanced cutting with a range of dimensions.

23. Fungi, which discolour pine wood without decomposing it, usually impart to the wood a bluish-grey colour. This colour is commonly referred to as "blue stain". Although its presence has a negligible effect on the strength properties and seasoning of the timber, "blue stain" detracts from the appearance of the wood and the sawn product becomes unattractive to buyers.

"Blue stain" in Pine.

24. To prevent the development of "blue stain" it is common practice to dip green sawn pine, straight off the saw, in a solution of sodium pentachlorophenate (P.C.P.). The strength of the solution to be used and the precautions to be taken when handling the dry chemical or when using the solution, are to be found in the Appendix.

Dipping for "blue stain" prevention.

25. As dipping involves an extra charge to the buyer, Sales Orders (F.D. 324) are endorsed "dipped" or "not to be dipped" as the case may be. Delivery Notes should also show the appropriate endorsement.

Endorsement of Sales Orders and Delivery Notes.

REPORTS AND RETURNS

26. At the end of each pay period, the details of sawn timber entered by sizes in the Daily Cutting Book will be totalled and transferred to Form F.D. 412.

27. Composite Form F.D. 412 is divided into two parts, the top portion covering the mill intake and the bottom portion the mill output. Thereunder, on the left, the standard headings of this form are set out in their order, with explanations, opposite on the right, as to where this information is to be obtained from.

Composite Form F.D. 412.

Loads Felled.—Mill Landing Book, F.D. 184; Log Book, F.D. 183.

Loads Carted.—Mill Landing Book, F.D. 184; Log Book, F.D. 183; Pine Carter's Record, F.D. 240c.

Loads on Mill Landing at Start of Period.—From Form F.D. 412 for previous pay period.

Loads Milled (Round).—As set out in paragraph 18.

Loads on Mill Landing at Close of Period.—This figure is arrived at by adding the "Loads Carted" to the "Loads on the Mill Landing at the Start of the Period" less "Loads Milled".

Electricity Units.—Only for mills using electric power.

Production Details of Timber Sawn.—Obtained from Daily Cutting Book by adding up output for fortnight.

Total Lineal Feet/Super Feet.—These calculations will be made at head office, thus these two columns are to be left blank.

Fortnightly Issues.—List numbers of all Delivery Notes, F.D. 456, issued during fortnight.

Fortnightly Purchases.—Where timber is purchased for the mill from either departmental or private mills the Delivery Note or invoice numbers and the name of supplier are to be listed.

Following the receipt of this form at head office, the mill will be advised each fortnight the volume (super feet) produced, the volume sold, and the book balance of stocks on hand.

Head Office
Stock Records.

28. Separate stock records are kept in head office for each type of sawn timber produced and sold, and for this reason it is necessary to show separately on the Form 412 production of cases, fitches and sawn timber. Quantities of sawn timber stacked for seasoning, seasoned timber machined, and recovery from machining, should also be shown in order that stocks and trading statements can be adjusted and compiled.

In the case of machined timber, the quantity of seasoned timber in, and machined timber out, should be shown in order that any loss in machining can be written off and stocks adjusted (see paragraph 32).

Writing-off
procedure for
seasoned stock
ex stacks.

29. Seasoned timber, which has been rejected from sale because of degrade, must be written off on a Delivery Note in order that head office stock figures can be adjusted.

The procedure for writing-off is as follows:—

- (i) Place the timber in a separate stack where it can be measured.
- (ii) Write out a Delivery Note, endorsed "Write-off on a/c degrade."
- (iii) Obtain the signature of the Superintendent or Regional Inspector on the Delivery Note agreeing to the write-off.
- (iv) Forward the Delivery Note to head office for processing.

Dispose of written-
off timber
immediately.

30. It is important that written-off timber be disposed of immediately, either for local use or otherwise, so that it is not taken into account when stock-taking is made at the end of each quarter and each financial year (see paragraph 33).

Sale of degraded
timber.

31. If it is possible to sell the timber at a reduced price on account of degrade, the quantity and the price agreed by one of the senior officers mentioned in paragraph 29 (iii) should be shown on the Delivery Note. In such a case no write-off is necessary as the sale will be recorded, but the signature of the senior officer agreeing to the sale must appear on the Delivery Note.

Recording loss by
machining.

32. Timber found to be degraded when a stack is pulled down for machining can be treated as above, but timber lost in machining, i.e., loss in dimension or by docking, etc., does not have to be written-off in the usual manner.

The procedure is:—

The quantity used in the planer shed should be booked out on the production sheet for the planer. No Delivery Note covering this timber is required as figures will be taken from the production sheet, but the stack number pulled down should be advised. The production sheet will show the quantity in and quantity out of the planer, and any difference in super footage between the two will be treated by head office as a "loss in machining" and stocks adjusted accordingly.

33. Before disposing of this waste, the quantity lost as shown by the production sheets, must be noted by a senior officer (see paragraph 29 (iii)). Again it is important that the waste is disposed of as soon as sighted by the senior officer, so that it is not taken into account at a later date.

Senior officer to note loss.

34. At the end of every second pay period two additional returns—

- (i) Form F.D. 182—Summary of Sawmilling Operations;
 - (ii) Log Book Folios F.D. 183,
- must be completed and forwarded to head office.

Form F.D. 182 is self-explanatory and the information therein required is obtained by summing up the details of two consecutive periods of sawmilling operations from Forms F.D. 412. Item 2 on this form (F.D. 182) "Sawn Timber Produced" does not have to be completed at the local office. This part is completed at head office.

The use of Forms F.D. 183 is explained in paragraphs 16 and 17.

DELIVERY, SALES AND ORDERS

35. Each office should have supplies of—

- Delivery Note Books F.D. 456.
- Treasury Receipt Books.

36. Where a customer has a standing credit account at head office, or permission to sell on credit to approved clients has been obtained in writing from head office, each sale must be covered by the issue of a Delivery Note F.D. 456.

Full particulars to be shown on Delivery Note.

The Delivery Note must show the name and full address of the client, the full particulars of all timber sold, the Sales Order No., the Client's Order No. (if any), and the Railway Truck No. The original of this form is forwarded to head office, the duplicate sent to the client, and the triplicate retained at the local office. The Delivery Note will be priced and the account rendered from head office.

37. In all other cases sales must be on a strict cash basis. The Delivery Note and the receipt should be marked "Cash Sale" and the original sent to head office together with the Cash Abstract. Full particulars must be shown in the body of the Delivery Note and the Receipt Number entered in the space provided. Super footages of all sawn timber are calculated to the nearest super foot.

Cash Sales.

38. The originals and duplicates of all cancelled Delivery Notes must be forwarded to head office.

39. Discounts on sales are allowed only in the following instances:—

Discount on sales.

- (a) To officers and employees of the Forests Department—12½%.
- (b) To timber merchants buying truck lots run of mill—15%.
- (c) To *bona fide* registered builders—
 - (i) (a) Hardwood Timber.—10% trade discount (on timber only, not on delivery or freight).
 - (b) Pine Timber.—5% trade discount on timber only.
 - (ii) 2½% (of the balance) cash discount, if payment is made within 30 days of the rendering of the account.
- (d) To Forests Department for departmental use or resale—20%.

40. If the Officer-in-Charge is doubtful as to what discount should be allowed, and to whom, each case must be submitted to head office for decision.

41. The rates charged for all timber must be in accordance with current Price Lists issued from time to time by the Conservator, except as provided for in paragraph 31.

Local Order Book.

42. Each mill office should keep an Order Book, in which all orders received should be recorded. Details such as date received, name, address and 'phone number of client, dimensions and quantity of order, head office Sales Order No. (if any), date to be forwarded, forwarding instructions, any special conditions, and finally date completed, should be listed in this book.

Unless they are required for local purposes, there will be no necessity for the local office to issue Sales Orders, F.D. 324, to the mill.

EXPENDITURE

Forms F.D. 167c.

43. All expenditure incurred in the course of timber production must be brought to account in the first instance on Forms F.D. 167c. Standard headings as set out under Items 31, 32, 37 and 38 on Form 91/92 must be used.

Milling costs.

Special note should be made of the following items:—

Items 31D and 37D are to be used for milling of green sawn timber only.

Items 31E and 37E are to be used for milling of fitches or baulks only.

Items 31H and 37H are to be used for milling of cases only.

Items 31G and 37G are to be used for stacking for seasoning only.

(Block stacking prior to sale is to be treated as part of milling costs.)

Stacking costs.

Stacking costs incurred at sales are to be charged to 31N and 37N, sales and delivery.

Items 32 and 38 are to be used for machining of seasoned timber only.

Dressing costs.

Buzzing and dressing of green timber should not be shown under these items, but charged to the milling item. It should, however, be kept separate from general milling. The extra price charged for dressing will compensate for the expenditure incurred.

As each of the above types of production will be costed separately, it is essential that these item numbers be strictly adhered to.

Where two types of production are milled in the one period and costs cannot be separated, it will be necessary to apportion the expenditure according to the volumes produced.

Sales and delivery costs.

Sales and delivery expenses do not have to be separated into types of timber sold as these will be apportioned in head office. Rail freight will be charged direct in head office and picked up from the waggon number shown on the Delivery Note.

44. These figures will be combined and transferred to Form F.D. 91/92, which in turn will be forwarded to head office, and together with Forms F.D. 412 and extracts from Forms F.D. 68A and 68B, will form the basis for the final costing records at head office.

45. The following expenditure is not to be charged locally against any sawmilling items, but must be charged to the respective district items:—

- (a) Fuels and Oils.—These will originally be charged to Plant and Workshop Fund 7 and head office will obtain the cost of these items used in the mill from Form 68B.
- (b) Handtools Used in Felling Operations.—Action will be taken at head office to load the wages with a percentage for tools.
- (c) Leave payment will not be charged by the local office against the sawmill. This item, plus other overheads such as Workers' Compensation, Pay Roll Tax, etc., will be debited quarterly on a wages percentage basis by head office.

46. The only stocks of timber to be insured will be those held for seasoning purposes. Where such is the case, the Officer-in-Charge should submit an insurance proposal to head office, setting out full particulars of quantities, species, etc., on hand. Seasoned timber stocks should be notified at end of each quarter for insurance purposes.

Insurance of
sawn timber.

47. All salaried officers connected with the supervision and administration of departmental sawmills should show the percentage of their time spent on these duties on the back of their monthly Journals F.D. 1.

LOCAL OFFICE RECORDS

48. Where possible, a graph showing the output, recovery %, cost per load, etc., should be kept at the local office in order to illustrate production on a comparative basis from quarter to quarter.

Quarterly Production and Trading Statements for each type of timber produced will be prepared in head office and forwarded to the mill as soon as possible after the end of the quarter. There is no need for local officers to prepare statements of their own.

49. A physical stocktaking will be carried out as follows:—

Stocktaking.

- (i) By the Officer-in-Charge at the end of each quarter.
- (ii) By the Officer-in-Charge and an Independent Senior Officer at the end of the financial year.

50. Detailed stock sheets must be compiled for—

- (a) Logs felled and lying in the bush.
- (b) Logs on the mill landing.
- (c) Sawn timber on hand.

These stock sheets must be signed and forwarded to head office immediately after the conclusion of the stocktaking.

In double-ended stacks, for the purposes of stocktaking, an allowance of 3% for gaps between boards in closed stacks should be made.

51. Writing off or disposal of degraded stock is covered by paragraphs 29-33, inclusive.

52. Hereunder a summary of Forms, Books and Publications in use at departmental sawmills:—

- Forests Act and Regulations.
- T.I.R. Act and Regulations.
- Forestry Workers' Award.
- Sawmills (Forestry) Agreement.
- Table of Cubic Contents.
- Pine Carter's Record Book, F.D. 240c.
- Mill Landing Book, F.D. 184.
- Mill Intake Book.

Daily Cutting Sheets, F.D. 374.
 Daily Cutting Book.
 Weekly Progress Return, F.D. 497.
 Fortnightly Return, F.D. 412.
 Summary of Sawmilling Operations, F.D. 182.
 Sawn Timber Delivery Note, F.D. 456.
 Treasury Receipt Book.
 Order Book.
 Production Graph.
 Mill Maintenance and Lubrication Record Chart.
 Bulletin 56—Grading Rules for Jarrah, Karri and Wandoo.
 Radiata Pine—Sawn Qualities for Dressing and Milled Products. S.A.A. Nos. 0.72 to 0.75, 1960.
 Radiata Pine—Sawn Radiata Pine for Structural Engineering Application. S.A.A. Interim No. 376.
 Radiata Pine—Sawn Radiata Pine for Use as Light Framing Material. S.A.A. Interim No. 377.

SAFETY PROVISIONS

Timber Industry Regulation Act.

53. All departmental sawmills have to be conducted in accordance with the provisions of the T.I.R. Act, 1926-50, and all officers connected with the administration of departmental sawmills should be conversant with this Act. Hereunder are listed some of these provisions which are likely to be encountered in the day to day running of a sawmill and which must be followed.

Registration of Sawmills.

54. All sawmills have to be registered in accordance with the T.I.R. Act and it is the responsibility of the Officer-in-Charge of each departmental sawmill to see that the registration is renewed at the end of each calendar year. For this purpose, Form T.I.R. 19 has to be completed and forwarded to the Controlling Officer T.I.R. Act (Conservator of Forests) before the expiration of the current registration. No registration fees are payable for the registration of departmental sawmills.

Note.—Registration of staff and bushworkers under Regulation 53 of the Forests Act is not required for employees of departmental sawmills.

Weekly examination of sawmills.

55. Section 19 of the T.I.R. Act provides that the mill manager, or a duly qualified person appointed by him, shall once in each week carefully examine the buildings, plant, and machinery, and shall record in writing and sign the Record Book (T.I.R. Form No. 1) his opinion as to their condition and safety and any repairs and alterations required to ensure greater safety to the persons employed.

Advising accidents.

56. The procedure to be followed in Workers' Compensation cases is fully set out in paragraphs 25-42 in the Foresters' Manual, Pamphlet No. 3. If, however, an accident occurs in a departmental sawmill, an additional report form (T.I.R. Form No. 2) has to be completed in duplicate and the original forwarded to the District Inspector, T.I.R. Act.

Fatal accidents.

57. If a fatal accident or an accident causing serious bodily injuries has occurred, the District Inspector or the Workman's Inspector must be notified immediately and the place where such accident has occurred must not be interfered with until the Inspector has examined the scene. If such accident has occurred under the mill roof, the mill must be closed down, pending the Inspector's visit.

58. Particular attention must be given to the provisions covering guards on saws, belts, ropes and all other safety devices. These must be kept up to the required standard and in good condition.

A copy of the W.A. Sawmill Safety Code is to be issued to every mill worker.

FIRE PRECAUTIONS

A.—Sawmills

59. All departmental sawmills must be equipped with efficient fire fighting appliances which at all times must be kept in good working order and condition.

60. This fire fighting equipment should be kept in a place readily available in an emergency and the mill crew should be trained to work all such equipment.

61. An adequate water supply should be kept on the mill site. If no reticulated water is provided, a number of 44 gallon drums should be kept in readiness. It is also well to remember that engine cooling tanks and dipping tanks can provide water in an emergency.

62. The mill must be kept clear of all loose debris, bark, sawdust and other inflammable material which is likely to increase the risk of fire.

63. Except in specially provided incinerators, no debris, bark or sawdust must be burned within one and a half chains from the nearest part of the sawmill.

64. Periodic inspections of the sawmill during non-working hours should be arranged for the purpose of preventing any possible outbreak of fire in the sawmill.

65. During the summer season, immediately after operations in the sawmill cease on each working day, the interior of the mill and an area of 10 feet around the mill must be damped down by spraying with water.

B.—Logging Operations

66. Log hauling tractors must carry a tank spray—which must be kept filled with water—and have a vertical exhaust fitted with an efficient arrester whilst operating between the first day of October and the next following thirtieth day of April in any yearly period. (Bush Fires Act, Section 27).

67. Pine log hauling trucks must carry a knapsack or tank spray—filled with water—while operating in pine forests during the above period.

68. Chain and other power saws used in pine and hardwood forests during this summer period must have their exhausts fitted with an efficient spark and flame proof muffler.

69. Officers-in-charge of any departmental logging operation must ensure that adequate fire fighting equipment, to quell an outbreak of fire, is available on the logging site.

70. Spark arresters on all logging trucks, tractors and power saws must be inspected periodically and maintained in a clean, sound and efficient condition.

MILL MAINTENANCE

71. In order to ensure efficient and economical operations of the mill, proper maintenance procedure is essential.

72. For this purpose, a maintenance chart should be kept at each sawmill and all maintenance and lubrication should be regularly carried out in accordance with this chart at the prescribed periods for each item of machinery.

73. Where breakdowns and repairs are beyond local resources, the help of the Assistant P.M.E. should be sought immediately.

74. It should be remembered that the Department has spent large amounts of money on mill engines, transmission belting, shafting, bearings, etc., and it is up to the Officer-in-Charge to see that this equipment is properly maintained and cared for.

Equipment.

Water supply.

Cleanliness.

Burning of Waste.

After hours check.

Damping down.

Log hauling tractors.

Pine logging trucks.

Power saws.

Fire fighting equipment on logging site.

Maintenance chart.

APPENDIX

NOTES ON STAIN AND MOULD FUNGI WHICH MAY ATTACK SOFTWOOD

1.—TYPES OF FUNGI

(a) Deep Staining (Blue Stain).

The principal types are species of *Ceratostomella* (which may be more correctly called *Ophiostoma*) of the class Ascomycetae and *Graphium* of the class Imperfecti.

These fungi consume materials stored in the wood cells, principally the sap and ray tissue and the discoloration imparted to the wood is from the fine ramifying hyphae.

Sporing bodies may appear externally as dark coloured specks.

There is no appreciable weakening of the wood involved except perhaps a slight reduction of resistance to shock.

(b) Superficial Staining (Moulds).

The surface of the wood may be infected by a number of saprophytic fungi of the mould type, principally *Aspergillus* and *Penicillium* species but others such as *Stemphyllium*, *Alternaria*, *Cladosporium*, etc., may operate.

Some of these stains are yellow to brown, but the spores and other parts are frequently objectionable, sometimes forming into a greenish black mass covering the whole surface.

2.—PREVENTION OF STAIN

(a) Physiology.

Fungi of the types concerned require moisture and food materials for sustenance and an adequate supply of oxygen. The temperatures at which they operate are usually above freezing point, but some fungi can operate at or just below freezing point, while most fungi will be completely inactive at -6°C (i.e., 10.8°F below freezing point). On the upper range of temperatures there is a wide tolerance, but most fungi will not operate efficiently in temperatures much above those found in their normal habitat. Temperatures of 40°C to 50°C could normally be regarded as limiting for spore production, but killing temperatures are in excess of boiling point (100°C) for some organisms.

Most fungi operating on wood cease operating when the moisture content drops below 20%.

It is apparent that the limiting factor most easily controllable is moisture content and that surface moulds could be quickly limited by efficient surface drying. However, the deeper seated stain fungi would need complete seasoning. It is further apparent that close contact of damp faces or even dry faces of unseasoned timber could produce wood dampness and humidity sufficient for fungal growth.

Seasoned timber re-wet or stored in damp conditions will be attacked.

(b) Infection Potential.

Wherever infected material exists, a reservoir of infection at a high concentration is maintained, although it must be understood that spores (the "seed" of the fungus) are present in the air in low concentration (spores are microscopic and cannot be seen by the human eye).

It is, therefore, possible for clean discarded material or poorly stacked material to rapidly become heavily infested. In this connection, separating strips from stacks must be watched as they may carry infection.

Remember, in suitable conditions, three days is sufficient for severe attack.

(c) Precautions.

Normal.

- (1) Keep the mill and storage sheds clean and well ventilated.
- (2) Avoid roof leaks and accumulation of ground water.
- (3) Keep stacked material separated by clean strips and allow space between faces.
- (4) Observe stacking ventilation rules and avoid placing covers too close to tops of stacks.
- (5) With log material, bark is an efficient protection when green, but fungi can enter via abrasions. Also, logs left lying in damp unventilated situations or unstacked in contact with moist earth or old waste, may be rapidly attacked. Avoid stacking for protracted periods.
- (6) Always keep timber whether in log or sawn (particularly the latter) out of the weather.

Special.

- (1) Kiln dry if possible as soon as practicable after sawing.
- (2) Better still, dip with a suitable fungicide before kiln drying.
- (3) If facilities are not available for kiln drying, dip in a suitable fungicide and then strip out. Blocked material such as shooked boards should also have separating strips between shooks.
- (4) Treat also separating strips with fungicides and spray floors and bearers before re-using for stacking.

3.—FUNGICIDE

(a) Formulation.

Numerous fungicides are on the market, but probably the most economical and simple preventative is sodium pentachlorophenate with or without borax.

The following formula should prove effective:—

(Santobrite)	Sodium pentachlorophenate	0.75% or 1%
		(Either is effective.)
(Soda Ash)	Anhydrous sodium carbonate	0.05%
(Teepol)	Detergent	0.2%
	Water solvent	99.0% or 98.75%
		(If 1% Santobrite used.)

Some authorities prefer to add borax in the form $\text{Na}_2\text{B}_4\text{O}_7$ to about 1% level to the above solution, but it does not appear to be necessary.

The detergent (soapless soap) or wetting agent is purely to break down the surface tension of the solution and ensure a protective film.

The soda ash is added to keep the solution alkaline due to the fact that acid wood may cause the sodium pentachlorophenate to revert to pentachlorophenol (non-water soluble) and precipitate it out.

Actually after the boards have dried out, the carbon dioxide in the atmosphere does cause this change to pentachlorophenol on the board, but this compound is equally effective as a fungicide and since it is not then water soluble, there is less chance of it washing out.

"(b) Mixing:

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Sodium pentachlorophenate was formerly supplied as a powder containing 100% Napep but is now supplied either as "Santobrite" which is a thick solution containing 50% Napep or as "Pentapine" which is a paste containing 62½% Napep. The actual concentration should always be checked on the container label to see that the manufacturer has not changed his product.

When mixing it is convenient to make up first in a separate stock mixing tank a 10% stock solution which, using "Santobrite", will require 20 lb. to be added to 8 gallons of water or, using Pentapine, will require 16 lb. to be added to 8½ gallons of water. In each case the volume of 10% stock obtained will be about 9 gallons. The total quantity of this stock required will, of course, depend upon the volume of the dipping tank.

Using the following table to calculate quantities actually required place sufficient make-up water in the dip to bring the level close to that required but leaving room for the addition of the 10% stock.

Then add the soda ash premixed and properly dissolved in a small container.

Add the required amount of 10% stock and finally, add the detergent.

If borax is used it should be pre-mixed in hot water and added to the water in the dip, stirring well as the hot liquid is poured in."

(1) Cleaning and renewal.

From time to time the dipping container should be cleaned out, as dirt, sawdust, etc., will accumulate in it. Residual liquid should not be wasted as it is useful for ground sterilisation, both against fungi and termites (white ants).

4.—DIPPING

The type of dipping container and set up depends on the volume of boards to be dipped. The most popular method for small operators is a type of "green chain" at the bench side.

However, quite a cheap and effective tank could be constructed rather like a horse trough with a draining ramp and rack on the emergence side. Boards should be immersed fully, then left to drain on the rack for a short time, then stripped out or, in the case of case boards, loosely stacked

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(b) **Mixing.**

(As the sodium pentachlorophenate powder is objectionable the suggested mixing method is to weigh out the required quantity and place it in a paper bag. Immerse this bag in the mixing container and then slit using a knife or other suitable instrument. Stir thoroughly to dissolve.)

- (i) Calculate the volume of the dipping container then using a smaller mixing container, make up sufficient sodium pentachlorophenate solution at 10% concentration for this volume.
- (ii) Place the "make up" volume of water in the dipping container then add the soda ash (pre-mix in a small container to ensure it dissolves).
- (iii) Add the 10% sodium pentachlorophenate solution then add the detergent.
- (iv) If borax is used pre-mix in hot water and add water in dipping container, stirring well as the liquid is poured in.

(c) **Quantities.**

Water weighs 10 lb. per gallon and it is convenient to regard 1 lb. of sodium pentachlorophenate per gallon of water as a nominal 10% stock solution. The following table gives the mixing proportions per 100 gallons of water in the dipping tank. Smaller or larger quantities should be calculated in direct proportion.

Gallons of Water in Tank	Gallons of 10% Stock to add	Percentage of Dip		Weight of Soda Ash required	Weight of Teepol required
		Actual	Nominal		
100	8	0.735	0.75	oz. 9	lb. 2
100	11	0.981	1.0	9	2

(d) **Consumption of Solution.**

This depends on the initial moisture content of the timber dipped, the drainage efficiency, size of board, and the time left in the solution, but an approximate figure would be between 10 and 15 gallons per 1,000 super feet.

(e) **Stock Solution.**

It is often convenient to hold a supply of 10% stock solution in reserve for topping up the dipping tank and for this purpose, a graduated dipstick is useful for estimating additional solution required. However, it must be borne in mind that extra soda ash and detergent will be required.

(f) **Cleaning and Renewal.**

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4.—DIPPING

The type of dipping container and set up depends on the volume of boards to be dipped. The most popular method for small operators is a type of "green chain" at the bench side.

However, quite a cheap and effective tank could be constructed rather like a horse trough with a draining ramp and rack on the emergence side. Boards should be immersed fully, then left to drain on the rack for a short time, then stripped out or, in the case of case boards, loosely stacked

for initial drying before shooing. If desired, complete shooks can be dipped but in this case the immersion time should be regulated to 30 seconds and more draining time is needed. The drying out of dipped shooks is much slower than would be the case of single board dipping with slight pre-drying mentioned above.

Various designs of dipping assemblies are available from C.S.I.R.O., if required.

5.—PRECAUTIONS

Although not highly toxic in the quantities suggested there

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"(2) Use scoops etc. when weighing, avoid all direct contact with powder, paste, strong solution and stock solution and wash off with clean scapy water if contact does occur."

(4) "Impervious gloves should be used if operatives have to place hands in the dip solution or handle wet boards. A barrier cream is now considered by medical authorities to give insufficient protection. Since Napcp is quite readily absorbed through the skin it is important that wet boards should not be carried across the body and in contact with it unless an impervious apron is worn. Operatives must be warned against rubbing eyes with contaminated hands and should be instructed to wash hands thoroughly before eating, smoking etc."

(5) "Spraying of timber with portable sprays is not normally carried out but if it should have to be done respirators, goggles and impervious clothing should be worn to preclude all contact of the spray with the body."

... they have been thoroughly ventilated or spray drift has subsided.

(3) Pertinent precautions in the original regimen above should be observed.

for initial drying before shocking. If desired, complete shocks can be dipped but in this case the immersion time should be regulated to 30 seconds and more draining time is needed. The drying out of dipped shocks is much slower than would be the case of single board dipping with slight pre-drying mentioned above.

Various designs of dipping assemblies are available from C.S.I.R.O., if required.

5.—PRECAUTIONS

Although not highly toxic in the quantities suggested, there is danger of allergic reactions and operators should take precautions against direct contact with solution. The following regimen is suggested:—

- DISINFECTED CIRC 14/58*
- (1) Wear a dust respirator when handling dry powder.
 - (2) Use scoops, etc., when weighing, ~~avoid all direct contact with powder~~ and wash off with clean soapy water if contact does occur.
 - (3) Do not place bare hands in the ^{dry} solution, avoid all processes liable to cause splashing and avoid contact with face or eyes.
 - (4) Rubber gloves should be used if operatives have to place hands in solution, but for ordinary drained board handling, a barrier cream such as Kerrodex 51 thoroughly applied would give adequate protection. Operatives must be warned against rubbing eyes with contaminated hands and should be instructed to wash hands thoroughly before eating, smoking, etc.
 - (5) Barrier cream should be applied on starting, washed off before lunch, re-applied after lunch and washed off at end of day's work.
 - (6) Clothing used by operatives directly working with the solution should be washable and should be washed regularly but separately from other laundry.
 - (7) If any operative exhibits toxic effects immediate medical aid should be sought. In the case of any operative swallowing some of the solution administer an emetic at once and call medical aid.

A final set of precautions is necessary if spraying of solution is resorted to (some authorities recommend this process).

- (1) Spraying operatives should wear efficient respirators and goggles, plus neck to ankle overalls and barrier cream should be applied to hands and neck if bared to spray.
- (2) Operatives not protected should be kept clear of sprayed areas until they have been thoroughly ventilated or spray drift has subsided.
- (3) Pertinent precautions in the original regimen above should be observed.