ALBERTA PHASE 3

FOREST INVENTORY:

TREE SECTIONING MANUAL

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1988

Pub. No. T/168 Revised 1988 (formerly ENR Report Dept. 56)

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PUBLICATIONS IN THE PHASE 3 FOREST INVENTORY SET INCLUDE:

ENR REPORT NO.	TITLE
I/86	An Overview
I/92	Alberta Forests - Some Facts
Dept. 53	Ground Truthing Procedures
Dept. 54	Map Cover Type Measurement Specifications
Dept. 55	Large-Scale Photography Procedures
Dept. 56	Tree Sectioning Manual (See T/168)
Dept. 57	Mapping Specifications
Dept. 58	Forest Cover Type Specifications
Dept. 59	Temporary Sample Plot Procedures
Dept. 60a	Yield Tables for Unmanaged Stands (Main Body)
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Dept. 61a	Volumes and Stem Numbers for Forest Types: Steps to Volume Table Formulation
Dept. 61b	Volumes and Stem Numbers for Forest Types: Southern Alberta, Volume Sampling Regions 1, 2, 3 and 11
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1. INTRODUCTION

As the demand on the forest resource increases, forest managers require better information on tree and stand dynamics. In order to obtain a more accurate determination of tree form, rate of growth, site classification and amount of defect present in a stand of trees, detailed stem measurements and tree descriptions are needed.

Although devices such as dendrometers (which can measure standing trees) can provide some of this information, they are costly instruments and are often insufficiently accurate. Certainly they cannot be used to measure internal tree defect. The best way to obtain accurate internal and external diameter and decay measurements is through destructive sampling or tree sectioning, where sample trees are felled and the main stem is cut into predetermined lengths. This information is then analyzed and the results applied to the rest of the sampling area.

Alberta Forest Service personnel have felled and sectioned approximately 11,000 trees throughout the inventoried areas of the Province. The data collected from those trees were used to develop functions for estimating gross total volume, gross merchantable volume, average saw-log and pulp wood cull percentages, diameter-height curves, site index curves and taper functions. Tree sectioning is also done on a more localized basis to provide growth and form data on individual stands.

This manual is intended to provide the user with detailed field instructions on tree sectioning.

Further information on plot selection and data compilation can be obtained from the:

Department of Forestry, Lands & Wildlife
Alberta Forest Service
Timber Management Branch
Forest Measurement Section
8th Floor, Bramalea Building
9920 - 108 St.
Edmonton, Alberta
T5K 2M4
(1-403-427-8401).

2. FIELD PROCEDURES

2.1 Pre-Planning

The collection of tree sectioning data is time consuming, expensive and sometimes hazardous. It is important, before any field work is started, that objectives are set and that procedures such as plot layout, tree selection and plot location be firmly established. As well, the field crew(s) should be familiar with the contents of this manual.

2.2 Crew Responsibilities

Usually there are two people on a sectioning crew. Ideally, there should be three people as this increases production, and should an accident occur, one person can leave to summon help while the other stays with the injured person. It is strongly recommended that all crew members possess a valid first aid certificate, and that at least one member is familiar with the operation and safety procedures of working with a chainsaw as well as felling techniques.

The crew members share the following responsibilities:

a) selecting the trees to be sectioned,

b) marking stump height, breast height and tree number on each tree,

c) measuring diameters and radial increments,

d) determining ages,

e) determining and measuring external and internal defect,

f) recording all required data in a legible manner,

g) working in the safest possible manner and using proper safety equipment at all times,

h) maintaining all equipment issued,

i) retaining a good working knowledge of the contents of this manual.

One person on the crew will be appointed supervisor and will have the following additional responsibilities:

a) obtaining and becoming familiar with the aerial photos and maps for the work area,

b) ensuring that the quality of the work is up to the standard required,

c) checking all tally sheets for accuracy, legibility and completeness, and submitting them to the project supervisor.

2.3 Tree Selection

Currently the Alberta Forest Service (AFS) staff use either a variable-radius (prism point) plot or a circular fixed-area plot to select trees for sectioning.

2.3.1 Variable-Radius (Prism Point) Plots

If point sampling is being done simultaneously with sectioning, the crew should section the trees in a previously established temporary sample plot (TSP). Selection of the plot to be sectioned will depend upon the accessibility of the plot, the number of trees in the plot and whether or not the plot meets the objectives of the study.

When an established TSP is to be sectioned, the marked tie points and the directions on the cruise tally sheet are used to locate the plot. Once at the plot, the trees to be sectioned are selected consecutively, beginning with tree number one. The numbering system for the sectioned trees should be the same as that used for the cruise plot for convenience and easier tree identification.

If sectioning is not being done in a previously sampled area it will be necessary to select the stand from aerial photos or maps according to the information needed. A definite starting point and the distance and azimuth to plot centre are established and marked on the photo or map. The starting point is located in the field and clearly marked with a piece of seismic ribbon. The following information is written on it:

a) date (arabic numerals: year, month, day),

b) distance and azimuth to plot center,

c) type of plot (i.e. tree sectioning),

d) plot number,

e) initials of the crew members.

Following is an example of the required information as it should appear on the ribbon:

88-10-27/50 m @ 273° to TSP 5101/K.J., C.S.

88 - year, 1988

10 - month, October

27 - day, 27th

50 m @ 273° - 50 metres on a true bearing of 273°

to TSP 5101 - to tree sectioning plot number 5101

/K.J., C.S. - crews initials

If the plot centre falls on an unmapped road or seismic line, the plot should be moved ahead 20 m or be offset for 20 m at 90° from the line, whichever procedure results in moving the plot away from the opening. Plot centre is established with a sturdy stake and marked with a piece of seismic ribbon. Although it is unlikely to remain standing through the felling, the plot centre must be established accurately for the tree selection procedure. A prism is then used to select the trees to be sectioned. The prism must be held above the plot centre when selecting sample trees. These are numbered consecutively clockwise starting from the direction walked in to the plot. For more information on tree selection procedures, refer to the manual titled Alberta Forest Service, Phase 3 Forest Inventory: Temporary Sample Plot Procedures.

2.3.2 Circular Fixed-Area Plots

Circular fixed-area plots are preferred to prism point plots (when previously established prism point plots are not readily available) for a number of reasons:

a) Borderline trees are more easily defined "in" or "out" in fixed-area plots.

b) The problem of the prism not being held over the plot centre is eliminated. This also reduces crew training (staff do not necessarily have to be qualified as cruisers to section trees).

c) Trees in a cluster, or just "out of sight" of the prism, are no longer a problem.

d) Prism-point plots are biased toward larger trees. Diameter class distributions produced from such data contain poor estimates of numbers of the small trees.

2.3.3 Single Species and/or Cull Suspect Class

Often, information on only one tree species or cull suspect class is required. In such a case, a plot is established in the previously described manner, but only those trees that satisfy the species and size class desired (e.g. 10+ cm dbh pine) or cull suspect class wanted (e.g. 20+ cm dbh aspen with conks) are felled and sectioned, and the other trees in the plot are ignored.

When sectioning to determine the amount of defect only, it is strongly advised that the sectioning be done in conjunction with a timber cruise. This procedure will determine the number of cull suspect class trees in the stand, and thus provide a better estimate of percentage of defect.

2.3.4 In and Out Trees

When variable radius plots are being used, in and out trees are determined according to the instructions in Alberta Forest Service, Phase 3 Forest Inventory: Temporary Sample Plot Procedures, 1983.

When circular fixed area plots are used, a tree is considered "in" if, at breast height, at least half of the trunk is within the plot boundary (Figure 2.1).

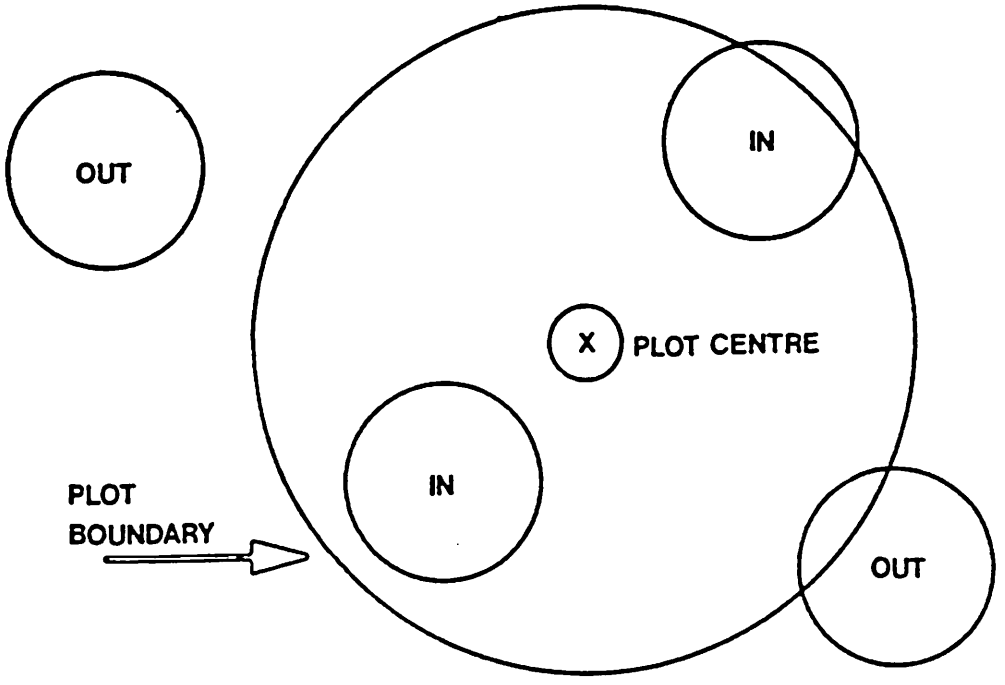


FIGURE 2.1 IN AND OUT TREES IN FIXED-AREA PLOTS

Normally every tree (in a desired class) within a sample plot is felled. At the supervisor's discretion a tree in a desired class may be left standing if that tree poses a definite safety hazard or is beyond the felling capabilities of the crew.

2.3.5 Talliable Trees

All trees which lie within the plot and meet project criteria are tallied. If a tree "hangs up" during felling or shatters (due to rot or cold) upon felling and measurement is not feasible, this fact should be noted on the tally sheets.

2.3.6 Species Code

For Phase 3 sectioning, all of the species listed in Table 1 will be measured.

Dead trees are recorded by species and an 'X' is placed in the box provided on the tally sheets (column 27, Figure 2.3). Trees are considered dead when they no longer have any live branches. All talliable dead trees must be standing, capable of withstanding a firm push, and have at least 50% of their gross volume as sound wood.

Table 1

TREE SPECIES

Common Name	Scientific Name Genus/Species	Species Code
Balsam	Abies	
Alpine Fir	A. lasiocarpa	FA
Balsam Fir	A. balsamea	FB
Birch	Betula	
White Birch	B. papyrifera	BW
Douglas-fir	Pseudotsuga	
Douglas-fir	P. menziesii	FD
Larch	Larix	
Alpine larch	L. lyallii	LA
Tamarack	L. laricina	LT
Western larch	L. occidentalis	LW
Pine	Pinus	
Limber pine	P. flexilis	PF
Jack pine	P. banksiana	PJ
Lodgepole pine	P. contorta	PL
Whitebark pine	P. albicaulis	PW
Poplar	Populus	
White poplar (Aspen)	P. tremuloides	AW
Black poplar (Balsam poplar)	P. balsamifera	PB
Spruce	Picea	
Black spruce	P. mariana	SB
Englemann spruce	P. englemannii	SE
White spruce	p. glauca	SW

2.4 Data Entry on Tally Sheet

Sectioned trees are recorded on Alberta Forest Service Sectioning Tally Sheets CSTM04. Measurements and data are recorded on the front of the tally sheet which is keypunched. These sheets are separated into two areas, the header (H) where general information is recorded and section(s), where tree section information is recorded. Section 2.4.1 and 2.4.2 provide information on correctly completing the tally sheet. The back of the Tally Sheet provides an area to map and diagram decay if it is encountered during sectioning (an example of Sectioning Tally Sheet see Figure 2.3).

2.4.1 Header Section

Column	Name	Data Entry
1	M	Meridian
2	Rge	Range
4	Twp	Township, right justified, zero filled.
7	Stand	Right justified, zero filled eg. stand No. 34 as 0034.
11	Sub	A letter is used to indicated if the stand has been broken up into substands. Do not zero fill as alphabetic character only is accepted.
12	Plot	Plot number. Right justified, zero filled. Must be numeric.
18	Tree	Tree number. Right justified, zero filled. Must be numeric.
20	H	Header information

Alberta

FORESTRY, LANDS AND WILDLIFE
Forest Service

TM 04 (Rev. 12/87)

TREE SECTIONING TALLY SHEET

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)	(20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (27) (X)	# SEC. (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
6	04	062	0341		000001	03	H	607	AW			014.2	2	C

TREE CATEGORY (36) 1	2	3	4	5	C.C. (46)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)
01	02	14			C	.	.	X	C2AW ( )H92M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (75)	COND (77)	AREA (78)	PHOTO HEIGHT (81)
					.

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3	-	ADVANCED ROT

(28) - # SECTIONS TOTAL
(34) - AT TOP OF SEC #
(35) - DECAY IND.
(46) - CROWN CLASS
(57) - INT. DEFECT (X)

VSR

Page 1 of 1

Crew: S. Sneed, M. Davis

Date: MARCH 3, 1988

INCREMENT WIDTH

SEC NO.	0 - 10 YEARS	11 - 20 YEARS
01		
02		

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (36)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS PULP (47)	SAW (49)	INTERNAL DEFECT DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S	01	.	.	.	.	.				.	.	.
S	02	.	.	.	.	.				.	.	.
S	03	.	.	.	.	.				.	.	.
S	04	.	.	.	.	.				.	.	.
S	05	.	.	.	.	.				.	.	.
S	06	.	.	.	.	.				.	.	.
S	07	.	.	.	.	.				.	.	.
S	08	.	.	.	.	.				.	.	.
S	09	.	.	.	.	.				.	.	.
S	10	.	.	.	.	.				.	.	.
S	11	.	.	.	.	.				.	.	.
S	12	.	.	.	.	.				.	.	.
S	13	.	.	.	.	.				.	.	.
S	14	.	.	.	.	.				.	.	.
S	15	.	.	.	.	.				.	.	.
S	16	.	.	.	.	.				.	.	.
S	17	.	.	.	.	.				.	.	.
S	18	.	.	.	.	.				.	.	.
S	19	.	.	.	.	.				.	.	.
S ▼	20	.	.	.	.	.				.	.	.

FIGURE 2.2 TALLY SHEET PRIOR TO FELLING

TREE CATEGORY CODES
(by priority):

26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

2.4.1 Header Section con't

Column	Name	Data Entry
21	Management Unit	Left justified, blanks in a management unit are indicated by a zero, while zeroes are indicated by a 5. M.U. F1 = F01 blank M.U. F15 = F15 blank M.U. S02 = S52 blank Do not zero fill as column 24 is alphabetic characters only.
25	Species	Recorded according to the species code (Section 2.3.6) If tree is dead it is coded as the same species as when it is alive.
27	Dead	If a tree is dead place X in column. If tree is not dead column 27 is left blank.
28	# Section	Number of sections total
30	DBH(OB)	Diameter breast height (outside bark) zero filled. DBH(OB) is measured at 1.3 m above ground and is recorded in centimeters to one decimal place (see figure 2.2)
34	Top (At top of Sec. #)	Indicates at which section location diameter at breast height is measured at. This is most commonly the top of section 2.
35	D.I. (Decay Indicator)	Decay indicators are external features which suggest the probability of internal decay. Recorded as one letter (C,O,S,N). This is further described in section 2.5.2 "Decay Indicator".

2.4.1 Header Section con't

Column	Name	Data Entry
		Conks and punk knots = C Old broken tops = O Scars and other wounds = S Non suspect = N
36	Tree Category	Up to 5 tree category codes can be listed in order of severity. This column does not have to be zero filled; however, if no defect or code is present condition code 00 (no defect present) is tallied. Tree category codes are further described in Section 2.4.4
46	C.C. (Crown Class)	Crown Class recorded as one letter (D,C,I,S or O) described in Section 2.4.5 refers to the position of an individual tree within the canopy of a stand.
47	Total Height	Total length of the stem including stump. Zero filled.
52	Total Height to Live Crown	Length of the stem including stump to the base of live crown. Zero filled.
57	I.D. (Internal Defect)	Internal defect considered. Marked with X if internal defect is being recorded for a project.
58	Phase III Map Overstory Type	Left justified, recorded as a density code, height code and species composition using the following specifications.

2.4.1 Header Section con't

Column	Name	Data Entry
		Density (Column 58)

Code	Crown Density %
A	6-30
B	31-50
C	51-70
D	71-100

Height (Column 59)

Code	Stand Height
0	0- 6.0 m
1	6.1 m-12.0 m
2	12.1 m-18.0 m
3	18.1 m-24.0 m
4	24.1 m-30.0 m
5	> 30.1 m

60		Species 1. Record the first species code for this stand as it appears on the Phase 3 map.
62		Species 2. If present record the second species code for this stand as it appears on the Phase 3 map.
64		Species 3. If present record the third species code for this stand as it appears on the Phase 3 map.
66		Bracketed Species. If present record the species in brackets as it appears on the Phase 3 map.
68		Stand commercialism is based on 4 classes:

2.4.1 Header Section con't

Column	Name	Data Entry
		Lumber = L Roundwood = R High Uncommercial = H Low Uncommercial = U
69		Stand origin less the first and last digits of that year eg. stand originated 1870 is 87.
71		Site index is an expression of site quality based on average height. Good = G Medium = M Fair = F
72	Imperial Units	Mark X if imperial units are used for the measurements (eg. private company studies)
73-84		These columns are not currently used. They were completed by photo interpreters. Information on species crown area, crown condition and tree height were obtained from large scale photography (LSP) plots. These photo measurements were then correlated to ground measurements of dbh, tree height and calculated tree volume. For further information, refer to Large Scale Photography Procedures, ENR Report No. 55.

2.4.2 Section Information

Column	Name	Data Entry
20	S	Section information.
21	Page	Always completed as more than one page may be required.

2.4.2 Section Information

Column	Name	Data Entry
22	Sec. No.	Section number
24	Length of Section	Zero filled, recorded to two (2) decimal places.
28-43	Inside bark	Per section, two measurements of diameter inside bark taken at right angles to each other. Taken to one decimal place in columns 28-31 and 36-39.
	Outside bark	Per section, two measurements of diameter outside bark taken at right angles to each other. Taken to one decimal place in columns 32-35 and 40-43.
44	Ring Count	Number of rings in each section. Must be numeric.
47	Pulp	External pulp defect expressed as a percentage. Applicable only if the defect occurs below a 10 cm dib. Due mainly to missing wood (broken tops, scars) and reduces the amount of pulp manufactured from pulpwood sized logs.
49	Saw	External saw defects are expressed as a percentage and calculated for each 2.5m section. It applies to stems with at least one 2.5m section below a 10 cm dib. These defects are a loss of gross volume due to missing wood or poor stem form. These include scars, broken tops, sweep, cat faces, etc.
51	Decay Level 1	Softwoods: Pulp cull is a loss of pulp recovery due to voids or soft rot in the wood. It is calculated as

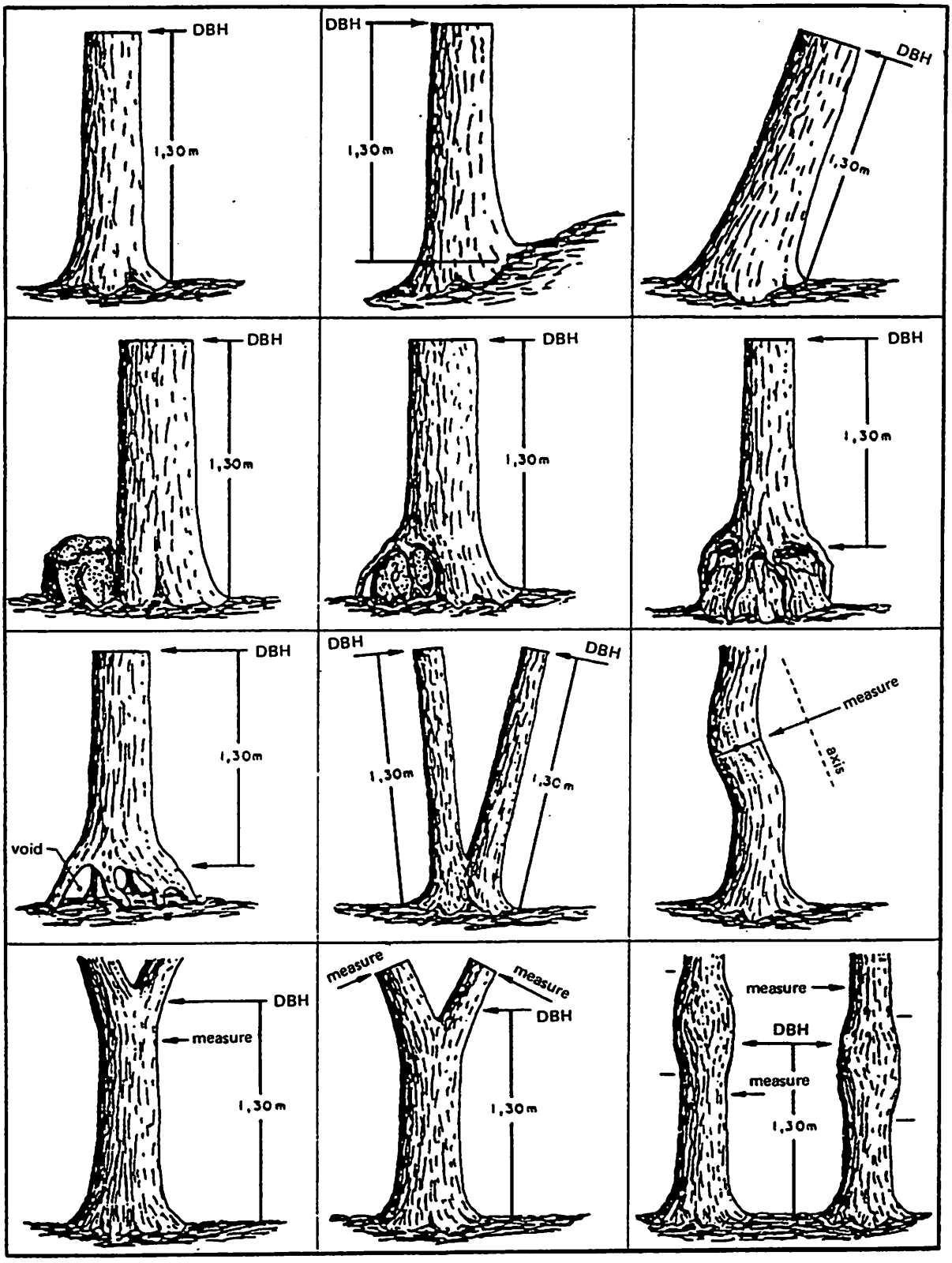
Column	Name	Data Entry
		the actual volume of the defect. Refer to Section 2.8.1. Hardwoods: Stain is a loss of pulp recovery due to discoloration in the wood. It is calculated as the actual volume of the defect. See section 2.8.1.2 for definition of stain.
57	Decay Level 2	Softwoods: Saw cull is a reduction in lumber recovery due to voids or soft rot in the wood. It is calculated in areas of the log which cannot be converted to lumber and is measured in units of cubic meters of unrecoverable volume. Refer to Section 2.8.1. Hardwoods: Incipient rot is a loss of pulp recovery due to voids or soft rot in the wood. It is calculated as the actual volume of the defect. See 2.8.1.2 for a definition of incipient rot.
63	Decay Level 3	Softwoods: There is no Decay Level 3 for softwoods. Hardwoods: Advanced rot is a loss of pulp recovery due to voids or advanced rot in the wood. It is calculated as the actual volume of the defect. See 2.8.1.2 for a definition of advanced rot.
Green Shaded Area Information		This portion of the tally sheet includes page numbers, crew and date. It must be filled in for every sheet. The VSR is filled out in the office to assist in bundling tally sheets for keypunching.

2.5 Standing Tree Measurements

2.5.1 Marking the Tree

Trees to be sectioned should be clearly numbered and marked with a lumber crayon 0.3 m above germination point (stump height) and 1.3 m above germination point (breast height). This is done to ensure that felling cuts are made below stump height and that the standing diameter at breast height (dbh) measurement is made in the correct place. Figure 2.2 shows how to determine germination point and breast height. Should an abnormal swelling occur at either point, the location measured is raised or lowered in 0.5 m increments until "normal" stem diameter is reached (see Section 2.5.1 Marking the Tree). Such changes must be noted in the comments section on the back of the tally sheet and the section lengths adjusted accordingly.

FIGURE 2.3 DETERMINING BREAST HEIGHT AND POINT OF GERMINATION



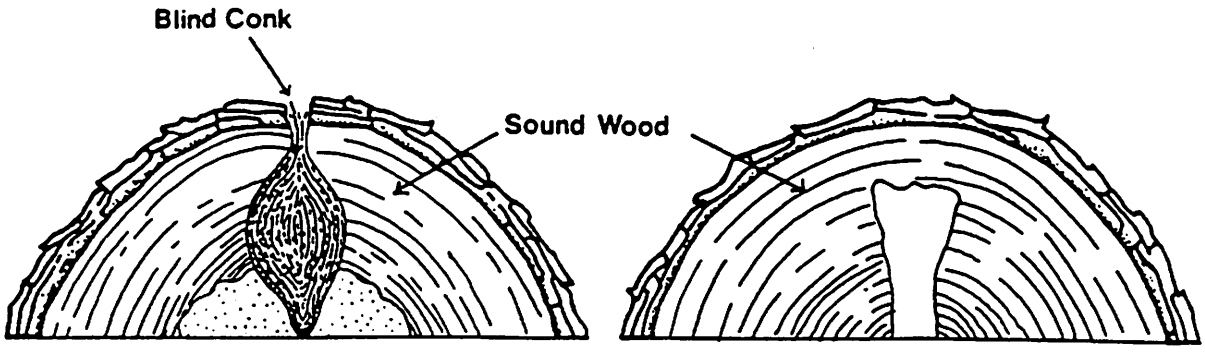
2.5.2 Decay Indicator (Cull Suspect Class)

The cull suspect class is used to assist in predicting the amount of decay in a given tree. There are three decay indicators: conks and punk knots, scars, and old broken tops. A tree without any of these decay indicators is considered to be nonsuspect.

Cull suspect class is not recorded for dead trees.

Conks and Punk Knots. Conks appear most frequently on the underside of dead branch stubs or on the underside of live branches in the crown. Punk knots, swollen knots and blind conks appear as swellings around knots and result when the tree tries to heal over an abortive conk (Figure 2.4). When these types of conks are suspected they must be cut into in order to positively determine if conks are present. On deciduous trees, severe weeping from knots and branches also indicates decay. Deep woodpecker holes in rotten stems should be recorded as Code "C".

Moss-covered branch stubs and burls can be mistaken for conks especially when viewed from directly below. Black knots frequently develop from a superficial saprophytic fungus which feeds on the exuded sap from a wound. Unlike blind conks, they are quite sound when cut into and do not indicate decay.



BLIND CONK SOUND KNOT

FIGURE 2.4 BLIND CONKS AND SOUND KNOTS

Conks and punk knots take precedence over all other decay indicators present and "C" is recorded as the cull suspect class.

Scars and Other Wounds. Scars, as decay indicators, are wounds which penetrate through to the cambium at a point below the 10 cm dib top. These wounds must be at least one growing season old and not healed over by resin. Cankers caused by fungi result in the death of the immediate area of the bark and cambium and are also recorded as scars. Aspen trees that show a salmon-pink color on the bark indicate possible decay and the cull suspect class is recorded as 'S'. In cases where both an old broken top and a scar are present the scar will take precedence and an 'S' is recorded as the cull suspect class.

Old Broken Tops. The decay indicator "old broken tops" is used to describe tops that have been broken below 10 cm diameter inside bark (dib) for at least one growing season. If present, this cull suspect class is recorded as "O". Newly broken tops, broken branches or dead tops are not considered to be "old broken tops".

Non-Suspect. If the stem does not show any of the three external indicators, decay is not suspected and an "N" is recorded.

It is important that an evaluation of non-suspect be done on the basis of external features only. If a tree does not externally display any of the three types of decay indicators and is found to have some decay after it has been felled, it must still be classed as non-suspect (N).

2.5.3 Tree Category (Condition Code)

There are a total of 22 tree category codes listed by priority on the front of the tree sectioning tally sheet. Up to five of these codes can be used. If the tree shows no visible damage or distortion, it is coded as 00. If a condition code is discovered after the tree is felled, it is still indicated on the tally sheet. A description of the condition codes follows.

2.5.3.1 CONDITION CODES

00 No Defect	This condition code indicates that the tree has been checked and there is no apparent damage or distortion. All trees free of damage must have the '00' condition code recorded.

01 Conk/Blind Conk

Conks appear most frequently on the underside of dead branch stubs or on the underside of live branches in the crown. Conks, by definition, are woody, shelflike basidiocarps (fruiting bodies) of wood-rotting fungi. Blind conks appear as swellings around knots that result when the tree tries to heal over an abortive conk. In many instances, the affected knot is partially covered by sound wood, hence "blind conk". Moss-covered branch stubs and burls can be mistaken for conks especially when viewed from directly below. Black knots frequently develop from a superficial saprophytic fungus which feeds on the exuded sap from a wound but, unlike blind conks, they are quite sound when cut into. See Figure 2.5

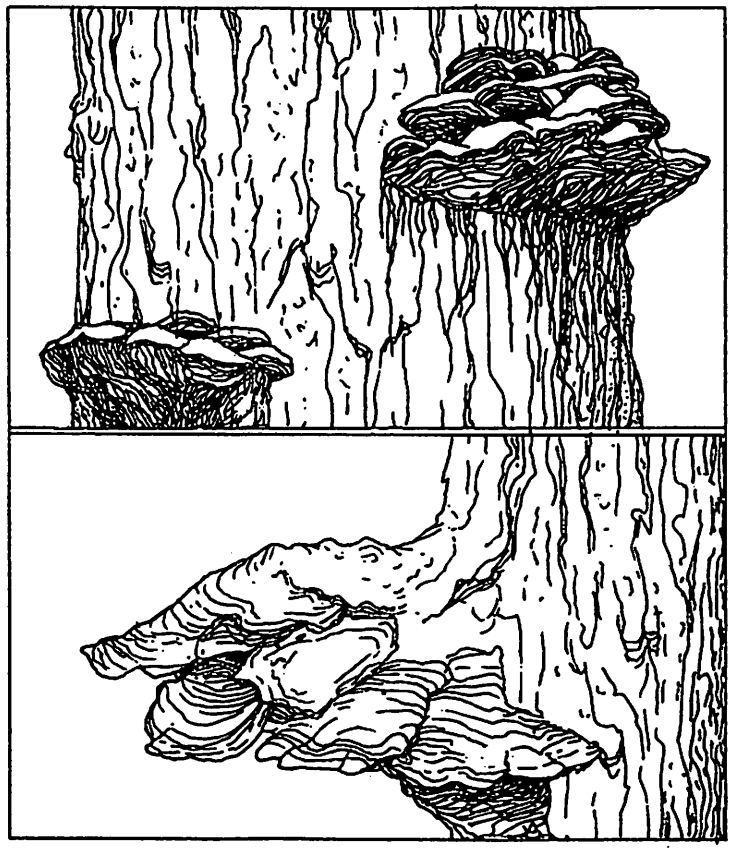


FIGURE 2.5 CONK

02 Open Scars

Open scars are wounds which have penetrated through to the cambium. These wounds must not be healed over and may be caused by a variety of reasons such as fire, lightning, old blazing, machinery, animals, etc. Scars are considered to be entry points for decay fungi. Open scars are illustrated in Figure 2.6.

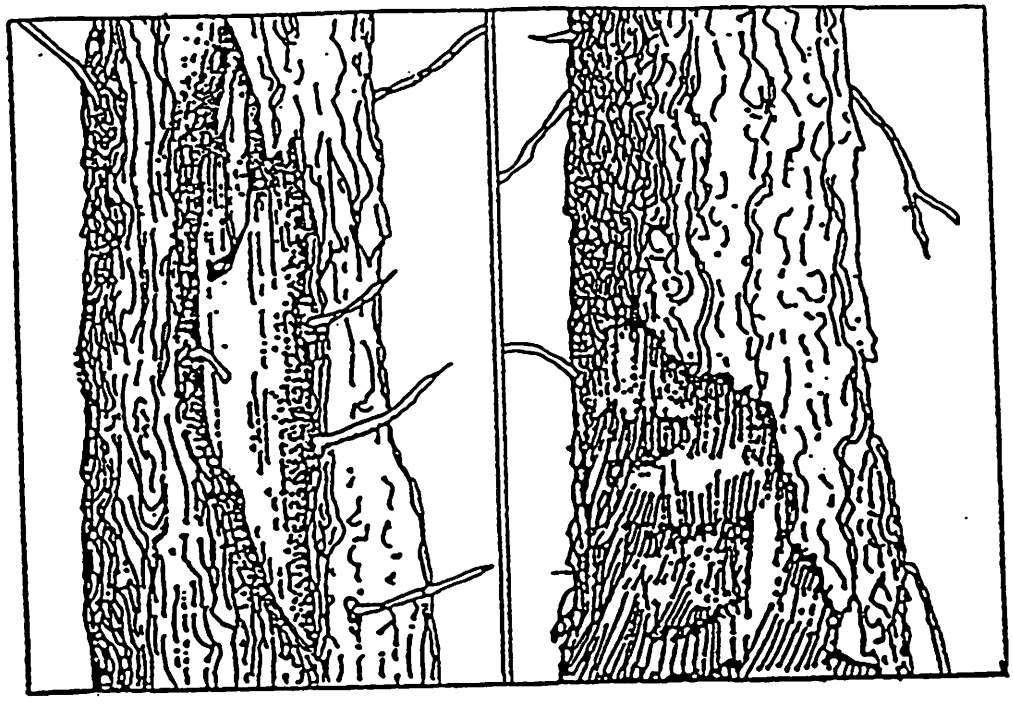


FIGURE 2.6 OPEN SCARS

12 Burls and Galls

Burls are abnormal swellings of the main stem or branches resulting from abnormal wood cell development following disturbance to the cambial layer. A burl is illustrated in Figure 2.7.

Galls are localized trunk and branch swelling of mainly bark tissue. There is little or no damage to the underlying wood.

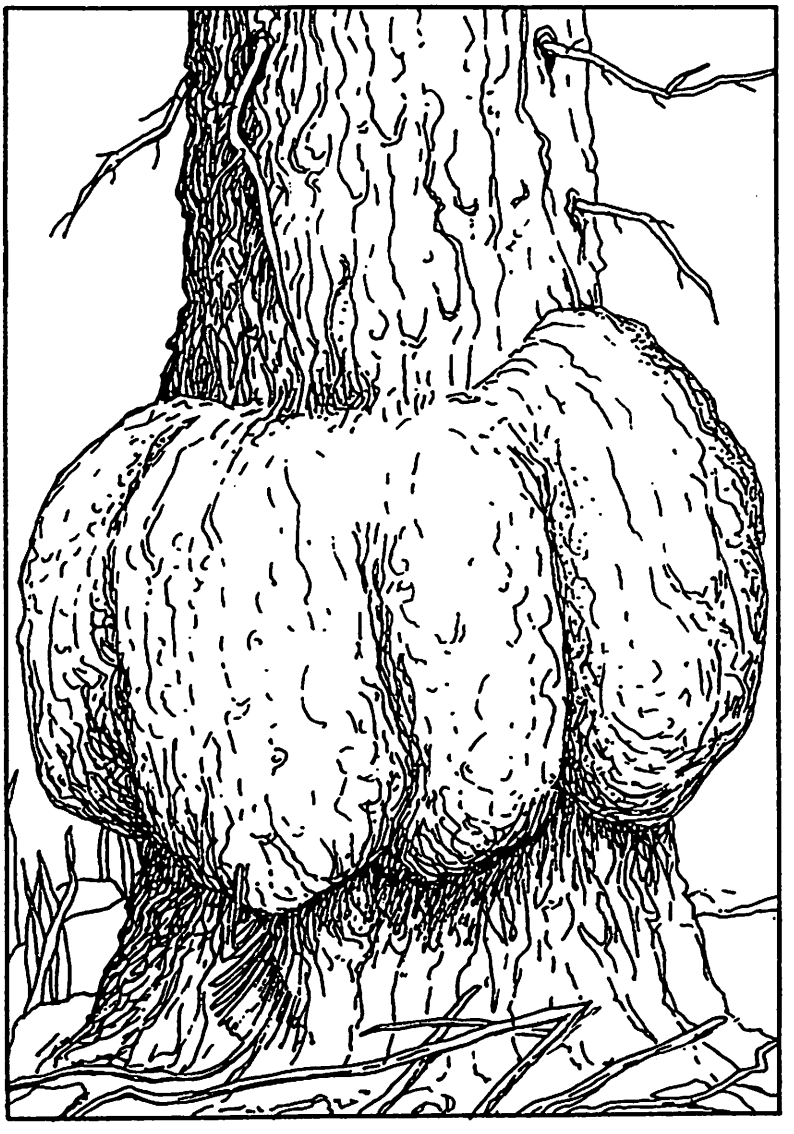
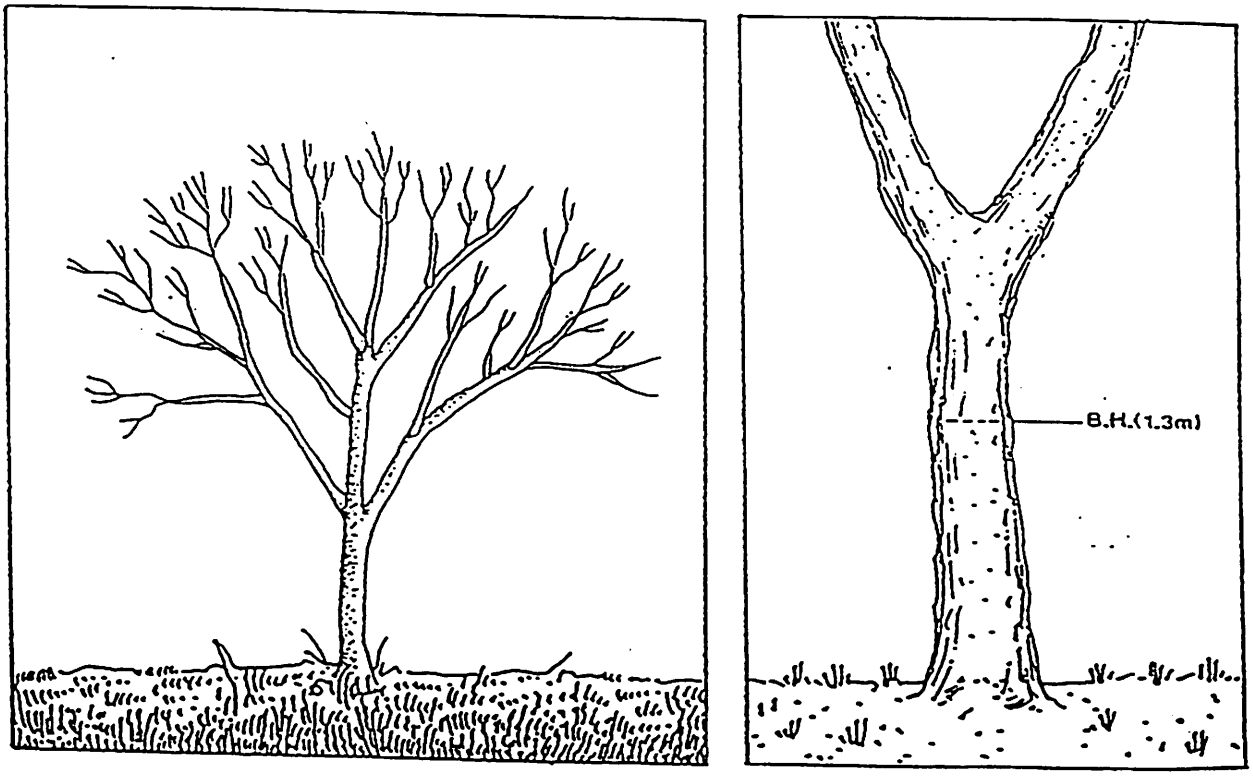


FIGURE 2.7 LARGE BURL ON MAIN STEM

13 Fork

Forks usually develop when there is malformation, injury or death of the terminal leader. Forks tend to be V-shaped and are only recorded when above 1.3 m (DBH level). Forks below this point are recorded as same stump (condition code 28). Natural branching on deciduous trees is not to be recorded. A fork must be at least 7.0 cm DIB, 2.5 m past the fork to be considered. Figure 2.8 demonstrates the difference between forks and natural branching.



NATURAL BRANCHING

FORKED TREE

FIGURE 2.8 FORKS

14 Pronounced Crook

This condition develops from the death of the terminal leader or the breaking off of a forked leader. When this occurs, a lateral branch takes over apical dominance as shown in Figure 2.9. A crook is recorded when the inside bark diameter is at least 7.0 cm, 2.5 m above the defect.

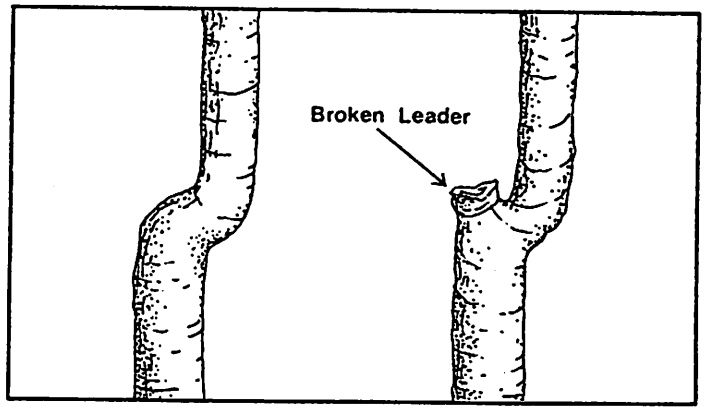


FIGURE 2.9 PRONOUNCED CROOK

19 Broken Top

Broken tops are recorded when the tree bole is less than 10 cm DIB at the break.

22 Limby

A tree recorded as limby has long, heavy, low limbed branches. Usually limby trees are open-grown or older, dominant veterans.

23 Leaning

A tree is considered leaning if it is standing greater than 10° off of vertical (see Figure 2.10). If the angle is greater than 45° to the ground, the tree has a severe lean. In this situation the leaning code has the highest priority and a crown class is not recorded.

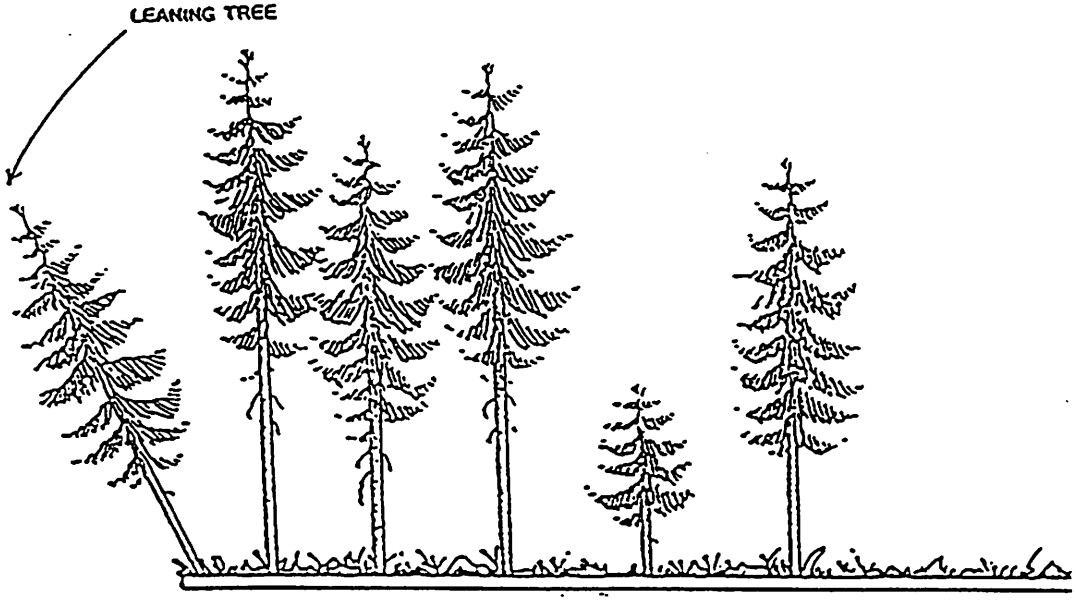


FIGURE 2.10 LEANING TREE

24 Broken Stem

A broken stem is recorded if the tree bole is greater than 10 cm DIB at the break.

25 Standing Dead

A standing dead tree is one that is dead but still standing.

26 Missing

A missing tree is one that was selected in advance but cannot be found at time of sectioning.

27 Dead and Down

Stem was standing when selected in advance for sectioning, but at time of sectioning tree is dead and down. The cause of death must be by natural causes (ie. windfall, insect or disease, etc.)

28 Same Stump

The same stump refers to two stems that are joined below breast height - 1.3 m (see Figure 2.11).

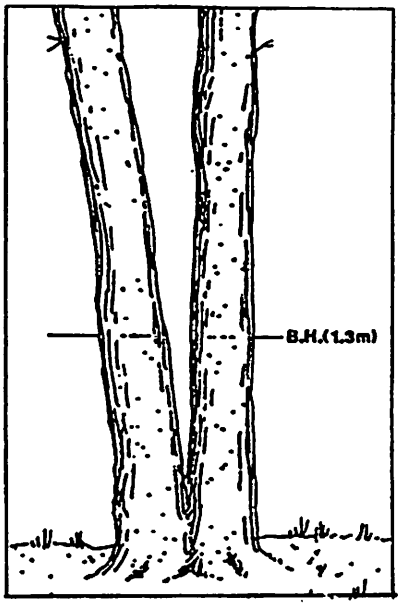


FIGURE 2.11 SAME STUMP

30 Stem Insects

This code is recorded when there is evidence of an insect infestation attacking the bole of the tree. Bark beetles are the most prevalent stem insects but sawyer beetles and others are included.

Bark beetles, Dendroctonus spp., are a very serious problem in Alberta. The adult female enters the bark in early summer and lays eggs in the tree's cambium. The eggs overwinter and hatch as larvae in the early spring. Damage to the tree is done by the larvae eating the cambium and usually results in death. The tree will not turn red until the next summer. Other symptoms of attack are piles of "sawdust" (frass) at the base of the tree, entry holes in the bark, and pitch tubes (the tree tries to push the beetles out with resin). The beetles also carry a blue stain that causes further deterioration of wood quality. Beetles attack all species of pines, spruce, and Douglas fir.

Sawyer beetle infestations are common in burned timber.

31 Stem Disease

All diseases that infect the main stem are documented with this code. Included in this code are cankers, rusts, and rotten branches.

Stem cankers are caused by fungi that invade stems and branches resulting in localized areas of infection in the bark and underlying woody tissue. Cankers may be annual or perennial. In perennial cankers the infected area may be eventually exposed to the underlying wood when the dead bark sloughs off. A common stem canker on lodgepole pine is Atropellis piniphila (Figure 2.12a). This can cause a distortion in growth and a blue-black stain on the wood.

Stem rusts are also included in this condition code. Rusts are host specific parasitic fungi usually requiring two alternating living hosts. Stems and branches may be girdled resulting in large malformations or even death. In particular, Endrocronartium harknessii on young pines is a serious problem in Alberta. Spruce broom rust, Chrysomyxa arctostaphi (see Figure 2.12b), can also be noted but only if the broom is no longer green (i.e. red or missing needles).

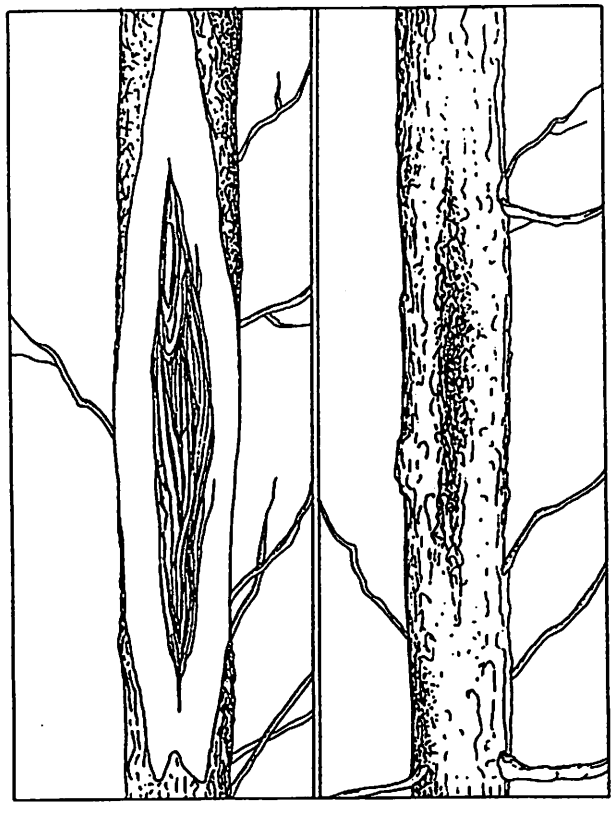


FIGURE 2.12a ATROPELLIS CANKER ON LODGEPOLE PINE

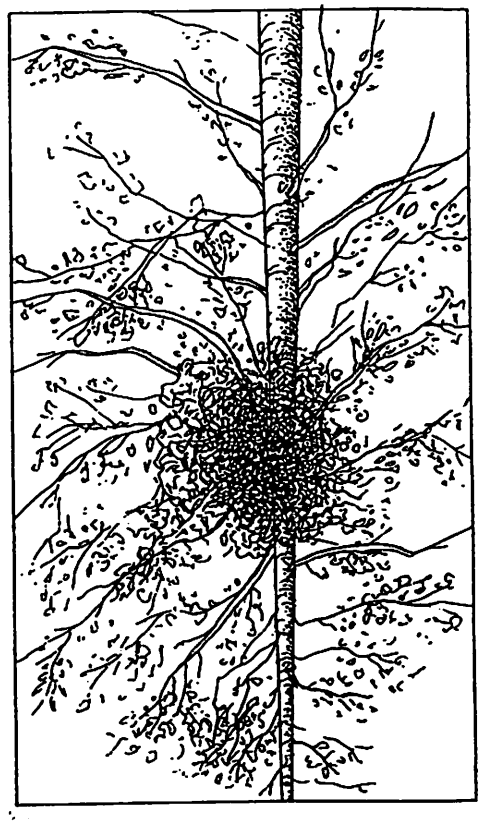


FIGURE 2.12b WITCHES BROOM

Large rotten branches typically appear on overmature, decadent trees and can be indicative of decay. Large rotten branches are those well below the base of the live crown and are > 5 cm in diameter, are unweathered, appear punky, and are weeping (see Figure 2.12c). Often a black ring appears on the stem surrounding the branch.

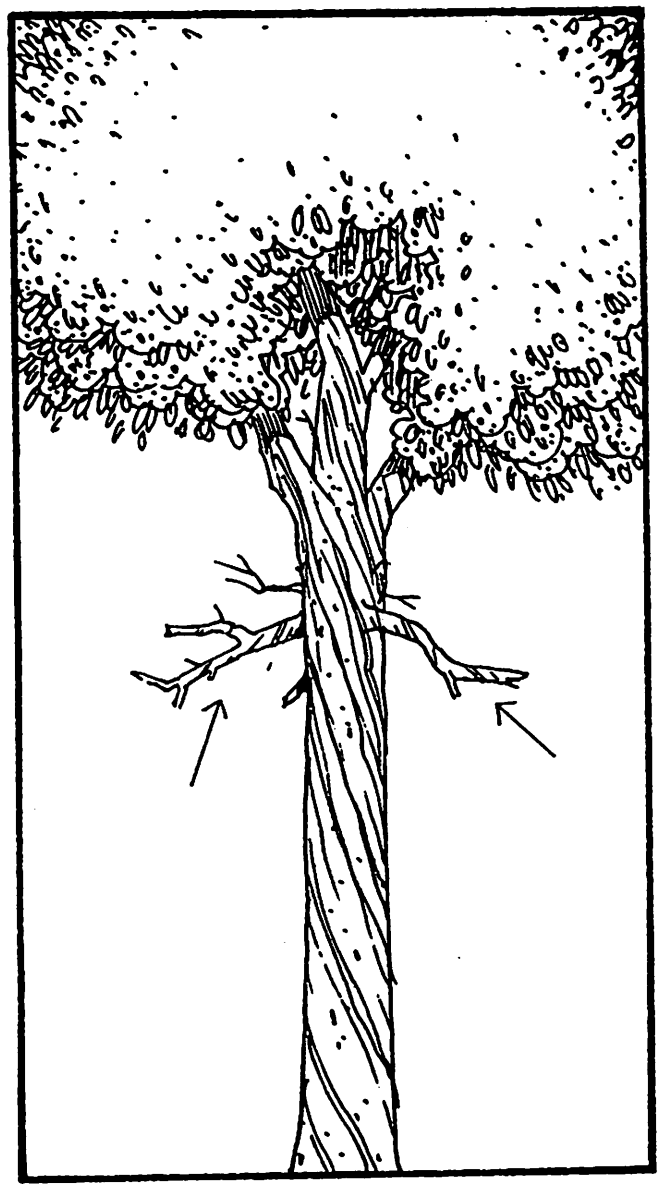


FIGURE 2.12c ROTTEN BRANCHES

32 Foliar Insects

This condition code pertains to all insects that infest parts of the tree off the main stem. Included in this category are the tent caterpillar, spruce budworm, jack pine budworm, etc.

The forest tent caterpillar, Malacasoma disstria, causes severe defoliation in hardwood stands in Alberta resulting in a significant reduction in annual growth.

The spruce budworm, Choristoneura fumiferana, infests mature white and black spruce, and balsam fir stands. This insect attacks the buds and new needles. Their feeding spreads to old needles and eventually kills the tree.

The jack pine budworm, Choristoneura pinus, attacks stands of jack and lodgepole pine and is a relatively new forest pest in Alberta. This insect feeds and spreads in the same manner as the spruce budworm.

33 Foliar Disease

This code is used for all diseases that infect parts of the tree off the main stem. Mistletoe, needle casts and blights, and rusts are included in this condition code.

Dwarf mistletoes are parasitic flowering plants requiring living hosts. Mistletoe is usually recognized by swellings on branches and stems or by witches' brooms. Heavy infestation results in reduced vigour (tree can become susceptible to secondary attacks such as bark beetles), lower wood quality and growth losses (can be from 30-60%). The major tree hosts in Alberta are: lodgepole pine, Douglas fir, and larch. Figure 2.13 illustrates the effect resulting from mistletoe infestations and the individual flowering plant.

FIGURE 2.13 MISTLETOE

34 Stem Form Defects

This condition code is used when there is damage or a distortion resulting in a loss of volume. Included in this category are defects such as sweeps and bends, spiral grain, frost cracks, and windshake.

A sweep or bend is the gradual bowing or curving of the main tree stem. It has no decay significance, but may cause a loss of volume in a sawlog.

Spiral grain is the twisting of the grain seen in exposed wood or in the direction of the bark fissures. Spiralling frost cracks and scars also indicate the presence of spiral grain.

A frost crack is a deep radial splitting of the trunk caused by uneven shrinkage of the wood after a sudden drop in temperature. The cracks usually start at the base and extend up the trunk. They may be reopened repeatedly by wind stresses or low temperatures.

Windshake is a splitting in the wood along the grain or less frequently within an annual growth layer. It is caused by wind or snow stresses and is also known as ringshake.

35 Dead top/Dieback

Both of these conditions affect the terminal leader of the tree. The cause of death of the leader is uncertain but it may be caused by fungi, drought, flooding, or insects.

A dead top affects the terminal leader only while dieback may be progressive, appearing first in the upper crown and gradually spreading towards the base of the tree. See (Figure 2.14). Dieback does not usually result in the death of the tree.

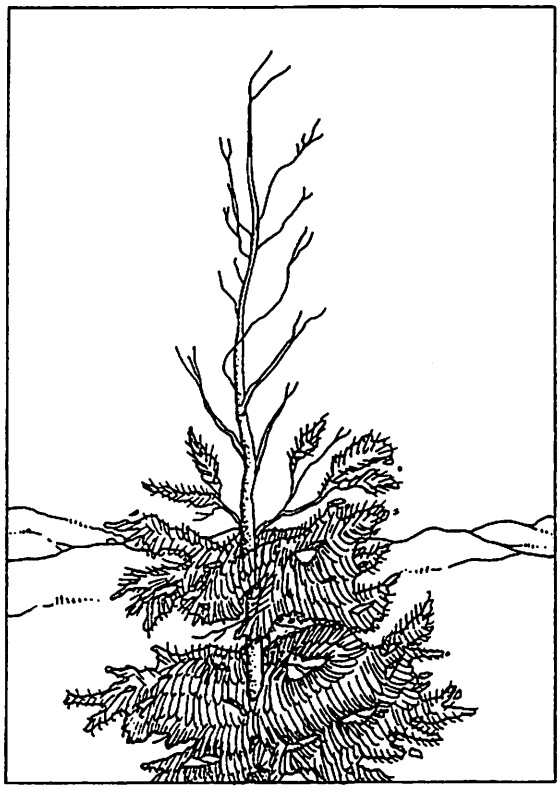


FIGURE 2.14 DIEBACK

36 Closed scars

Wounds that had penetrated the cambium but have now healed over are considered closed scars. A closed scar is characterized by an irregular indentation in the bole of the tree that would result in a loss of volume due to poor wood quality. Before healing over, the scar provided an entry point for disease.

37 Unknown

This condition code is to be used only when there appears to be something affecting the tree but the other condition codes do not describe the situation.

2.5.4 Crown Class

Crown class refers to the position of an individual tree within the canopy of that stand. It is recorded as one of the following:

D	Dominant	-- Crowns extend above the general level of the canopy.
C	Codominant	-- Crowns form the general level of the canopy.
I	Intermediate	-- Crowns are below but extending into the bottom of the general level of the canopy.
S	Suppressed	-- Crowns entirely below the general level of the canopy.
O	Open Grown	-- Used only in special situations for trees in very open stands.

Figure 2.15 shows the types of crown classes in a single-layer stand.

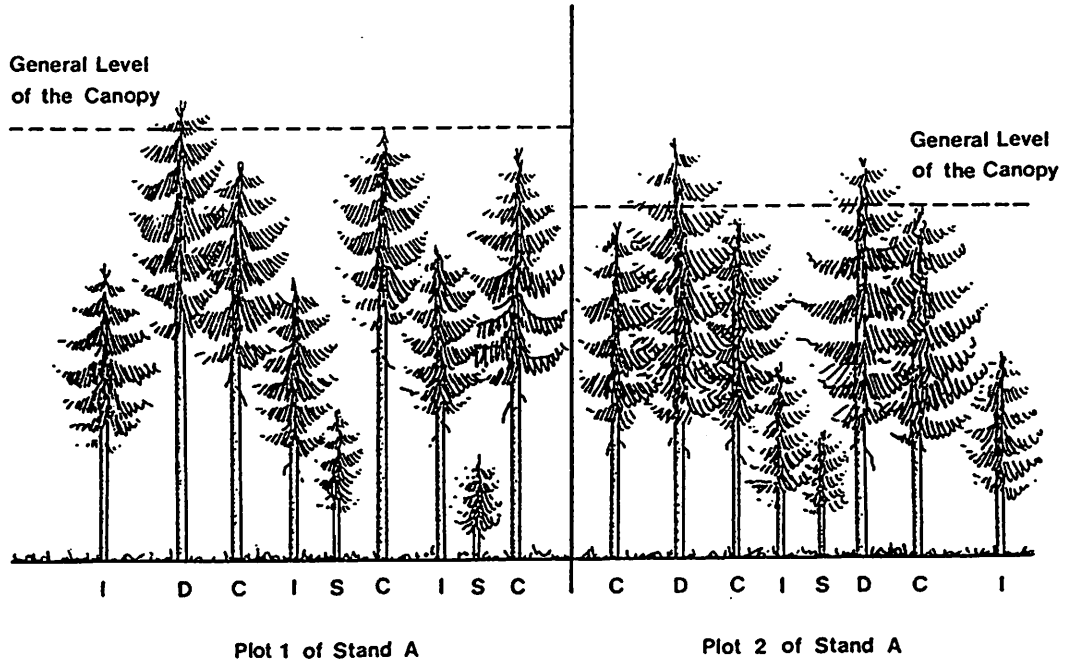


FIGURE 2.15 CROWN CLASS

2.6 Measurements Taken After Felling

2.6.1 Marking the Tree

2.6.1.1 Section Lengths. After falling tree below stump height (0.3 m), the stem is cleanly cut at the stump line (0.3m mark) and then limbed.

Using a 30 m tape, the stem is marked with a lumber crayon at 1.0 m from the stump (dbh). The following section length is 1.5 m long. The rest of the stem is then marked in 2.5 m intervals (Figure 2.16).

Should a swelling occur (because of heavy branching, burls, etc.), where a section length is to be marked, the section length is shortened by 0.5 m intervals until "normal" stem diameters are reached. The rest of the stem is then marked in 2.5 m intervals to the top (Figure 2.17). Never increase section lengths more than 2.5 m as formulas used to determine section volume are not accurate for longer lengths.

The total length of the stem including the stump section of 0.3 m is zero filled and recorded at this time as total height and is recorded in the Header Section under (zero filled) columns 47 - 51. The number of sections may be recorded along with section lengths at this time (section information, columns 24 - 27, right justified and zero filled). The sum of the section lengths must equal the total height of the tree, recorded in Header columns 47 - 51. If a section is shortened because of swelling, that fact must be recorded immediately on the back of the tally sheet in the comments section.

Should a tree have more than 20 sections (the maximum allowed on one tally sheet), a second tally sheet must be used. Columns 1-20 are completed and the proper page number indicated. No other header information should be filled in.

2.6.1.2 Numbering the Sections. The sections are numbered consecutively, starting with the stump section (number one). Figures 2.16 and 2.17 illustrate the correct marking and numbering of a stem.

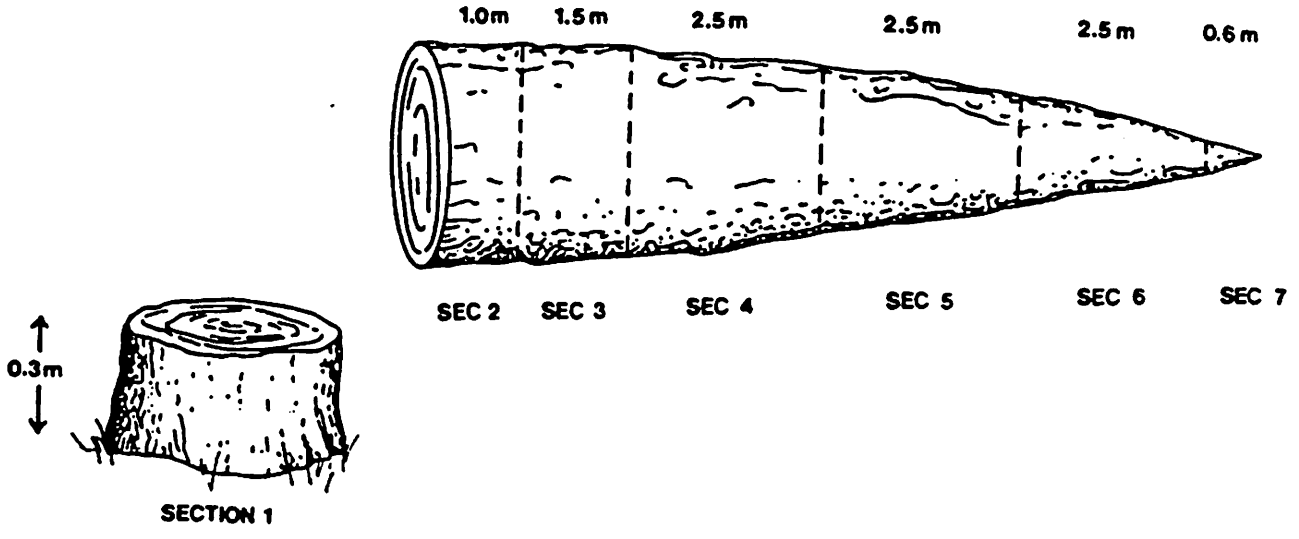


FIGURE 2.16 MARKING A FELLED TREE

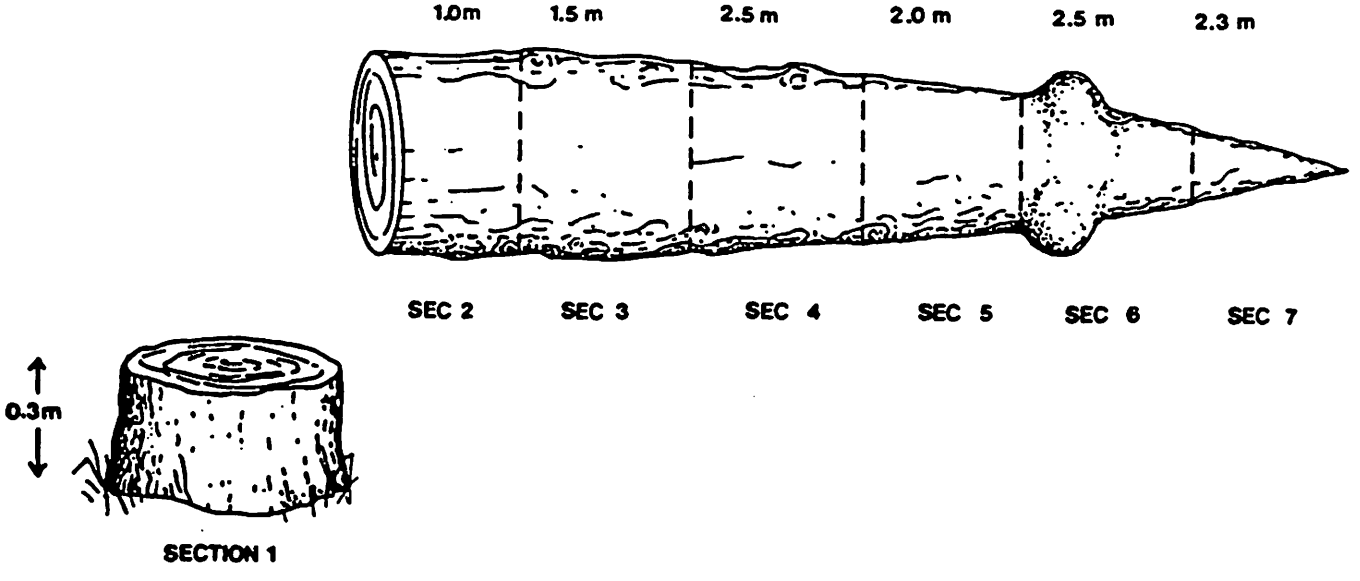


FIGURE 2.17 ABNORMAL SWELLINGS

2.6.1.3 Height to Live Crown. The height from the ground to the base of the live crown (see Figure 2.18) is measured, and recorded in column 52-56 and is zero filled. This includes the length of the stem from the bottom, including 0.3 stump, up the base of the live crown. The base of the live crown is the point that separates the continuously branched portion of the tree and the part that has sporadic or no branching. The height to live crown is quite variable depending on stand maturity and density with young open stands having low live crowns and mature, stocked stands having higher, live crowns.

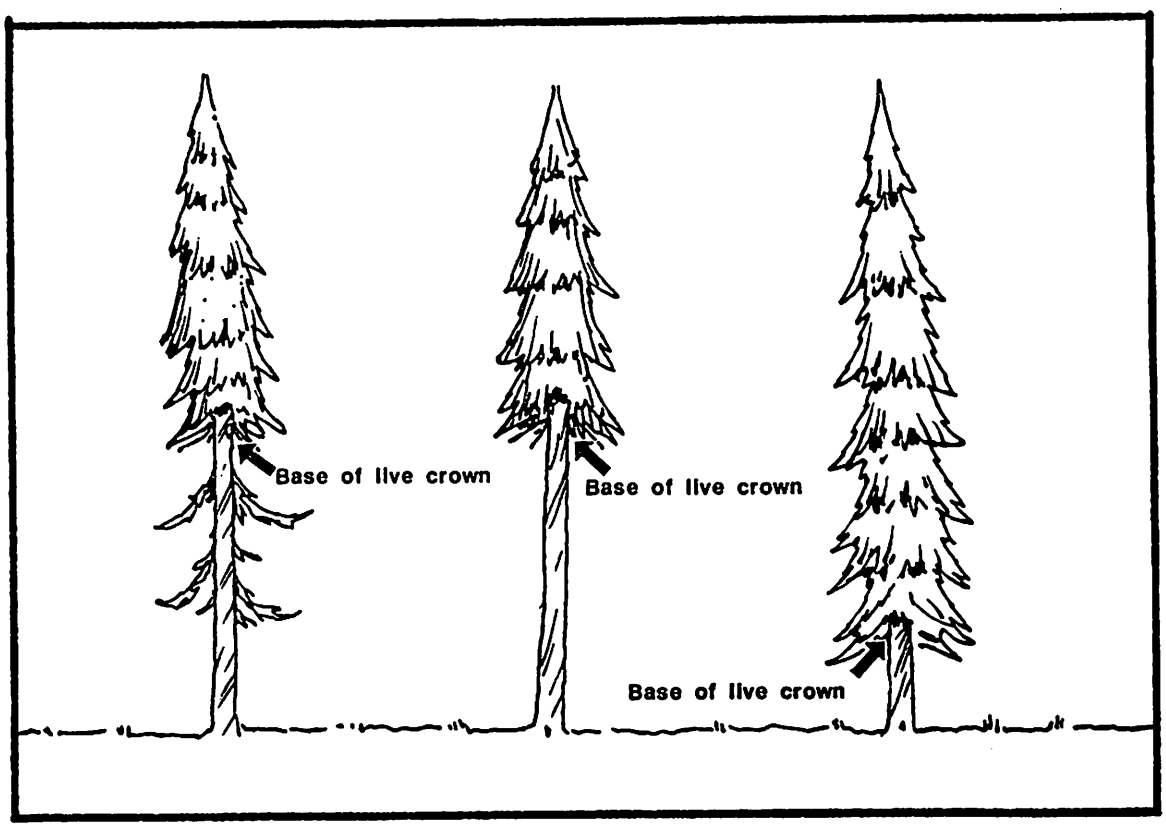


FIGURE 2.18 BASE OF LIVE CROWN

2.6.2 External Defects

External defects are losses in volume due to missing wood or poor stem form. These include cat faces, scars, broken tops, etc.

External defects can cause a reduction in pulp or lumber recovery or both. A defect which reduces pulp recovery will always reduce lumber recovery while the reverse is not necessarily true.

External defects are evaluated for each section separately and are recorded in columns 47-50 as the percent of volume lost from the section.

2.6.2.1 External Pulp Defect (EPD). External pulp defect (EPD) is due mainly to missing wood (broken tops, scars). It is applicable only if the defect occurs below a 10 cm dib. Severe crotches may also reduce pulp recovery as they are sometimes impossible to debark.

a) Missing Wood -- Losses due to broken tops are not accounted for in tree sectioning. Losses due to scars are estimated and recorded as a percentage of the volume (per section).

b) Severe Notches -- Assume a 0.5 m loss in length for the section and convert this to volume loss in percent (per section).

2.6.2.2 External Saw Defect. External saw defect (ESD) applies to stems with at least one 2.5 m section below a 10 cm dib. Defects such as sweep, crook, forks, etc., may reduce lumber recovery but not necessarily pulp, so an ESD must be determined. For more detailed information on external defects see the Alberta Phase 3 Forest Inventory: Temporary Sample Plot Procedures. Figure 2.19 illustrates various defect losses due to sweep and crook.

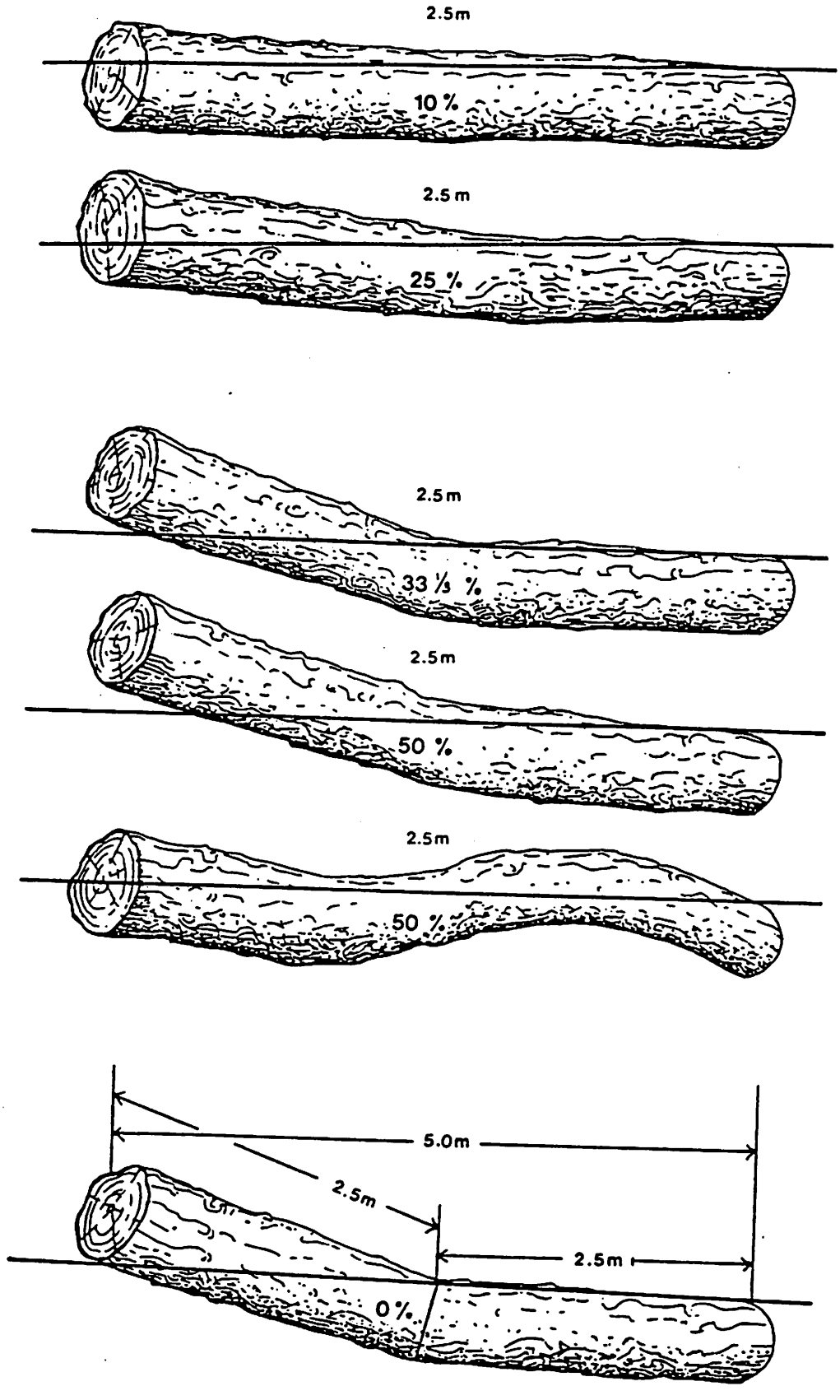


FIGURE 2.19 DEDUCTIONS FOR CROOK AND SWEEP

SOURCE: Alberta Scaling Manual.

2.6.3 Forked Trees

A tree is considered forked if it splits into two or more measurable limbs at or above dbh. For a limb to be measurable it must have a minimum length of 2.5 m to an estimated 7.0 cm top dib. Be sure not to confuse natural branching of some species such as aspen or poplar with forks. Figure 2.20 illustrates the difference between forked and non-forked trees.

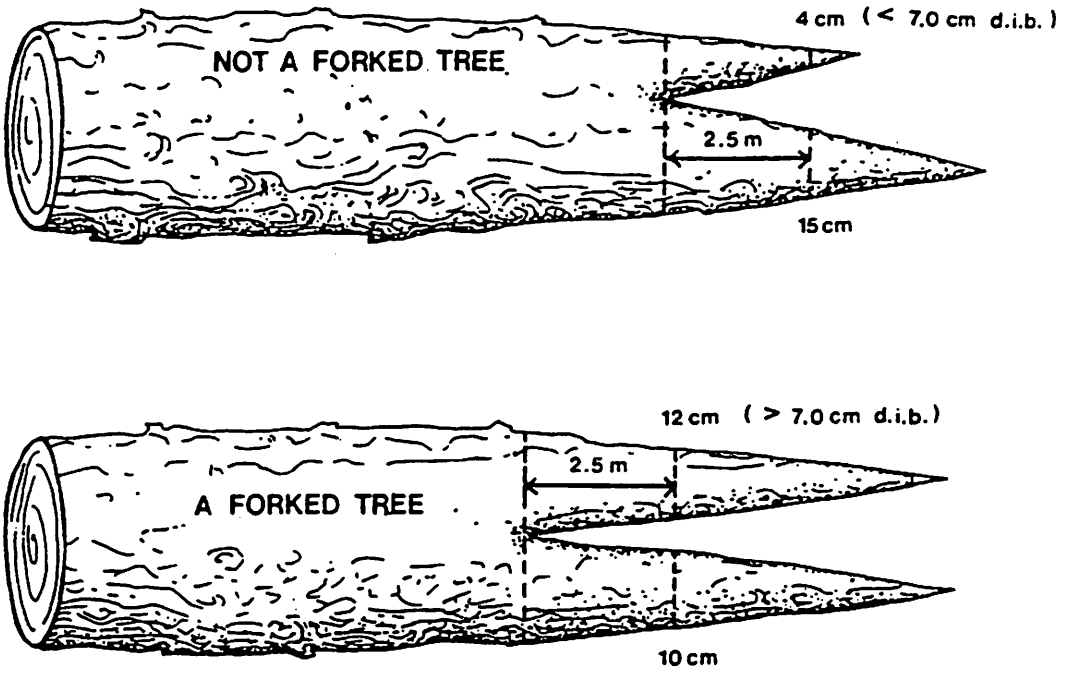


FIGURE 2.20 DETERMINATION OF A FORKED TREE

Begin marking the stem in the usual manner until the fork is reached. Mark the stem at the fork and record the length from the last 2.5 m interval to the fork. Continue marking the stem up the largest fork, the next measurement being 2.5 m from the fork. The remainder of the fork is marked in the usual manner (2.5 m lengths). The remaining fork(s) is marked in the same manner (Figure 2.21). The height of the tree is determined using the height to the tallest fork.

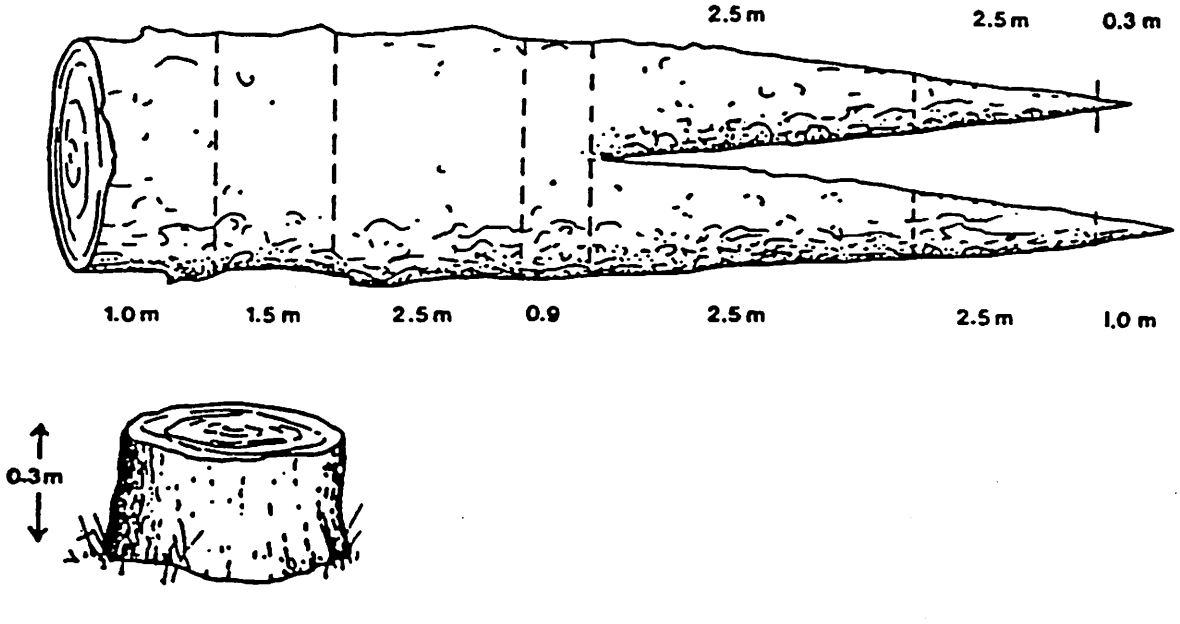
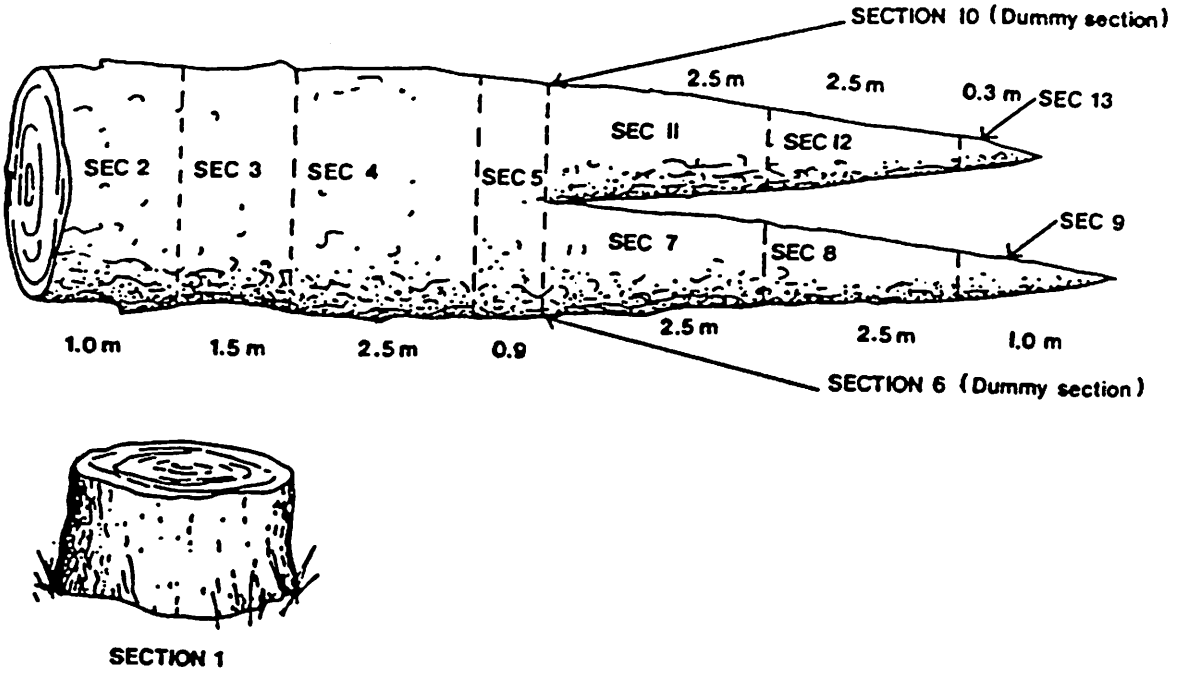


FIGURE 2.21 MARKING A FORKED TREE

The numbering of the sections of a forked tree is slightly different from that for an unforked tree. The sections are numbered in the usual manner up to the fork. The section length from the fork to the previous 2.5 m section (tree section 5, Figure 2.22) is recorded and the section top diameters (dib and dob) are recorded as 999.9. The following section is called a "dummy section". It has a length of 00.00 and its diameter is recorded as the bottom diameter of the next section (Sections 7 and 11 in Figure 2.22). The section following the "dummy section" will have a length of 2.5 m (Figure 2.21). The remainder of the fork is numbered in the usual manner. Any subsequent forks are numbered in the same manner, beginning with the "dummy section". Forked trees are recorded in this manner in order to meet the requirements of the computer program used to compile tree volumes. Figure 2.23 shows a forked tree tally sheet corresponding to the forked tree in Figure 2.21 and 2.22.



SECTION 1

FIGURE 2.22 SECTIONS OF A FORKED TREE

Alberta

FORESTRY, LANDS AND WILDLIFE
Forest Service

CSTM 04A (Rev. 12/87)

TREE SECTIONING TALLY SHEET

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)		MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (27) (X)	# SEC. (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
6	04	062	0341		00062	01	H	G07	PL		13	012.6	2	N

TREE CATEGORY (36) 1	2	3	4	5	C.C. (46)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)
13					C	012.20	10.11	X	C2PL (AW) H92M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (75)	COND (77)	AREA (78)	PHOTO HEIGHT (81)
					.

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3	–	ADVANCED ROT

(28) – # SECTIONS TOTAL
(34) – AT TOP OF SEC #
(35) – DECAY IND.
(46) – CROWN CLASS
(57) – INT. DEFECT (X)

VSR 1

Page 1 of 1

Cruiser A. Winter

Date June 7, 1991

INCREMENT WIDTH

SEC NO.	0 – 10 YEARS	11 – 20 YEARS
01	0.5	0.6
02	0.7	1.0

PAGE (20)	(21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION: INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (36)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS: PULP (47)	SAW (49)	INTERNAL DEFECT: DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S	1	01	00.30	14.2	16.1	14.1	16.3	10.1			.	.	.
S		02	01.00	12.5	12.7	12.5	12.6	87			.	.	.
S		03	01.50	10.6	11.1	10.7	11.2	56			.	.	.
S		04	02.50	8.3	9.6	8.9	9.4	29			.	.	.
S		05	00.90	9.9	9.9	9.9	9.9				.	.	.
S		06	00.90	7.4	8.2	7.0	7.9	27			.	.	.
S		07	02.50	4.3	5.1	4.9	5.6	15			.	.	.
S		08	02.50	3.2	3.9	3.0	3.5	6			.	.	.
S		09	01.00	0.0	0.0	0.0	0.0				.	.	.
S		10	00.00	7.2	7.7	7.0	7.4	29			.	.	.
S		11	02.50	4.1	4.4	3.9	4.2	15			.	.	.
S		12	02.50	1.0	1.5	1.0	1.6	6			.	.	.
S		13	00.30	0.0	0.0	0.0	0.0				.	.	.
S		14	.	.	.	.	.				.	.	.
S		15	.	.	.	.	.				.	.	.
S		16	.	.	.	.	.				.	.	.
S		17	.	.	.	.	.				.	.	.
S		18	.	.	.	.	.				.	.	.
S		19	.	.	.	.	.				.	.	.
S	▼	20	.	.	.	.	.				.	.	.

FIGURE 2.23 EXAMPLE OF A FORKED-TREE TALLY SHEET

TREE CATEGORY CODES
(by priority):

26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

2.7 Measurements Taken at Each Section

Diameter and radial increment measurements are taken at the top of each section. This is easily done by cutting a slab off the top of each section. These slabs, commonly called "cookies", must be cut perpendicular to the stem and care taken not to tear the bark as this will affect dob measurements.

The thickness of the "cookie" depends on species (conifer cookies should be 20 mm - 30 mm thick, but deciduous cookies need only be 10 mm to 20 mm thick), length of storage time, and treatment. Cookies to be stored one to two weeks should be thicker, as well as those that will be sanded to aid in ring analysis.

Each "cookie" should have the tree and section number clearly marked on it, tree number first, (eg., tree number 02, section 3 would be marked as 2/3). Using this technique, several trees may be felled, limbed and bucked at one time, the "cookies" marked and piled or stored for later use. It is recommended that if cookies are stored, that the plot number be included on a tag in the storage bag or box.

2.7.1 Diameters

Cross-sectional diameters at the top of each section are measured in centimetres with a ruler to one decimal place. A total of four measurements are required: two diameters inside the bark (dib) and their respective diameters outside bark (dob). The diameters should be taken at right angles to each other. If a tree is very irregular in shape, measurements

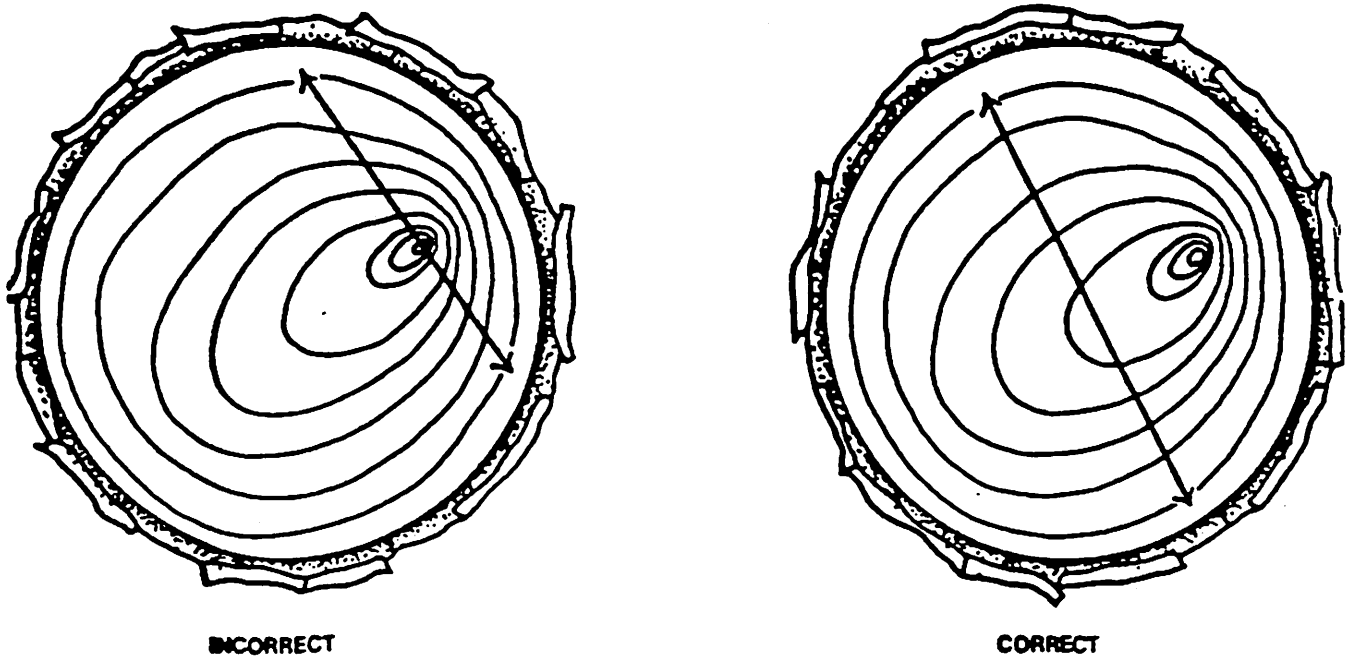


FIGURE 2.24 DETERMINING THE CENTRE

should be taken close to the average diameter rather than at the maximum and minimum. Measurements should be taken through the geometric centre not the growth centre (tree pith) (Figure 2.24). The apical or top section will have diameters of zero. Figures 2.25 and 2.26 indicate where diameter measurements should be taken.

If the "cookie" is damaged, it may not be possible to get two diameters at right angles to each other. If this occurs, two diameters should still be taken at as close to 90° to each other as possible. If only one diameter (dib or dob) can be taken, it should be recorded twice on the tally sheet and noted on the comments area on the back of the sheet.

If the bark is missing from the "cookie", the dob measurements should be recorded as 000.0.

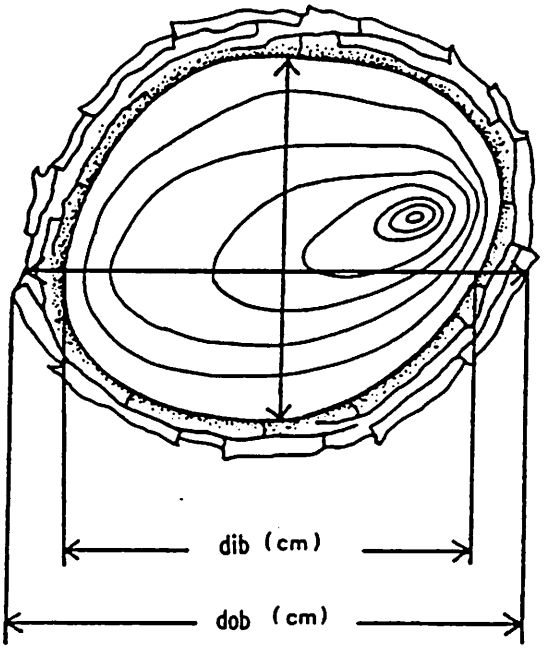


FIGURE 2.25 MEASURING DIAMETER INSIDE BARK AND DIAMETER OUTSIDE BARK

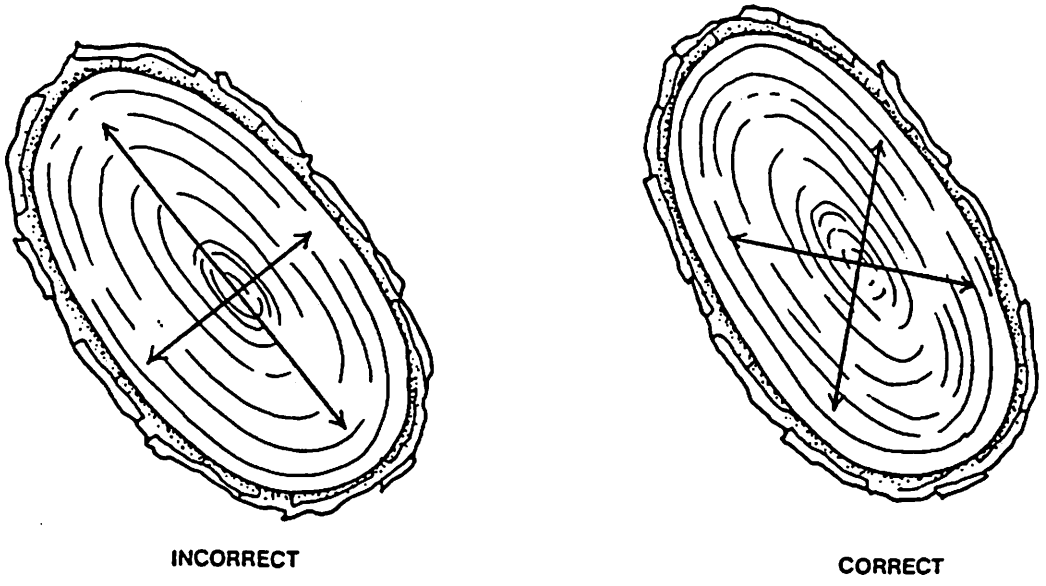


FIGURE 2.26 MEASURING IRREGULARLY-SHAPED STEMS

2.7.2 Ring Count and Radial Increments

Each section of the stem is to be aged and the 10-year radial growth increments measured for 0-10 years and 11-20 years for sections 1 and 2. Choose an average radius and begin counting the growth rings from the cambium to the center, marking the 10-year interval. (Figure 2.27). Measure and record each 10 year increment in millimeters.

In some cases, measurements will be required for each 10 year radial growth increment. The last inside increment if it accounts for less than 10 years growth is not measured (eg. six increments would be recorded for a 65 year old section). This information can be recorded on the second part of the tree sectioning tally sheet which is not yet available. The second page will also have space for sketches or drawings to illustrate aspects of the tree being sectioned.

Determine total age and record ring count in columns 44 - 46.

If the rings are too close or hard to count (because of stain, rot, or fibre pull), leave the radial growth and age for that section blank.

Figure 2.28 shows the front of a tally sheet correctly filled out.

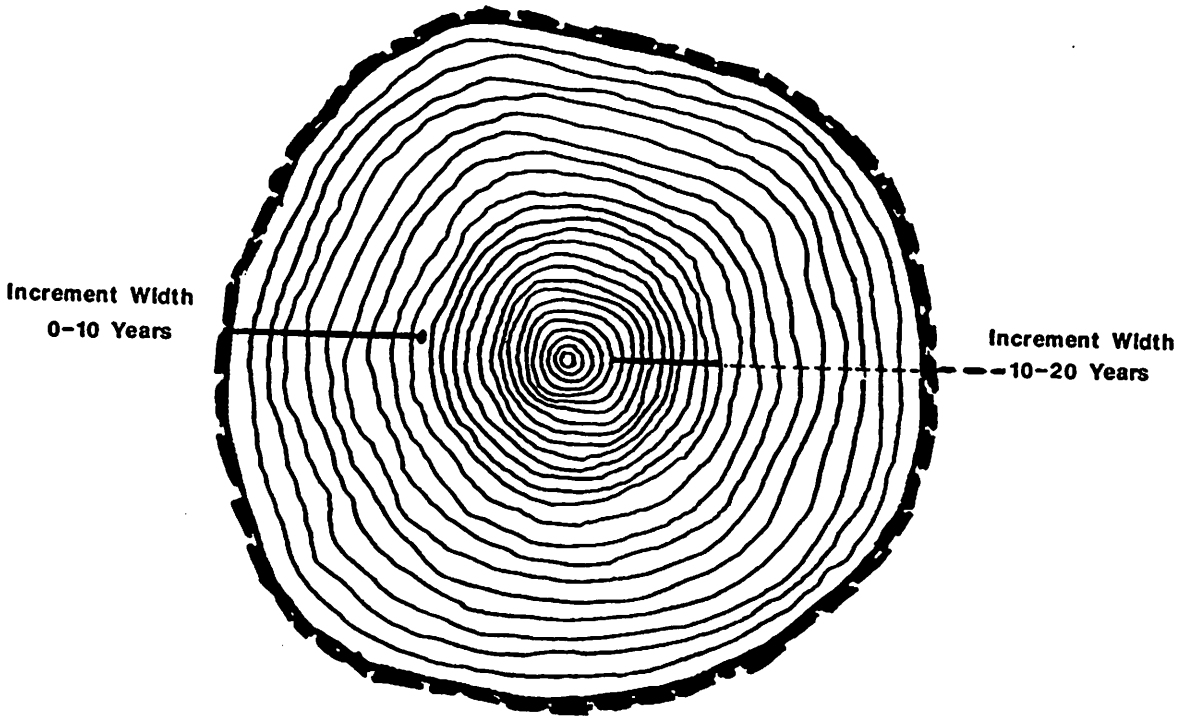


FIGURE 2.27 INCREMENT WIDTHS

Alberta

FORESTRY, LANDS AND WILDLIFE
Forest Service

(Rev.

TREE SECTIONING TALLY SHEET

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)	(20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (27) (X)	# SEC (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
6	0,4	0,6,2	0,3,4,1		0,0,0,0,0,1	0,3	H	G,0,7	A,W		0,7	0,1,4.2	2	C

TREE CATEGORY (36) 1	2	3	4	5	C.C. (46)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)		
0,1	0,2	1,4			C	0,1,0.9,0	0,0,7.1,0	X	C,2,A,W	(P,L)	H,9,2,M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (75)	COND (77)	AREA (78)	PHOTO HEIGHT (81)

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3	-	ADVANCED ROT

(28) - # SECTIONS TOTAL
(34) - AT TOP OF SEC #
(35) - DECAY IND.
(46) - CROWN CLASS
(57) - INT. DEFECT (X)

VSR

Page 1 of 1

Crew: A. Winter

Date: March 7, 88

INCREMENT WIDTH

SEC NO.	0 - 10 YEARS	11 - 20 YEARS
0 1	1,5	1,2
0 2	1,2	1,2

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION: INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (36)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS: PULP (47)	SAW (49)	INTERNAL DEFECT: DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S 1	0 1	0,0,3,0	1,5.6	1,7.2	1,5.4	1,6.9	5.6					
S	0 2	0,1,0,0	1,2.3	1,4.2	1,2.6	1,4.3	4.9					
S	0 3	0,1,5,0	1,0.9	1,1.6	1,1.1	1,2.0	1.9					
S	0 4	0,2,5,0	8.6	9.4	8.7	9.3	1.5					
S	0 5	0,2,5,0	7.2	7.9	7.0	7.4	1.0					
S	0 6	0,2,5,0	3.1	3.5	2.9	3.2	3					
S	0 7	0,0,6,0	0,0,0.0	0,0,0.0	0,0,0.0	0,0,0.0						
S	0 8											
S	0 9											
S	1 0											
S	1 1											
S	1 2											
S	1 3											
S	1 4											
S	1 5											
S	1 6											
S	1 7											
S	1 8											
S	1 9											
S ▼	2 0											

FIGURE 2.28 COMPLETED TALLY SHEET

TREE CATEGORY CODES
(by priority):

26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

2.8 Internal Defects

When cutting slabs or cookies off of the section lengths, observations should be made to detect internal defect. Internal defects are voids or decay within the stem which reduce recoverable volume. Internal decay may be in the form of a stain or rot which means the decomposition of wood substance caused by the action of wood destroying fungi, resulting in softening, loss of strength and mass, and often change of texture and color.

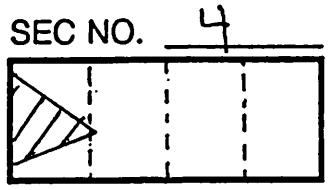
If defect is encountered it must be traced and mapped on the back of the tally sheet (CSTM04) to determine how far it extends through the stem (Figure 2.29). If the defect appears at one end of a section and not the other end it must be chased. This involves cutting the section in half to determine if the defect appears at the halfway mark. If the defect does not appear the section must be cut at 1/4 length to determine whether it is 1/4 or 1/2 of the distance through that section, ie. if defect appears at 1/4 and not 1/2 way it is 1/2 way through. If the defect does appear at the half, the section must be cut at 3/4 length to determine whether it is 3/4 of the distance through or if it ends at the top of the section. Do not chase decay to sections shorter than 0.625 m except in sections 2 and 3. The length of these sections are 1.0 m and 1.5 m respectively. In section 2, defect should not be chased to sections shorter than .25 m and not shorter than .375 m in section 3.

Internal defects are measured and sketched on the back of the tree sectioning tally sheet (Figure 2.30). Information recorded here must be accurate as defect volumes are calculated from this data. Defects must be sketched in the appropriate circle that corresponds to that tree section and measurements of the dimensions must be correctly marked. (See Figure 2.31 and 2.32).

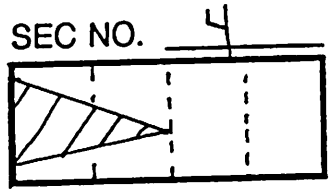
In the rectangular boxes provided, the length of that section must have the defect mapped as to whether it continues 1/4, 1/2, 3/4 or completely through the log and into the next section. The appropriate legend must accompany the diagram as to which is stain or rot for softwoods and stain, incipient rot or advanced rot for hardwoods. All different types of stains and rots must be chased.

Extreme care must be taken when diagramming crescent or C-shaped rot. The outside and inside diameters of the crescent must be measured as well as the width of the rot. Refer to deductions for crescent shaped rot in Section 3.2.1 number 5. The comments section should be used to note anything unusual about the tree. Figure 2.30 illustrates the back of a tally sheet correctly filled out.

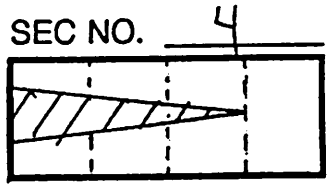
Defect appears at bottom of section but not at 1/4 of length



Defect appears at 1/4 length in section but not at 1/2 the length



Defect appears at 1/2 length in section but not at 3/4 the length



Defect appears at 3/4 length in section but not at end of section

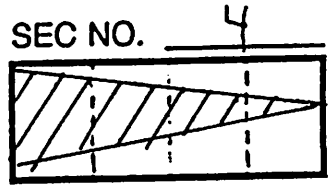
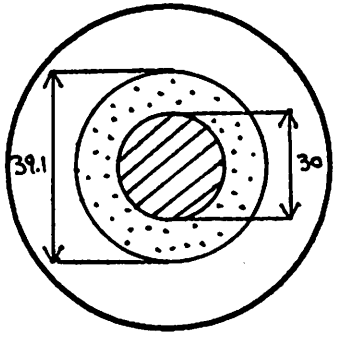


FIGURE 2.29 MAPPING DEFECT

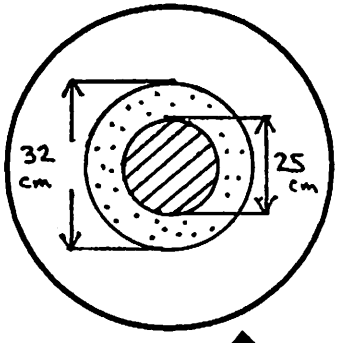
All defects must be measured and sketched. All stain and rot must be chased.

CSTM 04 (Rev. 12/87)

STUMP

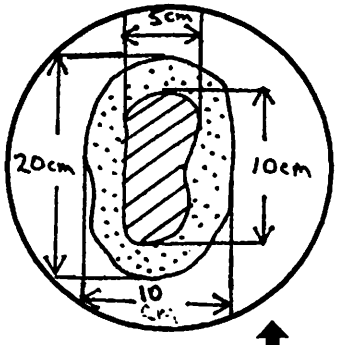


SEC NO. 2



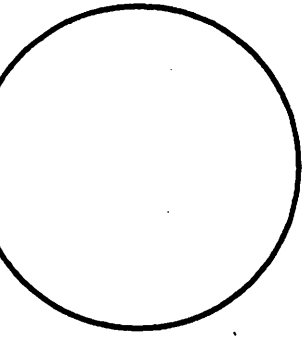
This cookie diagrams cull from the top of Section 2

SEC NO. 3

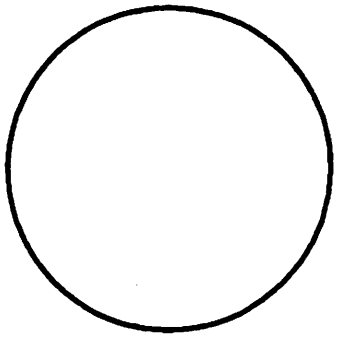


This cookie diagrams cull from the top of Section 3

SEC NO. 4



SEC NO.



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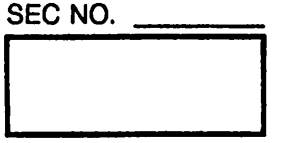

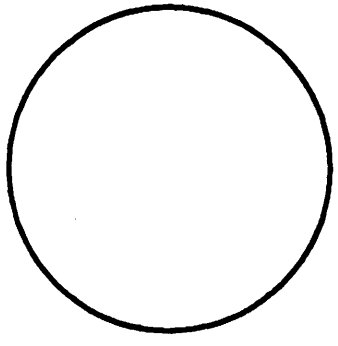

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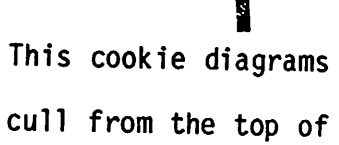

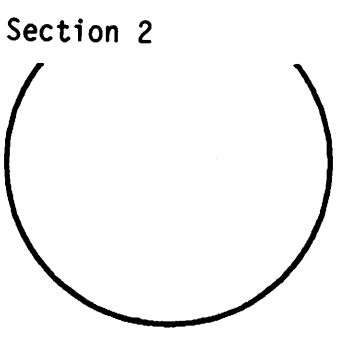

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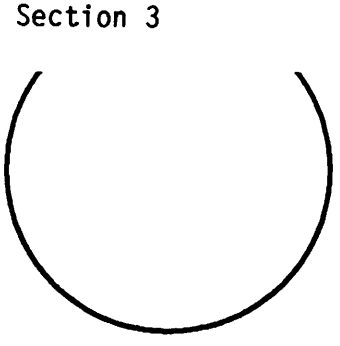

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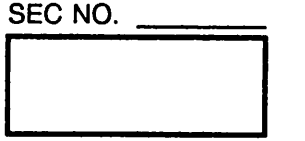

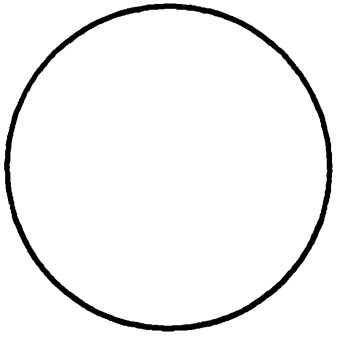

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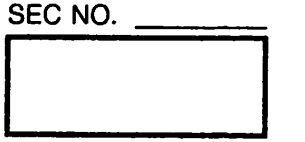

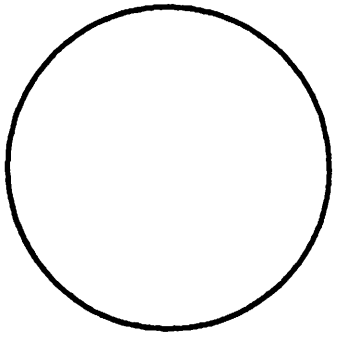

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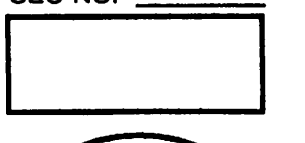

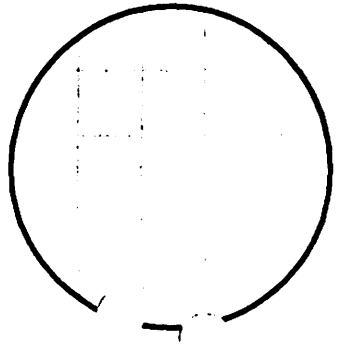

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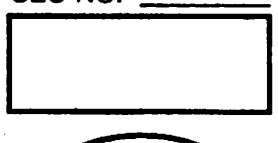
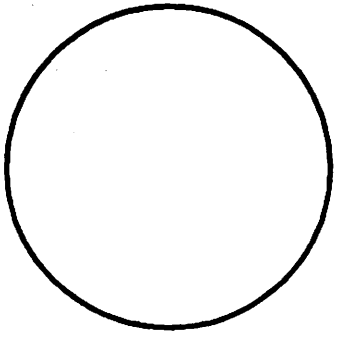




STAIN

ROT (SOFTWOOD)

INCIP. (HARDWOOD)

ADV. (HARDWOOD)

Comments _____

FIGURE 2.30 COMPLETED BACK OF TALLY SHEET

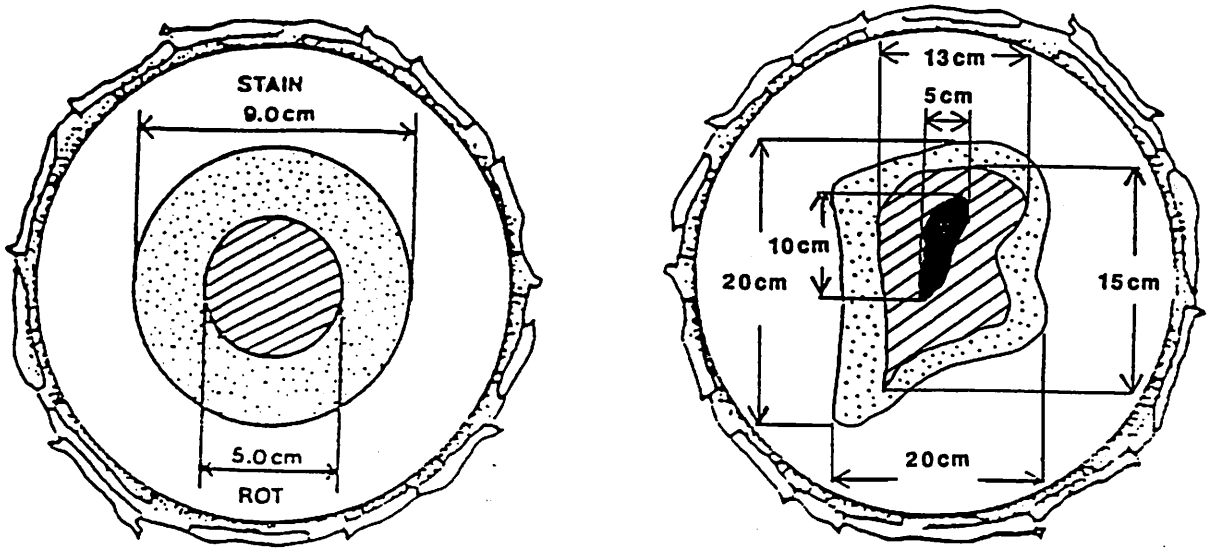


FIGURE 2.31 MEASURING ROT ENCIRCLED BY STAIN

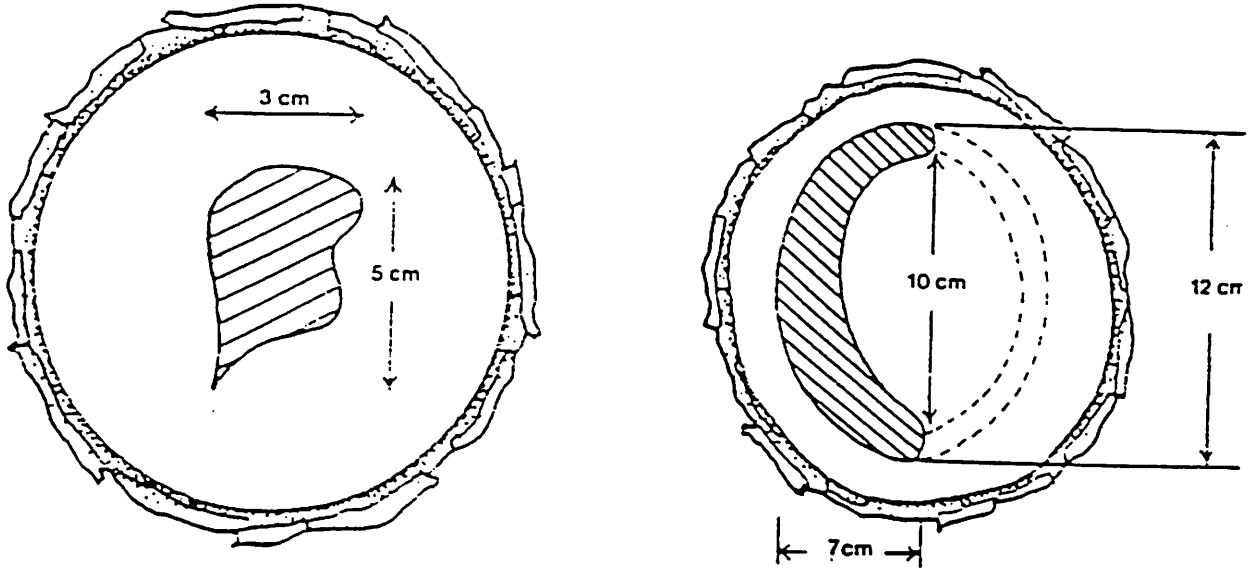


FIGURE 2.32 DIAGRAMMING IRREGULAR DEFECTS

2.8.1 Internal Defect Categories

Internal defect refers to the type of defect, such as stain or rot, and is sketched on the back of the tree sectioning tally sheet.

Cull volume refers to the total volume of wood that is not considered recoverable because of the internal defect. Cull volumes are calculated on the front of the tally sheet (columns 57-68).

Internal defect in softwoods are labelled as stain and rot. There are varying degrees of rot in conifers but all types are labelled rot. (Note: Rot in hardwoods is divided into 2 categories, incipient rot and advanced rot. The term incipient rot is not used for softwoods).

Cull volume for softwoods are labelled as pulpcull (Decay Level 1) and sawcull (Decay Level 2).

In hardwoods both the internal defect and the cull volume are referred to as stain (Decay Level 1), incipient rot (Decay Level 2) and advanced rot (Decay Level 3).

Trees that are clear throughout with no evidence of decay have no cull calculations and require no sketches on back of tally sheet. These stems must be clear and have no perceptible change in wood hardness from edge of cookie to the center. Discolorations which have a water soaked (mineral stain) appearance are not classed as stains and are not sketched.

2.8.1.1 Softwoods

Stain for softwood is a discoloration of the wood with some other color added (e.g. reddish-brown color). It is hard and firm to the touch.

Strength and resistance to pressure is the same as sound wood. There is no structural breakdown. At present no cull defect is calculated for stain in softwoods but it must be chased, measured and sketched.

Rot may or may not be discolored. The wood becomes stringy, pitted crumbly or punky which indicates a soft, often spongy wood condition. Wood may contain white pockets that characterize the more advanced stage of decay. Rot must be chased, measured and sketched for cull to be calculated.

2.8.1.2 Hardwoods

Stain for hardwoods is a discoloration of the wood with some other color added (e.g. red stain). It is hard and firm to the touch. Strength and resistance to pressure is the same as sound wood. Cull defect is calculated for stain on hardwoods. (Decay Level 1).

Incipient rot is the early stage of decay in which the decomposition has not proceeded far enough to soften or otherwise change the hardness of the wood perceptibly. The structure is firm but noticeably weaker than sound wood, it is not fibrous or loose. It is usually accompanied by a slight discoloration of the wood. Cull defect is calculated for incipient decay. (Decay Level 2).

Advanced rot is the late stage of decay in which the decomposition is readily recognized as the wood becomes punky, soft, stringy, pitted or crumbly. There usually is a change in color of the wood and it may appear with one or more dark bands called "black zones" outlined in a

discontinuous pattern. Advanced rot exhibits loss of strength that renders the wood unfit for general purposes. It is easily penetrated by a pen, pencil tip or even a blunt tipped tool. (Decay Level 3).

In distinguishing between the cull categories for both softwoods and hardwoods a subjective method which may assist in identification of defect involves the prodding of the cross section with an instrument such as a pen, knife, etc. By prodding the sound wood and comparing the resistance to that of the defective wood you should be better able to delineate zones where the defective wood is just as firm and hard (stain), slightly softer (incipient decay-hardwoods only) or much softer where cell wall structure is easily penetrated (advanced decay).

2.9 CALCULATING CULL VOLUMES

The presence of internal defect results in the reduction of gross tree volume (gross tree volume - cull volume = net tree volume). What is considered defect depends upon the product (pulp vs. lumber) and the processing technique. For softwoods, internal defect levels are calculated as pulp cull for Decay Level 1 and saw cull for Decay Level 2. Presently deductions are only completed for rot but stain must be sketched, measured and chased. For hardwoods all decay levels are calculated as pulp defects where stain is Decay Level 1, incipient rot is Decay Level 2, and advanced rot is Decay Level 3.

Internal defects may occur in 2 ways: it may appear as separate and distinct areas (Figure 2.33); or it may appear encircled within other defects. (Figure 2.34). Whether defects are separate or encircled, the decay level must be recorded as the volume of that defect. For example, in figure 2.32 the stain is separate and the volume can be calculated directly from the stain measurement. In Figure 2.34 the stain encircles the incipient and advanced rot. The volume calculated using the stain measurements also include both rot volumes. Therefore to determine the volume of stain in Figure 2.34 the volume calculated using the stain measurements minus the volume calculated using the incipient rot measurements equals the volume of the stain. See Figure 2.51B Sample Tally Sheet and Defect Calculations for an example of calculation procedures of encircled defects.

A generalized technique for determining saw and pulp defect volumes follows, (sections 2.9.1 and 2.9.2) based on Alberta Forest Service pre-1978 scaling procedures.

For the purpose of this manual, if the defect is less than 2 cm in diameter, the saw volume is considered nil, however, even defects less than 2 cm in diameter are still mapped.

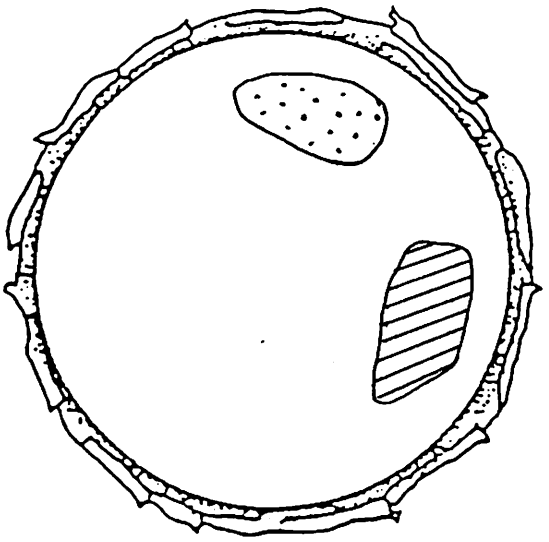


FIGURE 2.33 SEPARATE DEFECT

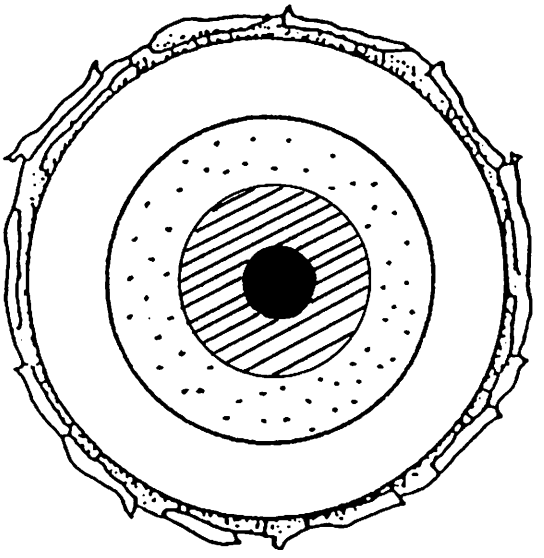


FIGURE 2.34 ENCIRCLED DEFECT

2.9.1 Saw Defect

Saw defect (SD) is a reduction in lumber recovery due to voids or soft rot in the wood. It is also calculated in areas of the log which cannot be converted to lumber (i.e. slabs, edgings, sawdust, trims, etc.). It does not include losses due to poor form as these deductions are accounted for in the external defect percentages. Saw defect is measured in units of cubic metres of unrecoverable volume, and is recorded (for each section) in columns 57-62 on the front of the tally sheet.

Some general guidelines for calculating SD are:

1. SD is calculated for lengths of 2.5 m. For convenience, the first three sections, with lengths of 0.3 m, 1 m and 1.5 m, respectively, are treated as one log, with a total length of 2.8 m. Refer to 2.9.1 (example 2) and Figure 2.38.

2. SD is calculated as the beam which is unavailable for conversion to lumber, as illustrated in Figure 2.35.

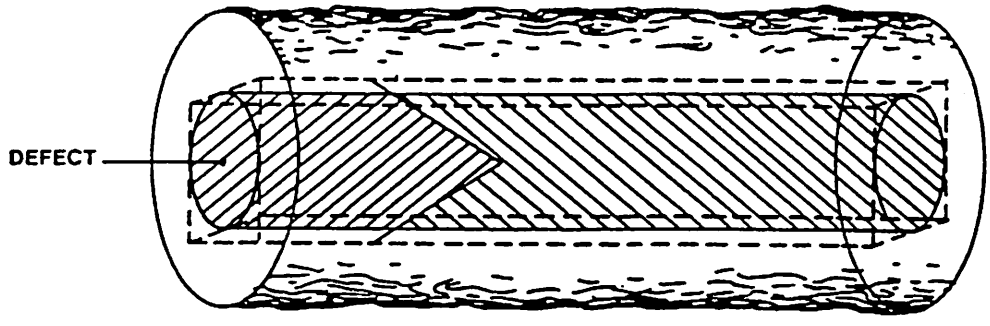


FIGURE 2.35 BEAMING OUT SAW DEFECT

The entire crosshatched area is "beamed out" as it is all lost during processing into lumber.

3. The person calculating SD should have a good knowledge of sawmill operating techniques. This will aid in determining total cull in sawlogs, a procedure which may be difficult when multiple defects and irregularly-shaped defects are present.

The generalized formula for calculating SD is:

$$SD = \frac{(D1)(D2) \times L}{K}$$

Where: SD = saw defect (m^3)

D1 = First diameter of the defect (cm) + 2 cm

D2 = Second diameter of the defect (cm) + 2 cm

-- D1 and D2 are the two largest diameters of the defect

-- 2 cm are added to the dimensions of the defect to account for losses due to processing

-- multiplying D1 and D2 results in the area of the defect (cm^2)

L = length of the section lost (m) (not necessarily the length of the defect)

K = conversion factor for converting square centimetres to square metres (10 000 cm^2 per m^2)

2.9.2.1 Saw Defect Deductions

When calculating saw defect, the largest rot diameter on the log is used (beamed out).

$$SD = \frac{(40 + 2)\ (40 + 2)\ X\ 2.5}{10\ 000} = 0.441\ m^3$$

1. Deduction for Solid Defect or Void

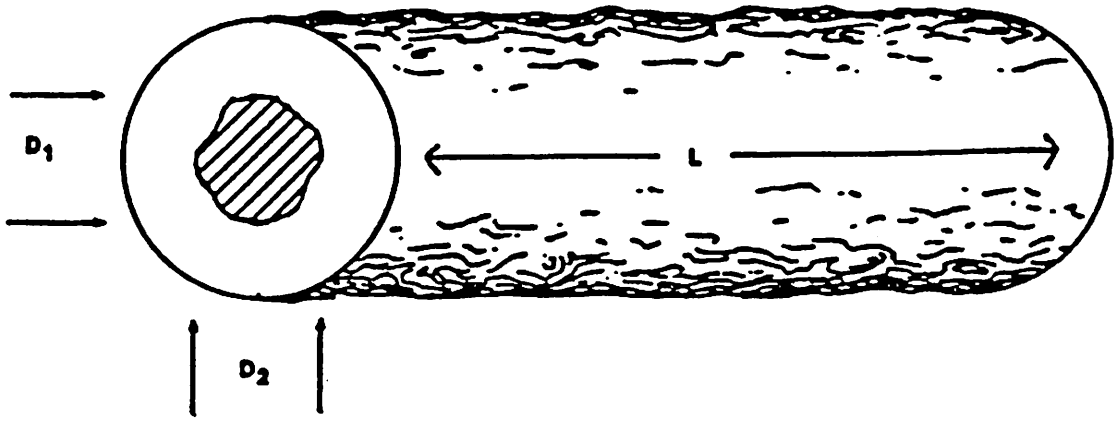


FIGURE 2.36 SAW DEFECT MEASUREMENTS

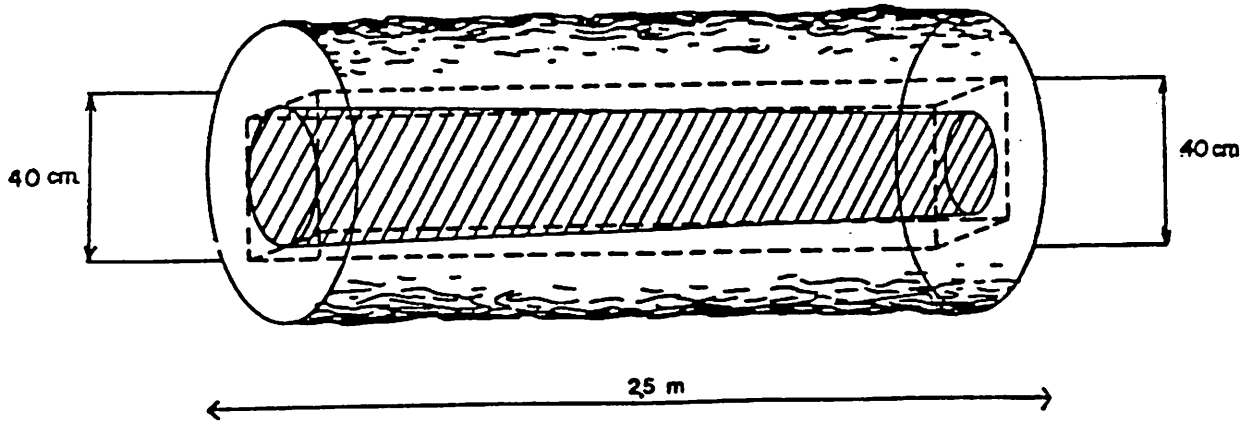


FIGURE 2.37 BEAMING OUT SOLID DEFECTS

2. Deductions in Sections 1, 2 and 3

If there is a defect in any one of the three sections it is beamed out from all three sections. This is done for sawlog defect only.

The largest diameters of the defect are used to determine the size of the beam, regardless of which section they occur in.

$$\text{Section 1: } SD = \frac{(5 + 2)\ (5 + 2) \times 0.3}{10\ 000} = 0.00147\ m^3$$

$$\text{Section 2: } SD = \frac{(5 + 2)\ (5 + 2) \times 1}{10\ 000} = 0.0049\ m^3$$

$$\text{Section 3: } SD = \frac{(5 + 2)\ (5 + 2) \times 1.5}{10\ 000} = 0.00735\ m^3$$

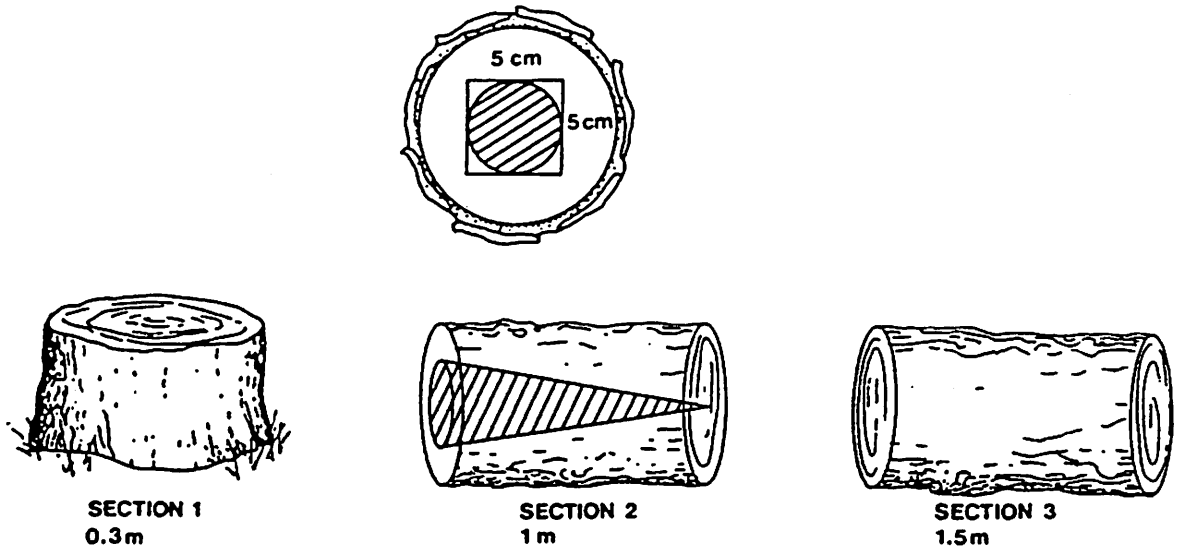


FIGURE 2.38 DEFECTS IN SECTIONS 1, 2 OR 3

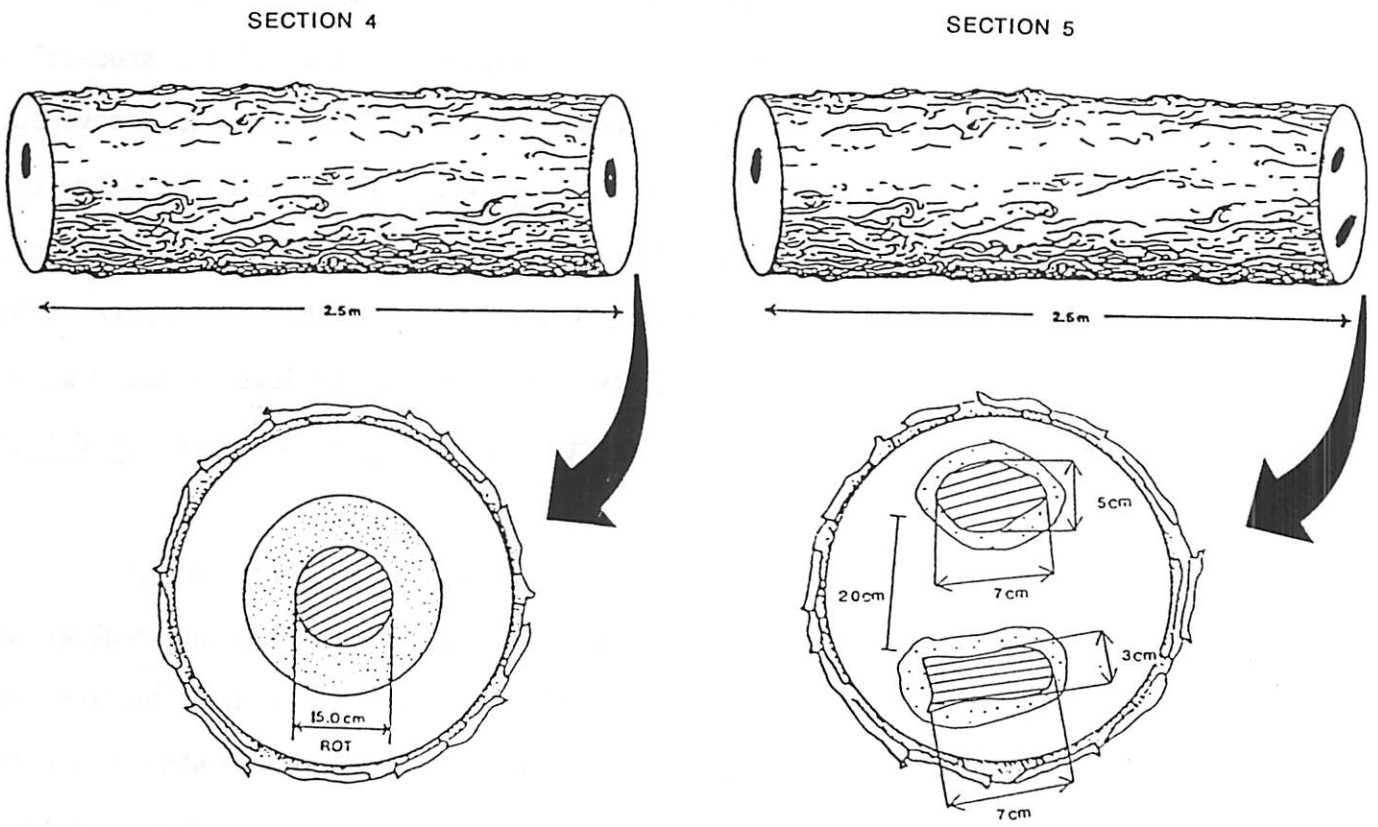
3. Deduction for Multiple Defects

Personal judgment and a knowledge of the processing technique must be used when calculating the volume of multiple defects. If the processing technique is such that solid wood between the defects could be recovered, then each defect must be treated separately. Their individual defect volume is then added to obtain the total defect volume for the section. Generally, if a log contains two separate defects and they are separated by 14 cm (before a 2 cm processing allowance is added) or less of sound wood, they shall be considered as one defect. This is done for saw log defect only.

Figure 2.39 shows how to calculate cull for multiple defects.

When multiple defects occur at one end of a section and regular or irregular shaped defects are found at the opposite end of that section saw defect volume calculations should be completed on measurements from both ends of that section to determine the largest volume. The larger volume should then be recorded for that section lengths saw defect. Figure 2.40.

FIGURE 2.40 MULTIPLE AND REGULAR DEFECT IN ONE SECTION



SECTION 4: $SD = \frac{(15 + 2)\ (15 + 2)\ X\ 2.5}{10,000} = 0.0722\ m^3$

SECTION 5: $SD_1 = \frac{(5 + 2)\ (7 + 2)\ X\ 2.5}{10,000} = 0.0157\ m^3$

$SD_2 = \frac{(3 + 2)\ (7 + 2)\ X\ 2.5}{10,000} = 0.0112\ m^3$

Total Saw Defect = $SD^1 + SD^2 = 0.0269\ m^3$

Since the volume of defect using the bottom measurement of section 5 is greater than the volume of defect using the top measurement of section 5, the defect recorded for section 5 is from the measurements at section 4.

$$SD_1 = \frac{(10 + 2)\ (4 + 2)\ X\ 2.5}{10\ 000} = 0.018\ m^3$$

SD_2 Since the two rot areas (2, 3) are less than 14 cm apart they are considered as one (Figure A.5)

$$\frac{(25 + 2)\ (7 + 2)\ X\ 2.5}{10\ 000} = 0.0608\ m^3$$

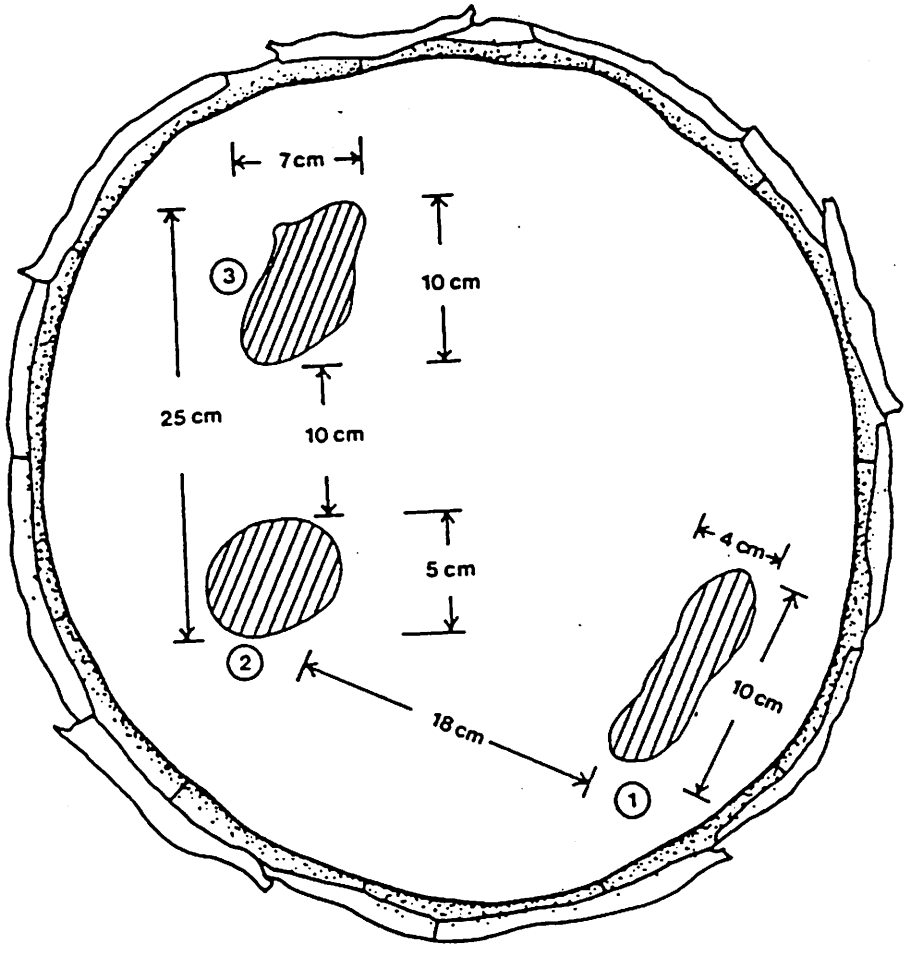


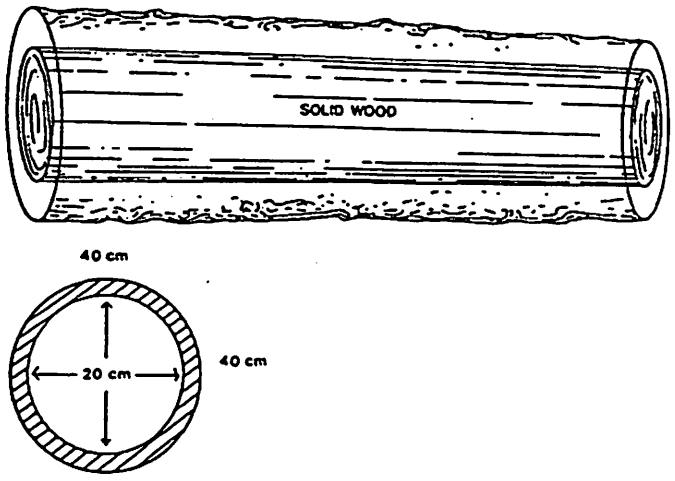
FIGURE 2.39 MULTIPLE DEFECTS

4. Deduction for Ring Defects

The wood which will be lost due to ring defects will be a hollow cylinder whose thickness is determined by the outermost and innermost diameters of the defect. The volume lost is the difference between the volumes enclosed by these diameters as in Example 1 (Figure 2.41).

Example 1

$$SD = \left(\frac{(40 + 2)\ (40 + 2)\ X\ 2.5}{10\ 000}\right) - \left(\frac{(20 - 2)\ (20 - 2)\ X\ 2.5}{10\ 000}\right) = .36\ m^3$$



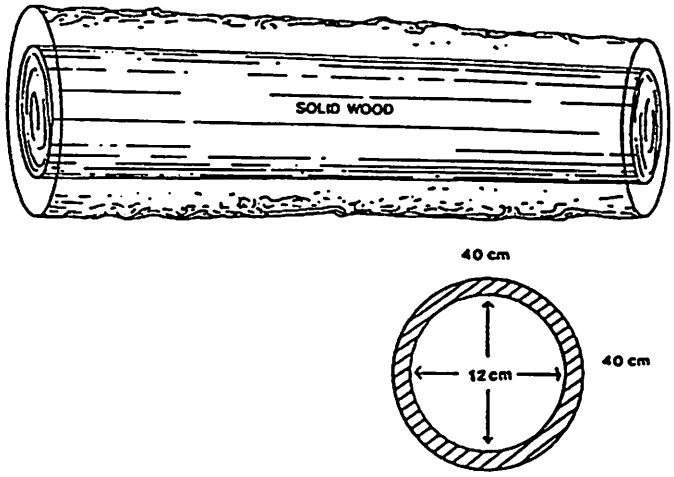
Example 1

FIGURE 2.41 RING DEFECTS

If the internal diameter of sound wood is less than 14 cm, the sound wood is considered lost and the defect is calculated as in Example 2.

Example 2

$$SD = \left(\frac{((40 + 2)\ (40 + 2)\ X\ 2.5)}{10\ 000}\right) = .441$$



Example 2

FIGURE 2.41 RING DEFECTS

For the purposes of these examples it is assumed that 40 cm is the largest ring rot diameter.

5. Sawlog Defect - Forked Trees

If cull is present at one or more forks of a tree, each fork must be treated as a separate log. Saw log length may be shorter than 2.5 m in forked trees only. (Figure 2.42). (Figure 2.43 - Sample tally sheet of forked tree and Figure 2.44 - Example of forked tree cull diagram).

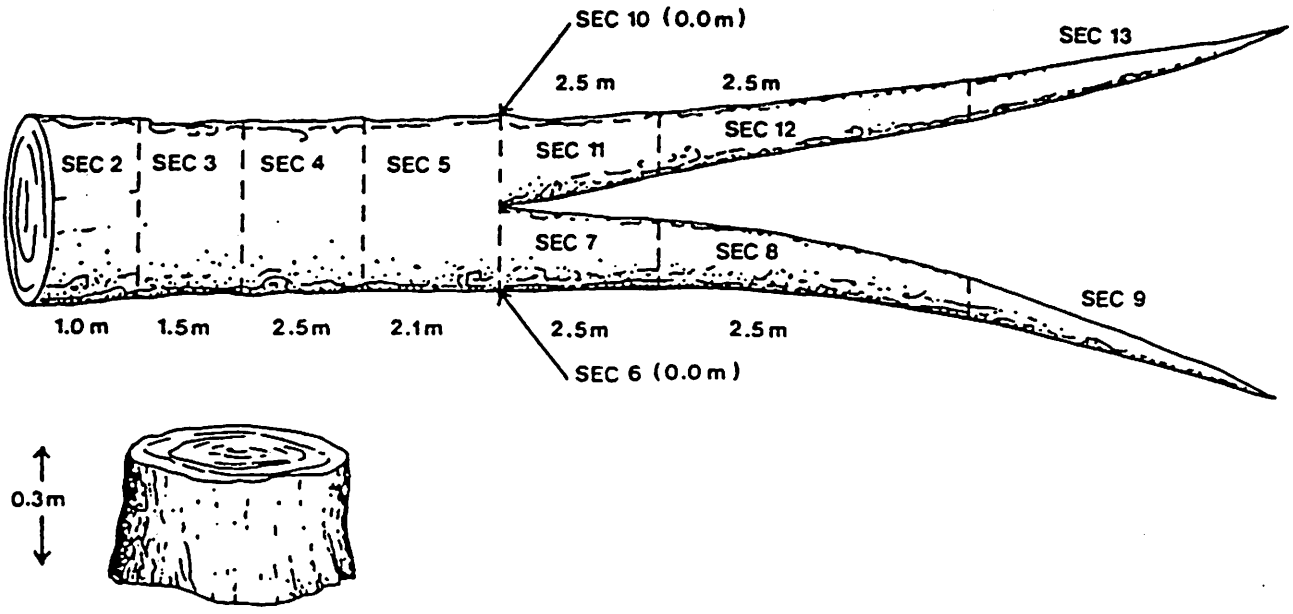


FIGURE 2.42 FORKED TREE DEFECTS

Alberta

FORESTRY, LANDS AND WILDLIFE
Forest Service

TREE SECTIONING TALLY SHEET

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)	. (20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (X) (27)	# SEC (28)	D.B.H (OB) (30)	TOP (34)	D.I. (35)
6	0,4	0,6,2	0,3,4,1		0,0,0,0,0,2	0,2	H	G,0,7	P,L		1,3	0,2,1.6	2	N

TREE CATEGORY (36) 1	2	3	4	5	C.C. (46)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)
1,3					C	0,1,4.9,0	0,1,0.1,0	X	C,2,A,W (P,L) H,9,2,M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (75)	COND (77)	AREA (78)	PHOTO HEIGHT (81)
					.

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3	-	ADVANCED ROT

(28) - # SECTIONS TOTAL
(34) - AT TOP OF SEC #
(35) - DECAY IND.
(46) - CROWN CLASS
(57) - INT. DEFECT (X)

VSR: 1

Page 1 of 1

Crew: A. Winter

Date: March 7/88

INCREMENT WIDTH

SEC NO.	0 - 10 YEARS	11 - 20 YEARS
0 1	1,0	1,2
0 2	0,9	0,6

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION: INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (36)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS: PULP (47)	SAW (49)	INTERNAL DEFECT: DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S	0 1	0,0.3,0	2,3.3	2,3.6	2,3.4	2,3.7	1,0,1			.	.	.
S	0 2	0,1.0,0	2,1.3	2,1.6	2,1.4	2,1.6	8,7			.	.	.
S	0 3	0,1.5,0	1,8.4	1,8.6	1,8.3	1,8.7	5,6			.	.	.
S	0 4	0,2.5,0	1,6.3	1,6.5	1,6.4	1,6.6	2,9			.	.	.
S	0 5	0,2.1,0	9,9,9.9	9,9,9.9	9,9,9.9	9,9,9.9				.	.	.
S	0 6	0,0.0,0	1,4.6	1,4.8	1,4.7	1,4.9	2,7			.	.	.
S	0 7	0,2.5,0	1,1.4	1,1.6	1,1.5	1,1.7	1,5			.	.	.
S	0 8	0,2.5,0	9.5	9.7	9.4	9.6	6			.	.	.
S	0 9	0,2.5,0	0,0,0.0	0,0,0.0	0,0,0.0	0,0,0.0				.	.	.
S	1 0	0,0.0,0	1,2.6	1,2.8	1,2.5	1,2.8	2,9			.	.	.
S	1 1	0,2.5,0	1,0.0	1,0.2	9.9	1,0.1	1,5			.	.	.
S	1 2	0,2.5,0	7.9	8.3	8.0	8.2	6			.	.	.
S	1 3	0,0.3,0	0,0,0.0	0,0,0.0	0,0,0.0	0,0,0.0				.	.	.
S	1 4	.	.	.	.	.				.	.	.
S	1 5	.	.	.	.	.				.	.	.
S	1 6	.	.	.	.	.				.	.	.
S	1 7	.	.	.	.	.				.	.	.
S	1 8	.	.	.	.	.				.	.	.
S	1 9	.	.	.	.	.				.	.	.
S ▼	2 0	.	.	.	.	.				.	.	.

FIGURE 2.43 EXAMPLE OF FORKED TREE TALLY SHEET

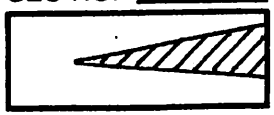
TREE CATEGORY CODES
(by priority):

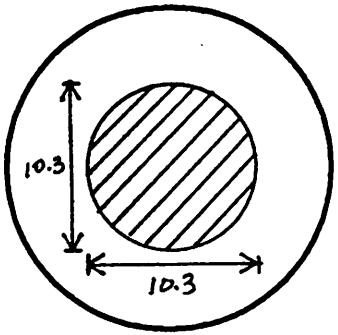
26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

All defects must be measured and sketched. All stain and rot must be chased. CSTM 04 (Rev. 12/87)

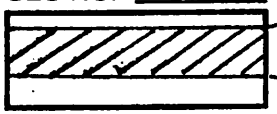
STUMP

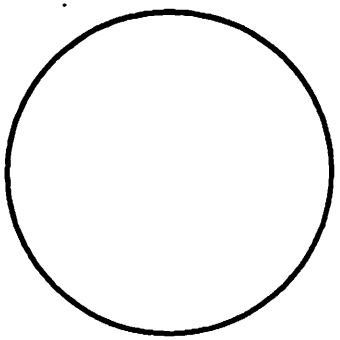
SEC NO. 4





SEC NO. 5





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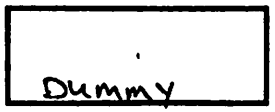

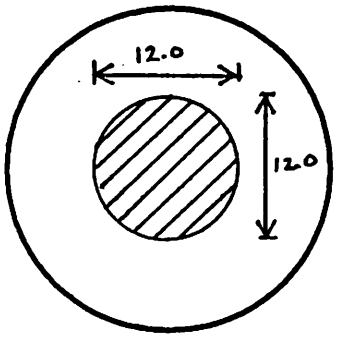

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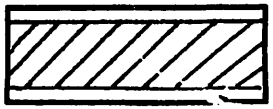

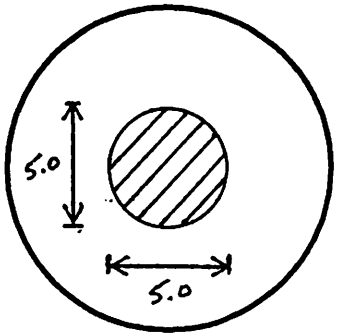

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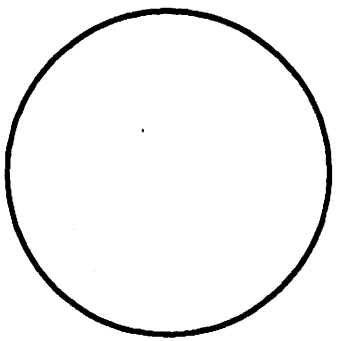

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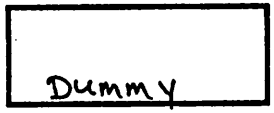
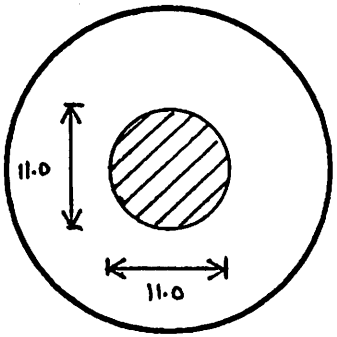
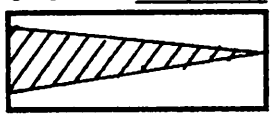
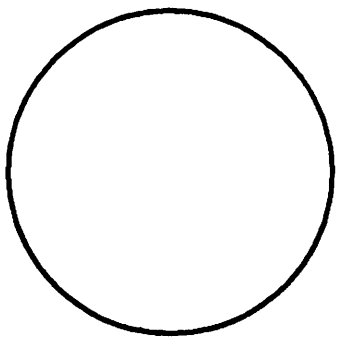




SEC NO. 11





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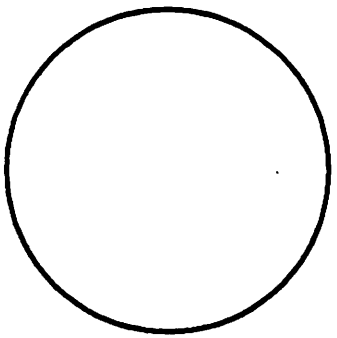

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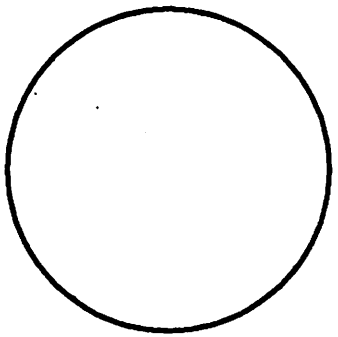

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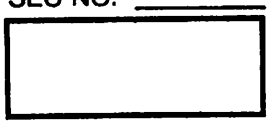

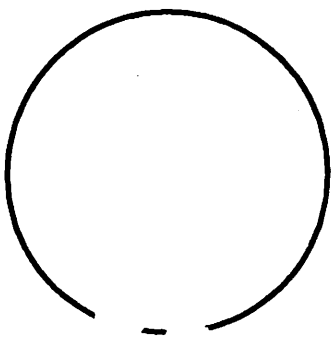

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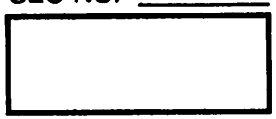
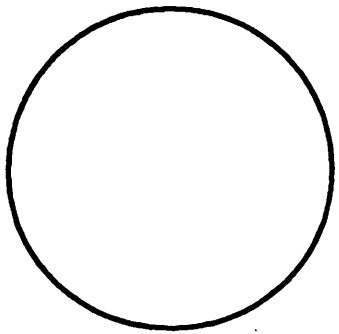




STAIN

ROT (SOFTWOOD)

INCIP. (HARDWOOD)

ADV. (HARDWOOD)

Comments Tree forked at 7.4 m.

2.44 EXAMPLE OF FORKED TREE CULL DIAGRAMS

Section 4 $SD = \frac{(10.3 + 2)(10.3 + 2) \times 2.5}{10\ 000} = 0.0378\ m^3$

Section 5 Cull volumes for the section immediately before the fork (in this example, section 5), are calculated using rot measurements from either the top of the section immediately before the fork (in this example section 4) or the combined measurements of the bottoms of the first sections of the forks (section 6 and 10 in this example), whichever is larger. If the measurements at the bottom of the forks are used, the sound wood between the two rot areas must be added on, as this will be lost in processing (see Figure 2.45).

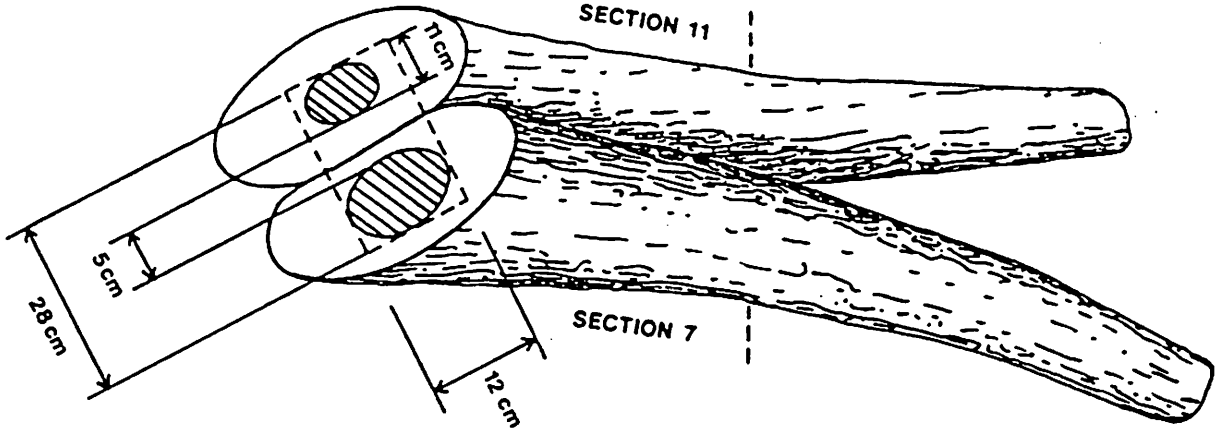


FIGURE 2.45 BOTTOM OF FORKS

Since the bottoms of the forks have greater rot diameters than the section preceeding the fork, the sum of the fork rot measurements are used.

Section 5 $SD = \frac{(12.0 + 2)\ (11.0 + 12.0 + 5.0\ (\text{sound wood lost}) + 2) \times 2.1}{10\ 000}$

$= 0.0882\ m^3$

Section 6 No cull volume is calculated in this example as the "dummy section" has no length.

Section 7 $SD = \frac{(12 + 2)\ (12 + 2)\ X\ 2.5}{10\ 000} = 0.049\ m^3$

Section 8 $SD = \frac{(5 + 2)\ (5 + 2)\ X\ 2.5}{10\ 000} = 0.012\ m^3$

Section 9 No cull volume calculated as the "dummy section" has no length.

Section 10 $SD = \frac{(11 + 2)\ (11 + 2)\ X\ 2.5}{10\ 000} = 0.0422\ m^3$

Section 11 No defect calculated as the rot is less than 2.0 cm in diameter.

2.9.2 Pulp Defect

Pulp defect (PD) is a loss of pulp recovery due to voids or soft rot in the wood. It is calculated as the actual volume of the defect. PD may be determined for any section length and is under decay level 1, columns 51 - 56.

The generalized formula for calculating PD is:

$$PD = \frac{L\ (K(DL^2 + DU^2))}{2}$$

Where: PD = pulp defect (m^3)
L = length of the defect (m) (may not be equal to the length of the section)
K = constant which converts a diameter measurements (cm) to basal area (m^2)

$$K = \frac{Pi}{4(10\ 000)} = 0.00007854$$

DL = diameter at lower end (cm)
DU = diameter at upper end (cm)
Pi = 3.1415926

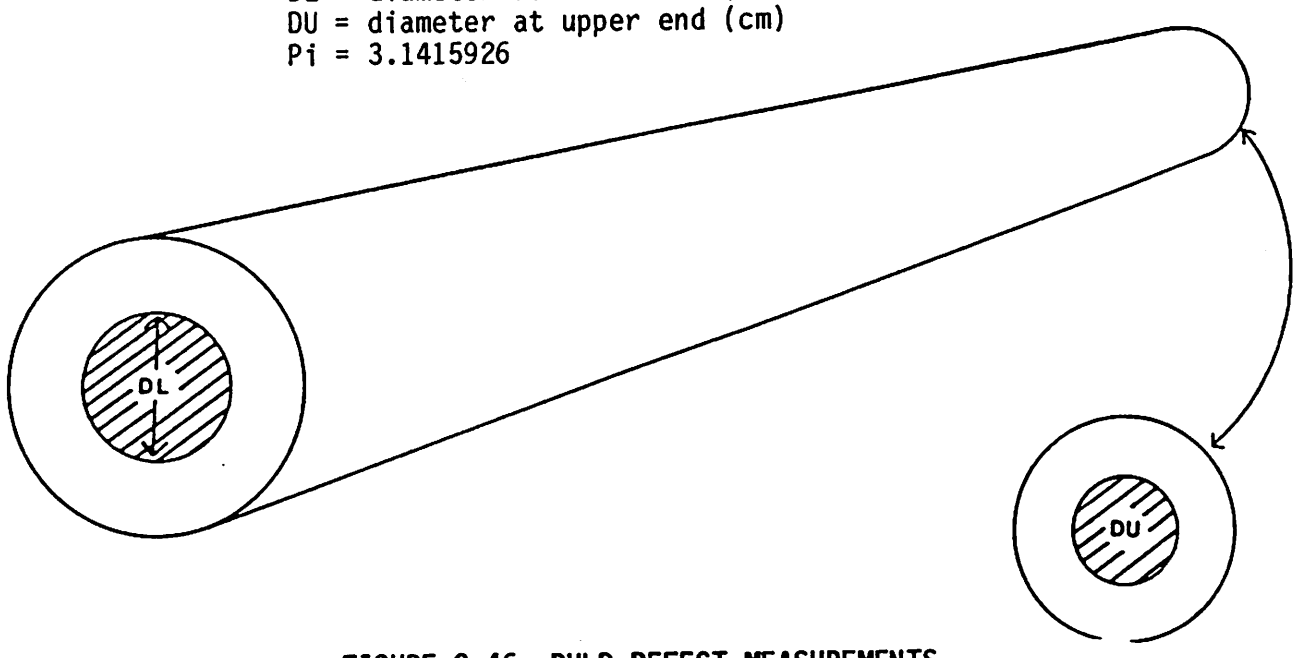


FIGURE 2.46 PULP DEFECT MEASUREMENTS

2.9.2.2 Pulp Defect Deductions

Should it occur that defect was only measured at one end of the section, and the length of the defect is unknown, the full length of the section is used for the unknown length of rot and 0.0 cm is used for the missing rot diameter (Du or DL).

1. Deduction for Solid Defect or Void (Figure 2.47)

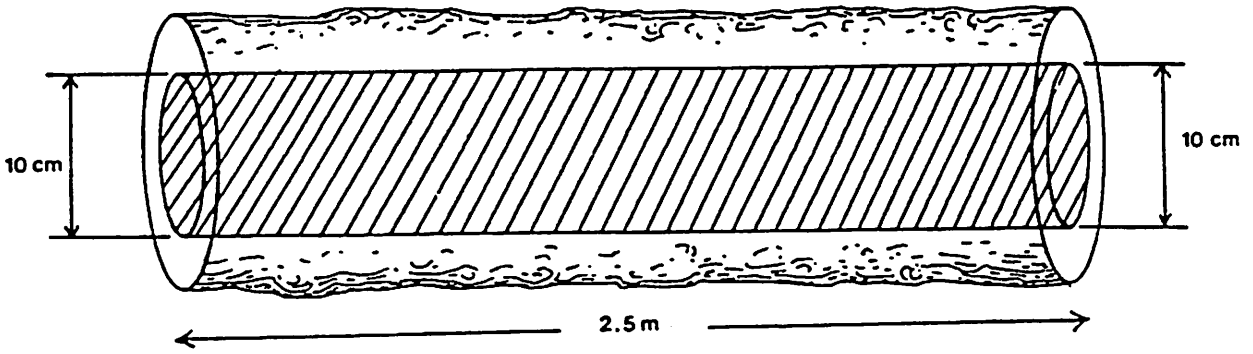


FIGURE 2.47 SOLID DEFECTS

$$PD = \frac{2.5\ (0.00007854\ (10^2 + 10^2))}{2} = 0.0196\ m^3$$

2. Deduction for Tapered Defects (Figure 2.48)

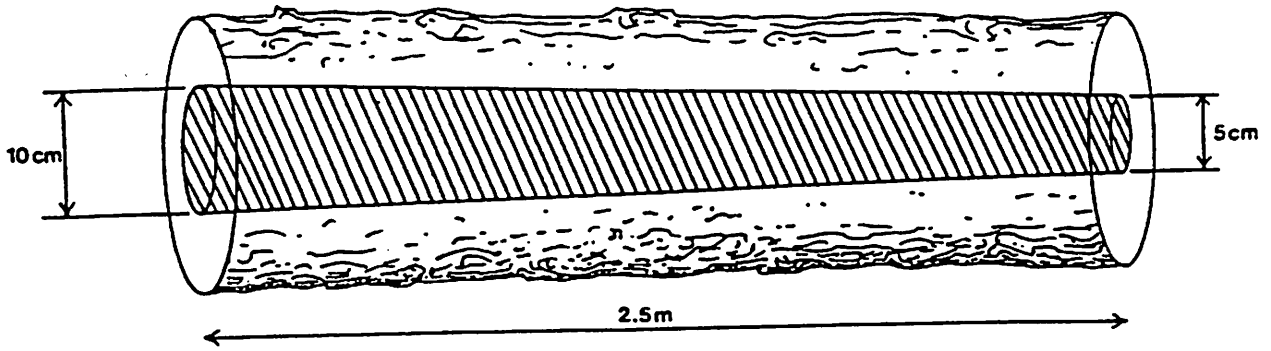


FIGURE 2.48 TAPERED DEFECTS

$$PD = \frac{2.5\ (0.00007854\ (10^2 + 5^2))}{2} = 0.0123\ m^3$$

3. Deduction for Defects Which are Shorter Than the Section (Figure 2.49)

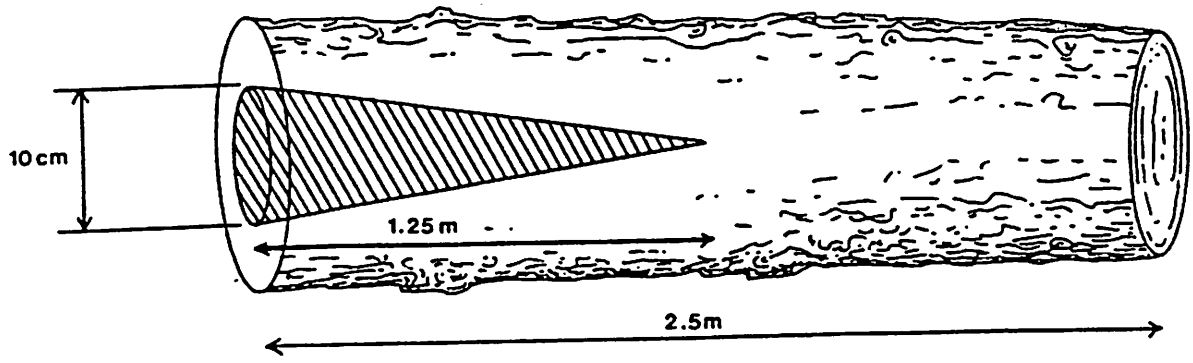


FIGURE 2.49 SHORT DEFECTS

$$PD = \frac{1.25\ [0.00007854\ (10^2 + 0^2)]}{2} = 0.0049\ m^3$$

4. Deduction for Irregular Defect (Figure 2.50)

For each end of the section, an average diameter of the defect is determined.

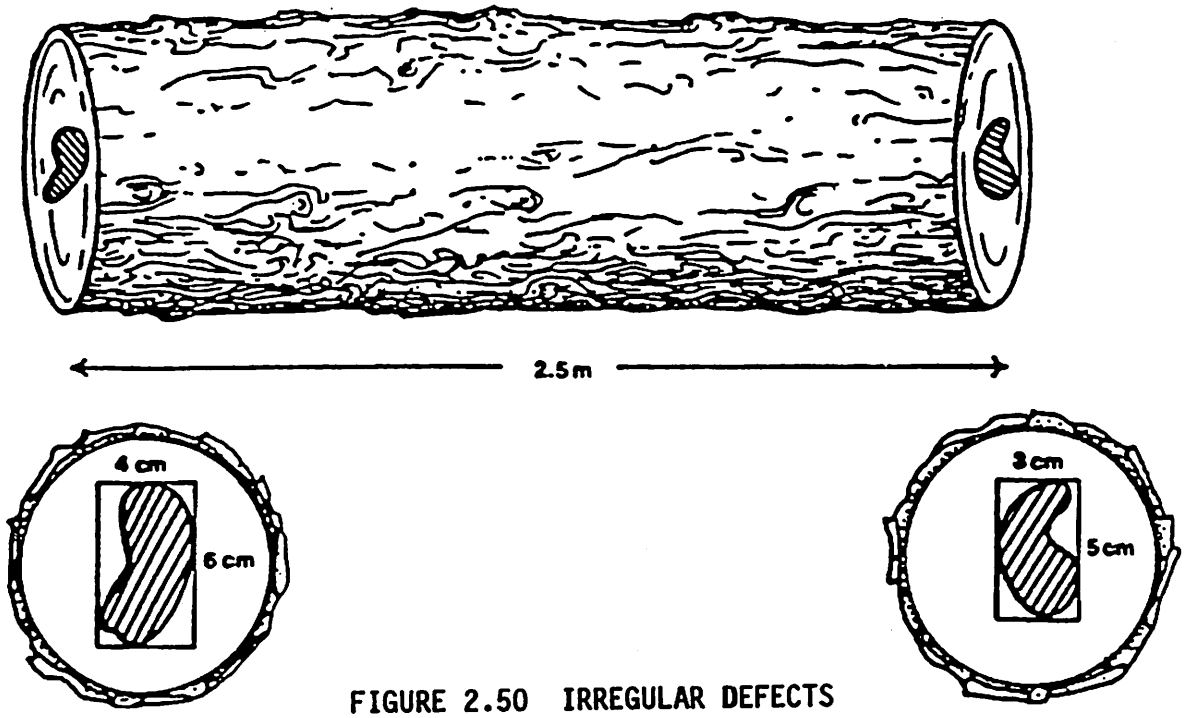


FIGURE 2.50 IRREGULAR DEFECTS

$$DL = \frac{6 + 4}{2} = 5 \qquad DU = \frac{3 + 5}{2} = 4$$

5. Deduction for Crescent-Shaped Defect

For determining the amount of cull in crescent-shaped defects, (Figure 2.51) several steps must be followed:

1. The diameter of an imaginary cull cylinder is determined. Using this diameter, a cull volume is calculated (average diameter of rot at both ends).
2. The diameter of inside the sound wood is determined and, using this diameter, the volume of inside sound wood is calculated (average diameter at both ends).
3. The sound wood volume is subtracted from the culled wood volume.
4. The volume of cull is then multiplied by whatever percentage of a circle the rot occupies.

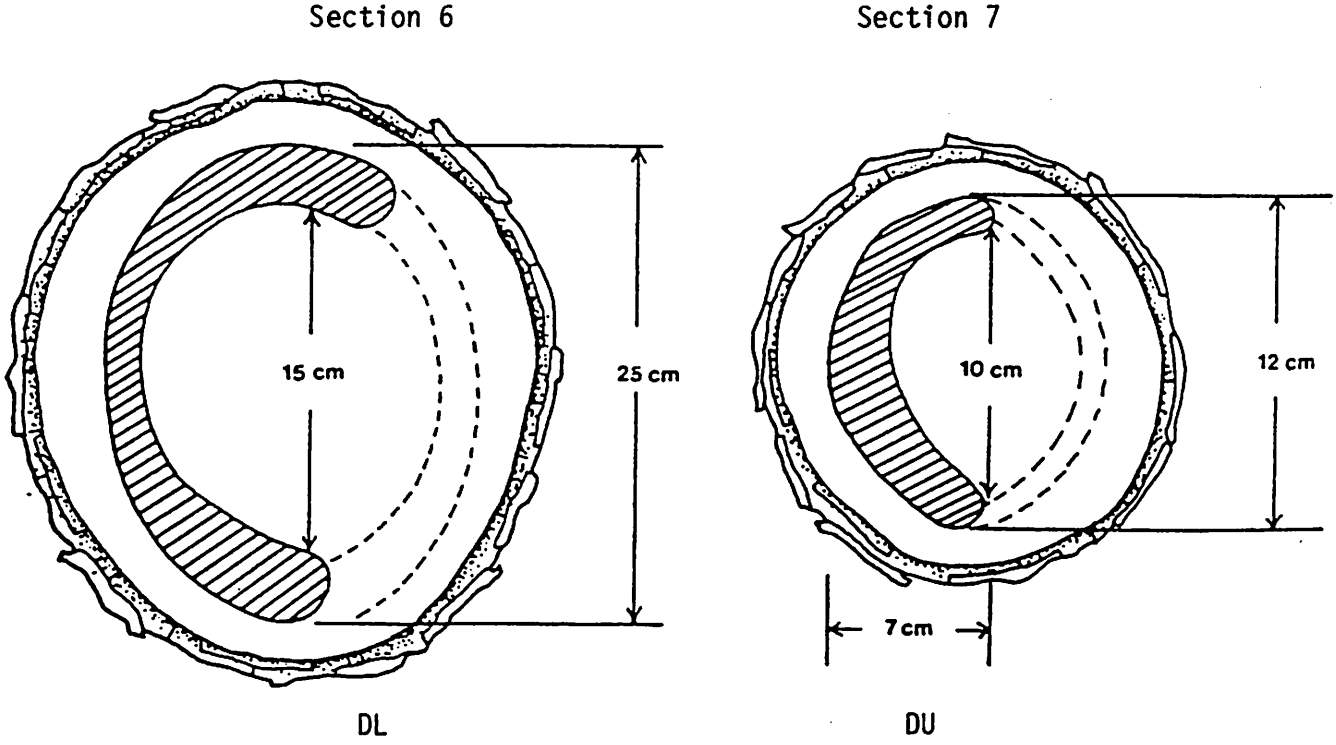


FIGURE 2.51 CRESCENT-SHAPED DEFECT

The end diameter of the imaginary cull cylinder equal 25 cm and 12 cm. (In this example it is assumed that the rot is 2.5 m in length.)

$$\text{Imaginary Cylinder (cull wood)} = \frac{2.5(0.00007854\ (25^2 + 12^2))}{2}$$

$$= 0.0754\ m^3$$

Inside Sound Wood Diameter equals 15 cm and 10 cm

Sound Wood Cylinder

$$= \frac{2.5(0.00007854\ (15^2 + 10^2))}{2}$$

$$= 0.0319\ m^3$$

Cull cylinder volume - Sound Wood cylinder Volume = Cull Wood Volume

$0.07545\ m^3$ $- 0.03189\ m^3$ $= 0.0436\ m^3$

Since the defect is approximately 50% of the circumference of a circle, the cull volume is multiplied by .50.

$$\text{Cull Volume} = 0.50 \times 0.04356\ m^3$$

$$= 0.02178\ m^3$$

6. Multiple Defects at One End Only

Should it occur that a log has only one defect at one end and multiple defects at the opposite end, the areas of the multiple defects are added and used in the formula (Figure 2.52).

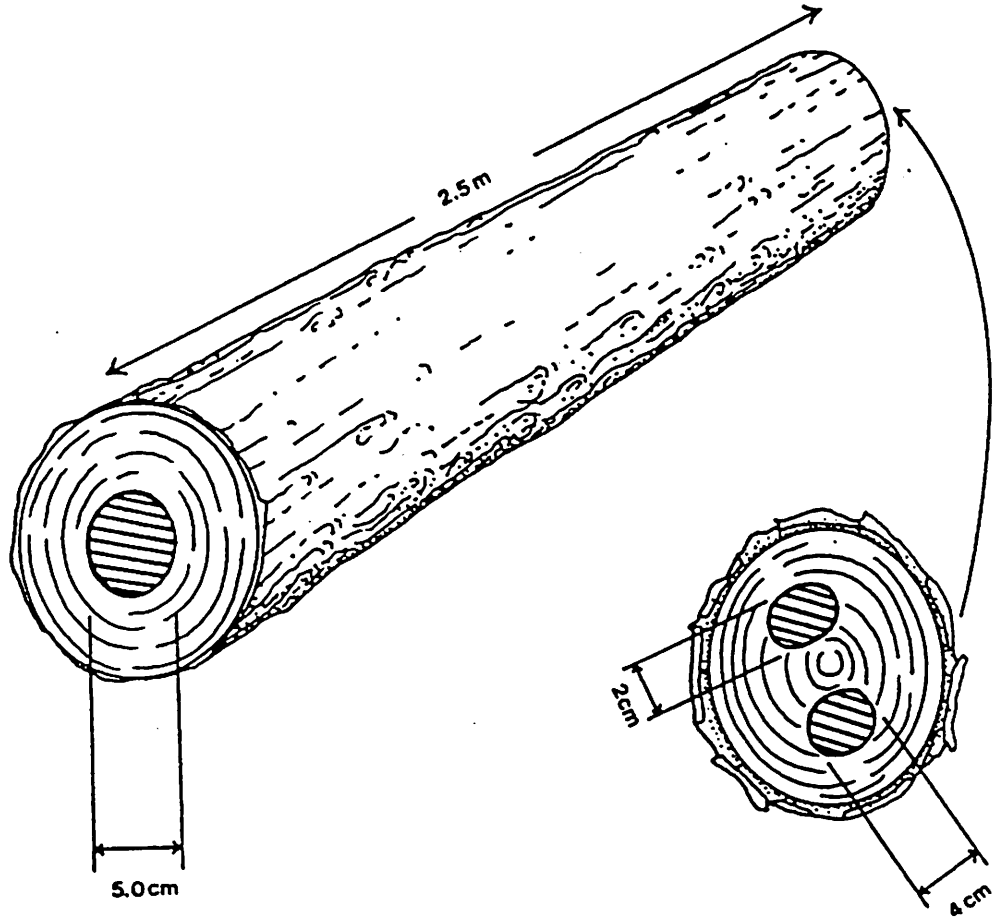


FIGURE 2.52 MULTIPLE DEFECTS AT ONE END ONLY

$DL = 5$ cm $\qquad\qquad$ $Du = 2 + 4 = 6$ cm

$$PD = \frac{2.5\ (0.00007854\ (5^2 + 6^2)}{2} = 0.0060\ m^3$$

7. Deduction for Stump Defect

Although only one measurement is recorded for stump defect (when present), it is assumed that the defect extends throughout the entire stump. Therefore, the defect for this section only, is calculated as a "cylinder". This is illustrated in Figure 2.52.

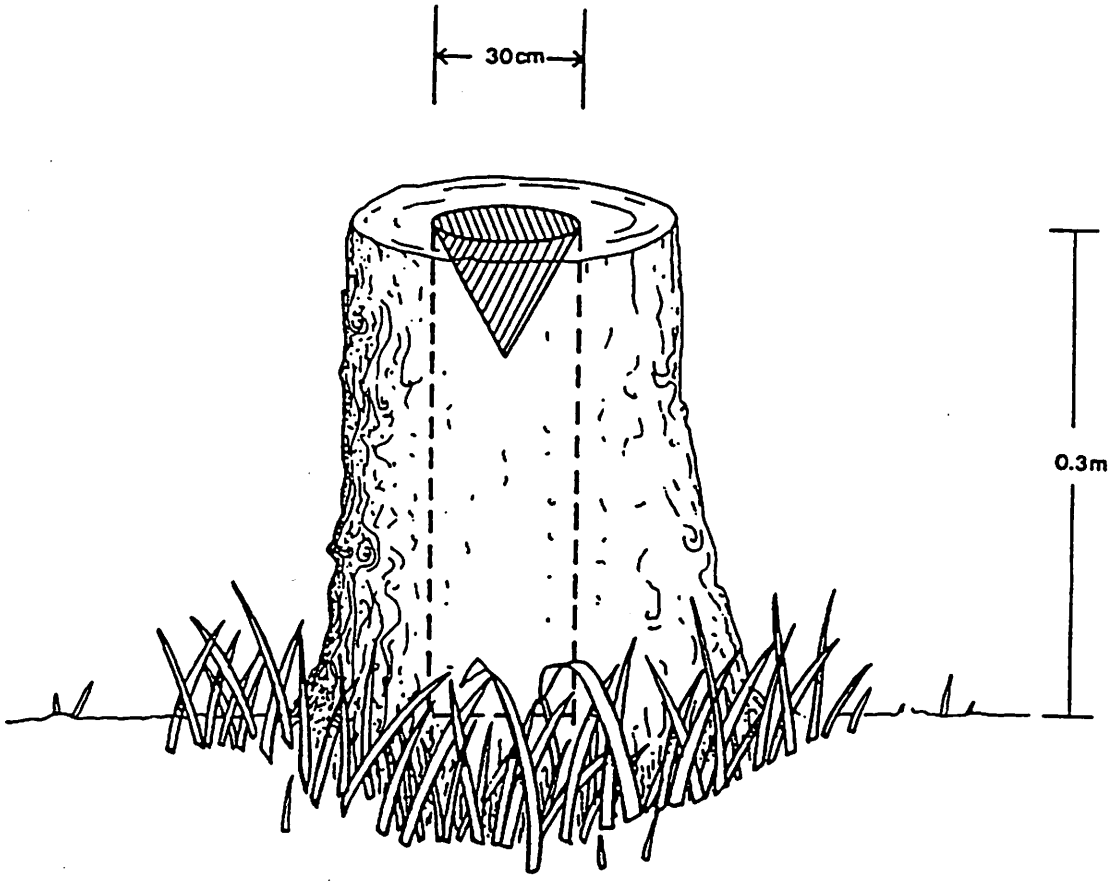


FIGURE 2.53 STUMP DEFECT

$$PD = \frac{0.3\ [0.00007854\ (30^2 + 30^2)]}{2} = 0.021\ m^3$$

Figures 2.53, 254 and 255 illustrates examples of a tally sheets with defect diagrams and calculations.

Alberta

1104 (Rev. 12/87)

TREE SECTIONING TALLY SHEET

FORESTRY, LANDS AND WILDLIFE
Forest Service

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)	(20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (27) (X)	# SEC. (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
5	09	065	0432		0000119	02	H	S06	SW		09	034	2	N

TREE CATEGORY (36) 1	2	3	4	5	C.C. (48)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)
00					C	017.80	014.90	X	C2SW ( )L92M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (76)	COND (77)	AREA (78)	PHOTO HEIGHT (81)
					.

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3		ADVANCED ROT

(28) – # SECTIONS TOTAL
(34) – AT TOP OF SEC #
(35) – DECAY IND.
(46) – CROWN CLASS
(57) – INT. DEFECT (X)

VSR

Page 1 of 1

Crew: B Woods

Date: March 8, 1988

INCREMENT WIDTH

SEC NO.	0 – 10 YEARS	11 – 20 YEARS
01	09	11
02	08	11

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (38)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS PULP (47)	SAW (49)	INTERNAL DEFECT DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S 1	01	00.30	13.91	13.95	13.93	13.98	7.0			00.02.12	00.03.07	.
S	02	01.00.0	13.42	13.47	13.45	13.50	6.5			00.05.99	00.10.24	.
S	03	01.50.0	12.93	12.98	12.96	13.01	5.4			00.04.01	00.15.36	.
S	04	02.50.0	12.44	12.49	12.47	12.52	4.3			00.00.14	00.02.10	.
S	05	02.50.0	12.25	12.30	12.28	12.32	3.2			.	.	.
S	06	02.50.0	11.96	12.01	11.99	12.04	2.1			.	.	.
S	07	02.50.0	11.47	11.52	11.47	11.52	1.5			.	.	.
S	08	02.50.0	11.08	11.33	11.07	11.33	1.0			.	.	.
S	09	02.50.0	00.00.0	00.00.0	00.00.0	00.00.0				.	.	.
S	10	.	.	.	.	.				.	.	.
S	11	.	.	.	.	.				.	.	.
S	12	.	.	.	.	.				.	.	.
S	13	.	.	.	.	.				.	.	.
S	14	.	.	.	.	.				.	.	.
S	15	.	.	.	.	.				.	.	.
S	16	.	.	.	.	.				.	.	.
S	17	.	.	.	.	.				.	.	.
S	18	.	FIGURE 2.54A SAMPLE TALLY SHEET FRONT AND DEFECT CALCULATIONS FOR SOFTWOODS									
S	19	.	.	.	.	.				.	.	.
S ▼	20	.	.	.	.	.				.	.	.

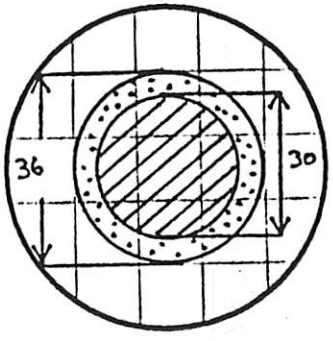
TREE CATEGORY CODES
(by priority):

26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

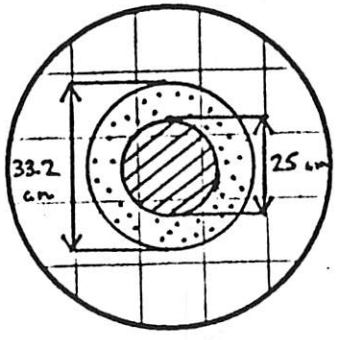
All defects must be measured and sketched.

All stain and rot must be chased.

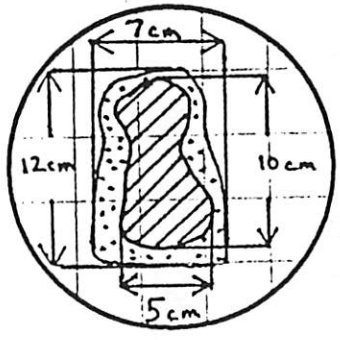
STUMP



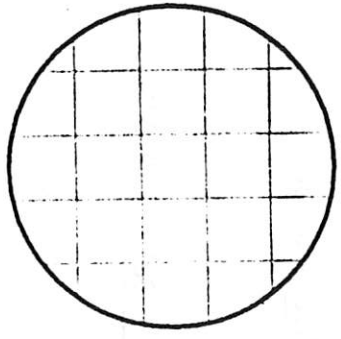
SEC NO. 2



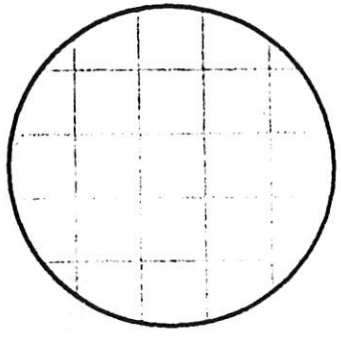
SEC NO. 3



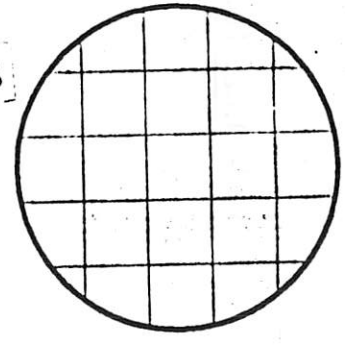
SEC NO. 4



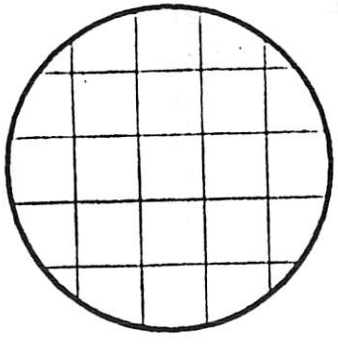
SEC NO. _____



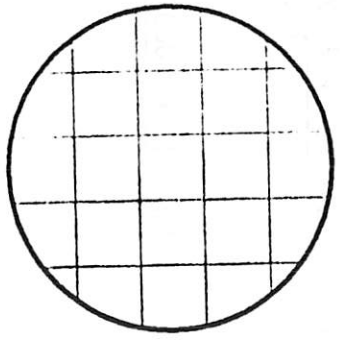
SEC NO. _____



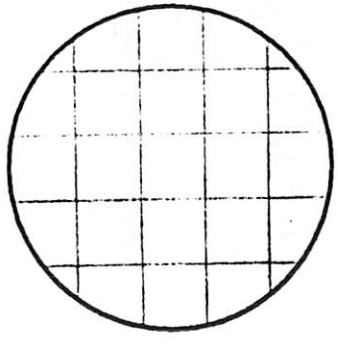
SEC NO. _____



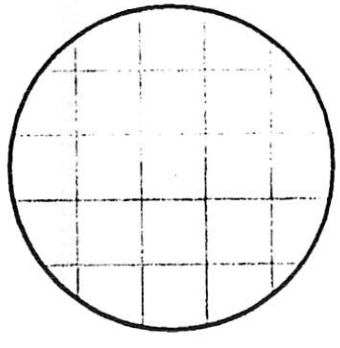
SEC NO. _____



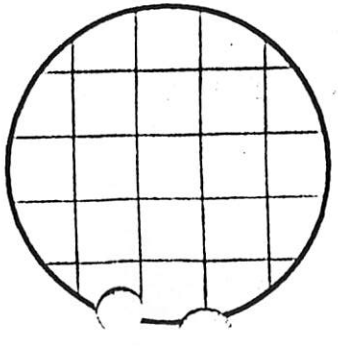
SEC NO. _____



SEC NO. _____



SEC NO. _____



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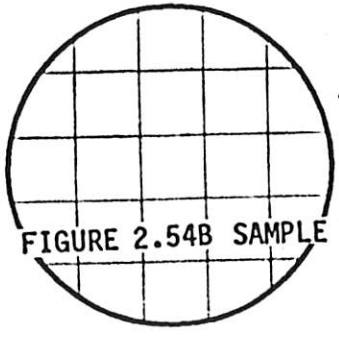
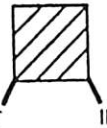


STAIN



ROT (SOFTWOOD)

INCIP. (HARDWOOD)

ADV. (HARDWOOD)

Comments ROT EXTENDS .625 m INTO SECTION 4.

STAIN EXTENDS 1.25m INTO SECTION 4

FIGURE 2.54B SAMPLE TALLY SHEET BACK AND DEFECT CALCULATIONS FOR SOFTWOODS

Defect Calculations for Figure 2.54

Section 1: $SD = \frac{(30 + 2)\ (30 + 2)\ X\ 0.3}{10{,}000} = 0.0307$

$$PD = \frac{0.3\ [0.00007854\ (30^2 + 30^2)]}{2} = 0.0212$$

Section 2: $SD = \frac{(30 + 2)\ 30 + 2)\ X\ 1}{10{,}000} = 0.1024$

$$PD = \frac{1\ [0.00007854\ (30^2 + 25^2)]}{2} = 0.0599$$

Section 3: $SD = \frac{(30 + 2)\ (30 + 2)\ X\ 1.5}{10{,}000} = 0.1536$

$$PD = \frac{1.5\ [0.00007854\ (25^2 + 7.5^2)]}{2} = 0.0401$$

Section 4: $SD = \frac{(5 + 2)\ (10 + 2)\ X\ 2.5}{10{,}000} = 0.0210$

$$PD = \frac{0.625\ [0.00007854\ (7.5^2 + 0^2)]}{2} = 0.0014$$

Alberta

TREE SECTIONING TALLY SHEET

FORESTRY, LANDS AND WILDLIFE
Forest Service

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)	(20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (27) (X)	# SEC. (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
6	0,4	0,9,1	0,3,0,2		0,0,0,0,0,3	0,1	H	P,0,2,	A,W		0,9	0,4,1.6	2	N

TREE CATEGORY (36) 1	2	3	4	5	C.C. (46)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)
0,0					C	0,1,7.8,0	0,1,4.9,0	X	C,2,A,W, ( ) H,9,1,M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (76)	COND (77)	AREA (78)	PHOTO HEIGHT (81)

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3		ADVANCED ROT

(28) – # SECTIONS TOTAL
(34) – AT TOP OF SEC #
(35) – DECAY IND.
(46) – CROWN CLASS
(57) – INT. DEFECT (X)

VSR: 1

Page 1 of 1

Crew: M.J.

Date: March 15/88

INCREMENT WIDTH

SEC NO.	0 – 10 YEARS	11 – 20 YEARS
0 1	0,9,9	
0 2	0,8	

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION: INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (36)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS: PULP (47)	SAW (49)	INTERNAL DEFECT: DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S 1	0 1	0,0,3,0	4,6.1	4,6.4	4,6.3	4,6.7	7,2			0,0,0,7,2	0,0,0,9,3	0,0,2,1,2
S	0 2	0,1,0,0	4,1.2	4,1.5	4,1.4	4,1.8	6,7			0,0,2,2,0	0,0,3,4,5	0,0,6,0,0
S	0 3	0,1,5,0	3,8.3	3,8.6	3,8.5	3,8.8	6,0			0,0,0,3,3	0,0,3,4,0	0,0,4,0,1
S	0 4	0,2,5,0	3,2.9	3,3.1	3,2.5	3,2.7	5,3				0,0,0,2,4	0,0,0,1,4
S	0 5	0,2,5,0	2,8.1	2,8.3	2,8.2	2,8.5	4,6			0,0,0,1,8	0,0,0,5,8	
S	0 6	0,2,5,0	2,4.2	2,4.5	2,4.3	2,4.6	3,9			0,0,0,6,0	0,0,2,1,7	
S	0 7	0,2,5,0	2,0.3	2,0.5	2,0.4	2,0.7	3,0			0,0,0,1,8	0,0,0,4,9	
S	0 8	0,2,5,0	1,6.4	1,6.6	1,6.5	1,6.7	2,0					
S	0 9	0,2,5,0	0,0,0.0	0,0,0.0	0,0,0.0	0,0,0.0						
S	1 0											
S	1 1											
S	1 2											
S	1 3											
S	1 4											
S	1 5											
S	1 6											
S	1 7											
S	1 8											
S	1 9											
S ▼	2 0											

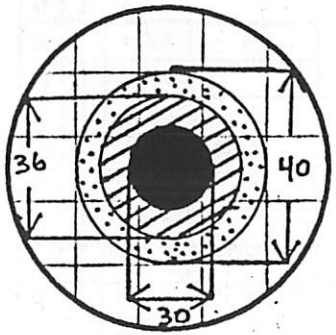
FIGURE 2.55A SAMPLE TALLY SHEET FRONT AND DEFECT CALCULATIONS FOR HARDWOODS

TREE CATEGORY CODES
(by priority):

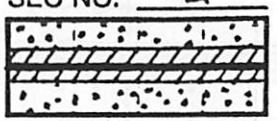
26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

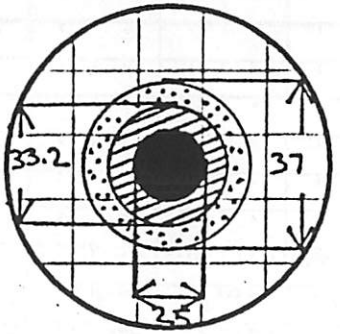
All defects must be measured and sketched. All stain and rot must be chased. CSTM 04 (Rev. 12/87)

STUMP

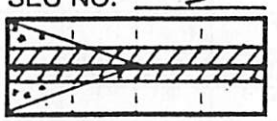


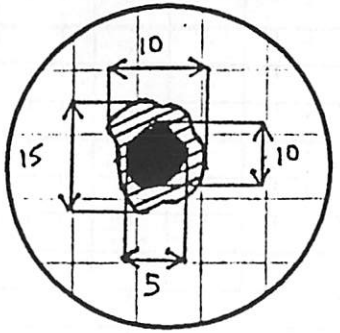
SEC NO. 2





SEC NO. 3





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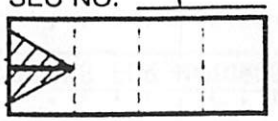

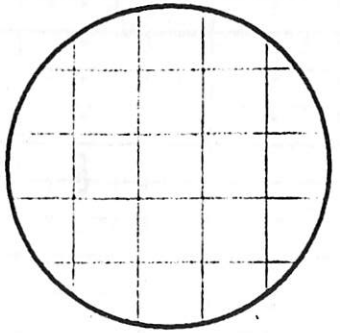

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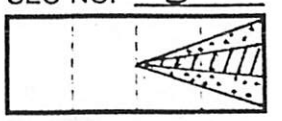

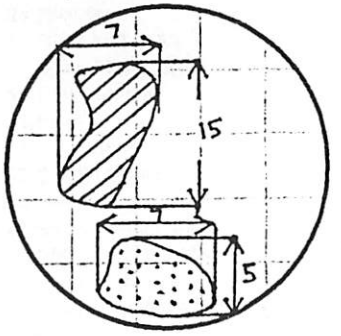

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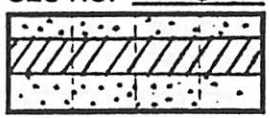

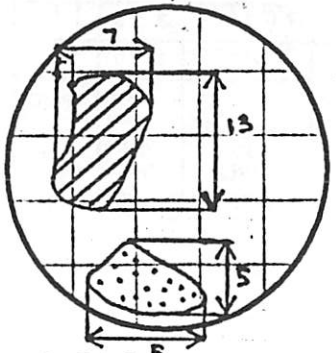

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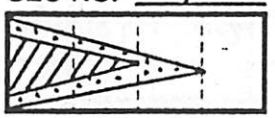

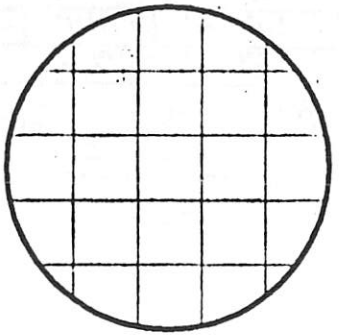

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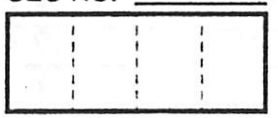

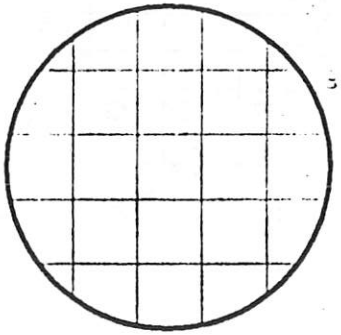

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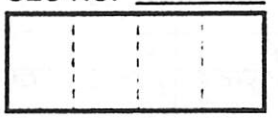

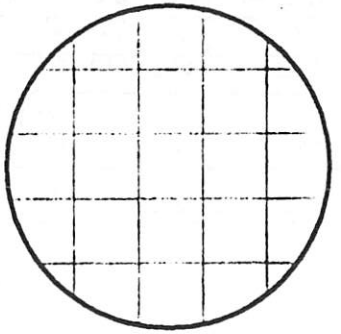

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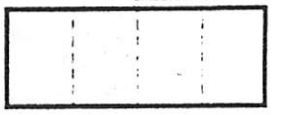

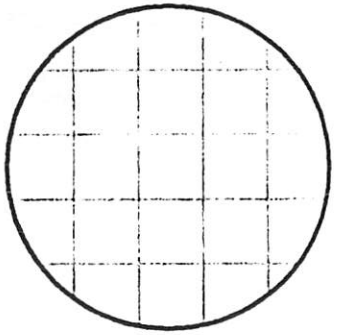

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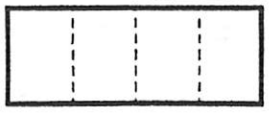

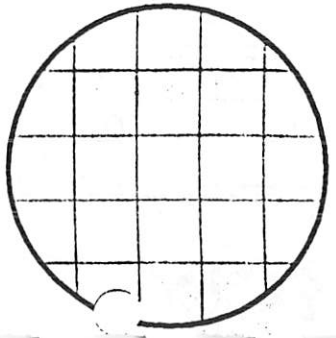

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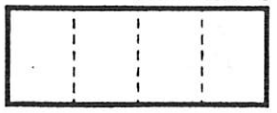
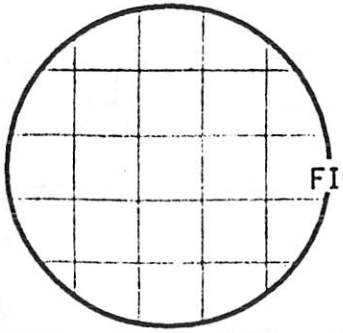




STAIN

ROT (SOFTWOOD)

INCIP. (HARDWOOD)

ADV. (HARDWOOD)

Comments

FIGURE 2.55B SAMPLE TALLY SHEET BACK AND DEFECT CALCULATIONS FOR HARDWOODS

Defect Calculations for Figure 2.55

Section 1: $ADV = \frac{0.3\ [.00007854\ (30^2 + 30^2)]}{2} = 0.0212\ m^3$

$INCIP\ \&\ ADV = \frac{0.3\ [0.00007854\ (36^2 + 36^2)]}{2} = 0.0305\ m^3$

$STAIN\ \&\ INCIP\ \&\ ADV = \frac{0.3\ [0.00007854\ (40^2 + 40^2)]}{2} = 0.03768\ m^3$

Decay Level 1 (Stain) $= .03768m^3 - .0305m^3 = 0.0072\ m^3$

Decay Level 2 (Incipient) $= .0305m^3 - .0212m^3 = 0.0093\ m^3$

Decay Level 3 (Advanced) $= 0.0212\ m^3$

Section 2: $ADV = \frac{1.0\ [0.00007854\ (30^2 + 25^2)]}{2} = 0.06\ m^3$

$INCIP\ \&\ ADV = \frac{1.0\ [0.00007854\ (36.0^2 + 33.2^2)]}{2} = 0.0945\ m^3$

$STAIN\ \&\ INCIP\ \&\ ADV = \frac{1.0\ [0.00007854\ (40.0^2 + 37.0^2)]}{2} = 0.1165\ m^3$

Decay Level 1 (Stain) $= 0.1165m^3 - .0945m^3 = 0.022\ m^3$

Decay Level 2 (Incipient) $= .0945m^3 - .06m^3 = 0.0345\ m^3$

Decay Level 3 (Advanced) $= 0.06\ m^3$

Section 3: $ADV = \frac{1.5\ [0.00007854\ (25^2 + 7.5^2)]}{2} = 0.0401\ m^3$

$INCIP\ \&\ ADV = \frac{1.5\ [0.00007854\ (33.2^2 + 12.5^2)]}{2} = 0.0741\ m^3$

$STAIN\ \&\ INCIP\ \&\ ADV = \frac{0.75\ [0.00007854\ (37^2 + 0^2)]}{2} = 0.0403\ m^3$

Decay Level 1 (Stain) $= .0403m^3 - .037m^3(1/2) = 0.0033\ m^3$

Decay Level 2 (Incipient) $= .0741m^3 - .0401m^3 = 0.034\ m^3$

Decay Level 3 (Advanced) $= 0.0401\ m^3$

Section 4: $ADV = \frac{0.625\ [0.00007854\ (7.5^2 + 0^2)]}{2} = 0.0014\ m^3$

$INCIP\ \&\ ADV = \frac{0.625\ [0.00007854\ (12.5^2 + 0^2)]}{2} = 0.0038\ m^3$

Decay Level 2 (Incipient) $= .0038m^3 - .0014m^3 = 0.0024\ m^3$

Decay Level 3 (Advanced) $= 0.0014\ m^3$

Section 5: $INCIP = \frac{1.25\ [0.00007854\ (11^2 + 0^2)]}{2} = 0.0059\ m^3$

$STAIN = \frac{1.25\ [0.00007854\ (6^2 + 0^2)]}{2} = 0.0018\ m^3$

Section 6:

$$INCIP = \frac{2.5\ [0.00007854\ (11^2 + 10^2)]}{2} = 0.217\ m^3$$

$$STAIN = \frac{2.5\ [0.00007854\ (6^2 + 5^2)]}{2} = 0.006\ m^3$$

Section 7:

$$INCIP = \frac{1.25\ [0.00007854\ (10^2 + 0^2)]}{2} = 0.0049\ m^3$$

$$STAIN = \frac{1.875\ [0.00007854\ (5^2 + 0^2)]}{2} = 0.0018\ m^3$$

CSTM 04 (Rev. 12/87)

Alberta

FORESTRY, LANDS AND WILDLIFE
Forest Service

TREE SECTIONING TALLY SHEET

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	SUB (11)	PLOT (12)	TREE (18)	(20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (27) (X)	# SEC. (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
4	1,1	0,6,7	0,2,3,7		0,2,3,7,0,5	0,5	H	L,0,1	S,W		1,2	0,6,0.3	2	N

TREE CATEGORY (38) 1	2	3	4	5	C.C. (48)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	PHASE III MAP OVERSTORY TYPE (58) (62) (64) (66) (68)
0,0					C	0,2,3.5,0	0,1,6.2,1	X	C,3,S,W, , , (,) L,8,7 M

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC) OPERATOR ID (73)	CROWN SPECIES (75)	COND (77)	AREA (78)	PHOTO HEIGHT (81)

LEGEND	SOFTWOODS	HARDWOODS
DECAY LEVEL 1	PULP CULL	STAIN
DECAY LEVEL 2	SAW CULL	INCIPIENT ROT
DECAY LEVEL 3		ADVANCED ROT

(28) – # SECTIONS TOTAL
(34) – AT TOP OF SEC #
(35) – DECAY IND.
(46) – CROWN CLASS
(57) – INT. DEFECT (X)

VSR

Page 1 of 1

Crew: S.S., R.P.

Date: MARCH 25/88

INCREMENT WIDTH

SEC NO.	0 – 10 YEARS	11 – 20 YEARS
0 1	1,3	1,4
0 2	0,7	0,8

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION INSIDE BARK (28)	OUTSIDE BARK (32)	INSIDE BARK (36)	OUTSIDE BARK (40)	RING COUNT (44)	EXTERNAL DEFECTS PULP (47)	SAW (49)	INTERNAL DEFECT DECAY LEVEL 1 (51)	DECAY LEVEL 2 (57)	DECAY LEVEL 3 (63)
S	0 1	0,0,3,0	6,3.0	6,3.3	6,3.1	6,3.4	1,1,5				0,0,0,4,5,6	
S	0 2	0,1,0,0	6,0.0	6,0.3	6,0.1	6,0.4	1,0,9				0,0,0,1,5,2,1	
S	0 3	0,1,5,0	5,7.0	5,7.3	5,7.1	5,7.4	1,0,0			0,0,0,6,0,5	0,0,2,2,8,2	
S	0 4	0,2,5,0	5,1.0	5,1.3	5,1.1	5,1.4	9,9			0,0,2,2,2,8	0,3,8,0,3	
S	0 5	0,2,5,0	4,5.0	4,5.3	4,5.1	4,5.4	8,8			0,0,1,3,3,7	0,3,8,0,3	
S	0 6	0,2,5,0	3,9.0	3,9.3	3,9.1	3,9.1	7,6			0,0,0,4,7,8		
S	0 7	0,2,5,0	3,3.0	3,3.3	3,3.1	3,3.4	6,8			0,0,0,0,0,6	0,0,0,1,2,2	
S	0 8	0,2,5,0	2,7.0	2,7.3	2,7.1	2,7.4	5,6					
S	0 9	0,2,5,0	2,1.0	2,1.3	2,1.1	2,1.4	4,0					
S	1 0	0,2,5,0	1,5.0	1,5.3	1,5.1	1,5.4	3,5					
S	1 1	0,2,5,0	9.0	9.3	9.1	9.4	1,1					
S	1 2	0,0,7,0	0.0	0.0	0.0	0.0						
S	1 3											
S	1 4											
S	1 5											
S	1 6											
S	1 7											
S	1 8											
S	1 9											
S ▼	2 0											

FIGURE 2.56A SAMPLE OF COMPLETED TALLY SHEET FRONT WITH MULTIPLE DEFECTS

TREE CATEGORY CODES
(by priority):

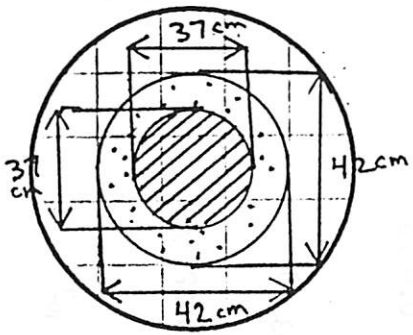
26 Missing
27 Dead and Down
25 Standing Dead
01 Conks/Blind Conks
30 Stem Insects
31 Stem Disease
32 Foliar Insects
33 Foliar Disease
24 Broken Stem
(less than 10 cm TOP D.I.B.)
02 Open Scars
19 Broken Top
(greater than 10 cm TOP D.I.B.)
34 Stem Form Defect
35 Dead Top/Dieback
14 Pronounced Crook
13 Fork
36 Closed Scars
23 Leaning
22 Limby
28 Same Stump
(Fork below DBH)
12 Burls and Galls
37 Unknown
00 No Defect

All defects must be measured and sketched. All stain and rot must be chased.

STUMP

SEC NO. 2

SEC NO. 3



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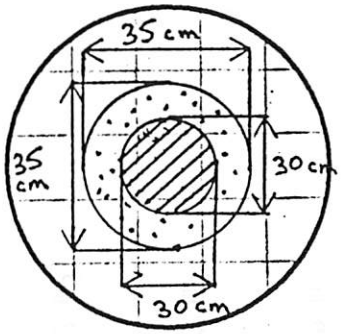

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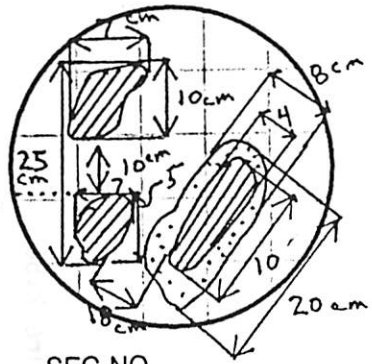

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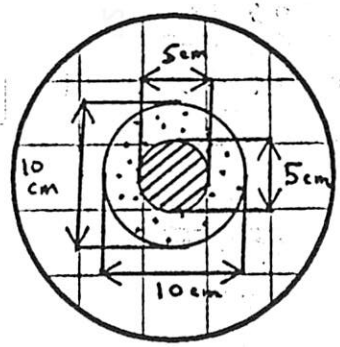

SEC NO. 7

SEC NO.

SEC NO.

SEC NO.

SEC NO.

SEC NO.

STAIN

ROT (SOFTWOOD)

INCIP. (HARDWOOD)

ADV. (HARDWOOD)

Comments

FIGURE 2.56B SAMPLE OF COMPLETED TALLY SHEET BACK WITH MULTIPLE DEFECTS

Defect Calculations for Figure 2.56

Section 1: $SD = \frac{(37 + 2)\ (37 + 2)\ X\ 0.3}{10{,}000} = 0.0456\ m^3$

Section 2: $SD = \frac{(37 + 2)\ (37 + 2)\ X\ 1.0}{10{,}000} = 0.1521\ m^3$

Section 3: $SD = \frac{(37 + 2)\ (37 + 2)\ X\ 1.5}{10{,}000} = 0.2282\ m^3$

$PD = \frac{1.125\ [0.00007854\ (37^2 + 0^2)]}{2} = 0.0605\ m^3$

Section 4: $SD = \frac{(37 + 2)\ (37 + 2)\ X\ 2.5}{10{,}000} = 0.3803\ m^3$

$PD = \frac{2.5\ [0.00007854\ (30^2 + 37^2)]}{2} = 0.228\ m^3$

Section 5: $SD_1 = \frac{(25 + 2)\ (7 + 2)\ X\ 2.5}{10{,}000} = 0.0607\ m^3$

$SD_2 = \frac{(10 + 2)\ (4 + 2)\ X\ 2.5}{10{,}000} = 0.018\ m^3$

Total $SD = SD_1 + SD_2 = 0.0787\ m^3$

Volume calculated for defect at bottom of Section 5 is greater than the volume for top of Section 5. Therefore record the bottom volume for bottom of Section 5.

$PD = \frac{2.5\ [0.00007854\ (30^2 + 21.5^2)]}{2} = 0.1337\ m^3$

Section 6: $SD = \frac{(5 + 2)\ (5 + 2)\ X\ 2.5}{10{,}000} = 0.0122\ m^3$

Volume calculated for defect at bottom of Section 6 is greater than the volume for top of Section 6. Therefore record the volume for bottom of Section 6.

$$PD = \frac{0.625\ [0.00007854\ (5^2 + 0^2)]}{2} = 0.0006\ m^3$$

Section 7: $SD = \frac{(5 + 2)\ (5 + 2)\ X\ 2.5}{10{,}000} = 0.0122\ m^3$

$$PD = \frac{0.625\ [0.00007854\ (5^2 + 0^2)]}{2} = 0.0006\ m^3$$

3.0 Checking Tally Sheets

Tree sectioning tally sheets should always be checked carefully before they are submitted for keypunching. Some of the problems encountered include:

1. Columns left blank - crown class must be filled in (column 46)
   - decay indicator must be filled in (column 35)
   - top of section must be filled in (column 34)

2. Non zero filled fields that need to be zero filled ie. Township, Range, section length.

3. Forest management unit must be left justified.

4. Tree category codes duplicated for same tree. Only use the appropriate category code once for each tree.

5. Tree category codes are not from the Tree Sectioning Manual.

6. Plot number is not numeric.

7. The sum of the section lengths must equal the height of the tree.

8. If no ages recorded, columns 44 - 46 must be left blank. Zero is only allowed on the very last section. Do no write in "rot".

9. The last section for every tree must be zero filled as it represents the very tip of the tree.

10. Writing must be legible, all letters must be capitalized.

- Alphabetic characters that are commonly illegible are:

  N that looks like W

  C that looks like L or O

  D that looks like P or O

  I that looks like T or L

- Numeric characters that are commonly illegible are:

  2 that is 'looped' and looks like 0

  6 and 9 that look like 0 or 4

  0 incompletely closed and looks like 6

  5 that looks like S

  7 and 1 mistaken for each other

  Scientific (European) 7 is not acceptable

  Four written as open (ie. not 4)

11. Missing sections. If a mid section "cookie" is missing the data is considered suspect and may not be used for analysis.

12. Diameter inside bark (dib) is greater than diameter outside bark (dob).

13. Diameter for previous section is greater than the following section.

14. Recording of internal defect. Often, improper or insufficient defect measurements make it difficult to calculate the percentage of cull. All irregular defects which are diagrammed must have a length and a width.

15. If only one diameter can be taken record it twice on the front of the tally sheet and make a note in the comments area on the back of the tally sheet. Only record 000.0 if bark is missing.

16. Sketches of defect in sections are often incomplete. No indication of where defect ends in a section, (1/4, 1/2, 3/4)

17. Diagrams of defect not coded as to type of defect (stain, rot, incipient rot, or advanced rot).

4.0 APPENDICES

4.1 EQUIPMENT

The following equipment is needed for tree sectioning:

-- photo holder

-- hand compass

-- tally sheets (CSTM04/Rev 12/87 Tree Sectioning Tally Sheet)

-- tally board

-- 30 m tape or loggers tape

-- diameter tape

-- ruler (cm and mm)

-- hand lens

-- lumber crayons, pencils

-- portable 2 way radio

-- chainsaws (at least two)

-- axe

-- felling wedges

-- files and file guides

-- screwdrivers and wrenches to fit saw

-- chain oil and mixed gas (according to chain saw manufacturer's specifications)

-- hard hats with eye and ear protection

-- safety pants, steel-toed boots

-- first aid kit

4.2 CIRCULAR AND SQUARE PLOT DIMENSIONS

Hectares	M^2	Radius (m)	Side of Square Plot(m)	Diagonal of Square Plot(m)
1.00	10 000	56.41	100.00	141.42
0.50	5 000	39.89	70.71	100.00
0.25	2 500	28.21	50.00	70.71
0.20	2 000	25.23	44.72	63.24
0.10	1 000	17.84	31.62	44.72
0.05	500	12.62	22.36	31.62
0.01	100	5.64	10.00	14.14
0.001	10	1.78	3.16	4.47

GLOSSARY

Advanced Rot -- The late stage of decay where the wood becomes punky, soft, stringy,pitted or crumbly. There usually is a change of color in the wood and it may appear with one or more dark bands outlined in a continuous pattern. Advanced rot exhibits loss of strength that renders the wood unfit for general purposes. Decay Level 3.

Diameter at Breast Height (dbh) -- Standard height, 1.3 m above point of germination, at which the diameter of a standing tree is measured. Unless otherwise stated, applies to the outside-bark dimension.

Diameter Inside Bark (dib) -- Diameter of a tree or log excluding the bark.

Diameter Outside Bark (dob) -- Diameter of a tree or log including bark.

Felling -- Act of cutting down a tree.

Forest Management Unit (FMU) -- Area of forest land managed as a unit for fibre production and other renewable resources. This unit can be the entire province or territory, a provincial forest management subdivision, an industrial timber limit, etc.

Incipient Rot -- The early stage of decay in which the decomposition has proceeded far enough to soften or otherwise change the hardness of the wood perceptibly. Structure is firm but noticeably weaker than sound wood, it is not fibrous or loose. It is usually accompanied by a slight discoloration of the wood. Decay Level 2.

Meridian (M) -- North-south reference line, particularly a great circle through the geographical poles of the earth, from which longitudes and azimuths are determined. Township and Range locations are referred as being West of the 4th, 5th or 6th meridians in Alberta.

Pulp Defect (Pulp Cull) -- Defect of such shape and size that it reduces the amount of pulp manufactured from pulpwood-sized logs. Decay level 1.

Range (Rge.) -- One of the north-south rows of townships in an Alberta public-land survey which is numbered east and west from the principal meridian of the survey. Range lines are six miles apart.

Right Justified -- Letters or numbers placed in a horizontal position such that the figures are as far to the right as possible.

E.g.:

	S	0	2

Left Justified -- Letters or numbers placed in a horizontal position so that the figures are as far to the left as possible.

E.g.:

S	0	2	

Saw Defect (SD)
(Saw Cull)

-- Defect of such shape and position so as to reduce the amount of lumber produced from a log. Does not include edgings or trimmings. Decay level 2.

Stain

-- Discoloration of the wood with some other color added. It is hard and firm to the touch. Strength and resistance to pressure is same as sound wood. There is no structural breakdown. Decay Level 1.

Township (Twp)

-- Numbered in Alberta consecutively from the Montana - Alberta (0) border to the Alberta - Northwest Territories (126) border. They are 6 miles wide and 36 sq. miles in area.

Zero Filled

-- Column spaces which may not have numerical or alpha characters are filled with zeros to clarify and aid to in key punching processes.

E.g.:

Zero filled			Non-zero filled		
0	2.5	0		2.5	
1	6.3	0	1	6.3	

CSTM 04A (Rev. 01/98)

Alberta Sustainable Resource Development
Forestry Division

TREE SECTIONING TALLY SHEET

Mark stump and breast height and fill in all essential boxes up to and including crown class before felling

M (1)	RGE. (2)	TWP (4)	STAND (7)	(11)	PLOT (12)	TREE (18)	(20)	MANAGEMENT UNIT (21)	SPECIES (25)	DEAD (X) (27)	# SEC. (28)	D.B.H. (OB) (30)	TOP (34)	D.I. (35)
				A			H					.		

TREE CATEGORY (36) 1	2	3	4	5	C.C. (46)	TOTAL HEIGHT (47)	TOTAL HEIGHT TO LIVE CROWN (52)	I.D. (57)	AVI FIELD OVERSTOREY TYPE (58) (62) (64) (66) (68)
						.	.		( )

IMP. UNITS (72) (X)	LARGE SCALE PHOTO (ALWAYS METRIC)				
	OPERATOR ID (73)	CROWN			
		SPECIES (75)	COND (77)	AREA (78)	PHOTO HEIGHT (81)
					.

LEGEND	SOFTWOODS
DECAY LEVEL 1	PULP CULL
DECAY LEVEL 2	SAW CULL

(28) - # SECTIONS TOTAL
(34) - AT TOP OF SEC #
(35) - DECAY IND.
(46) - CROWN CLASS
(57) - INT. DEFECT (X)

N.SR.

Page ____ of ____

Crew: _____

Date: _____

INCREMENT WIDTH

SEC NO.	0 - 10 YEARS	11 - 20 YEARS
0 1		
0 2		

PAGE (20) (21)	SEC. NO. (22)	LENGTH OF SECTION (24)	TOP DIAMETER OF SECTION (28) INSIDE BARK dib1	(32) OUTSIDE BARK dob1	(36) INSIDE BARK dib2	(40) OUTSIDE BARK dob2	RING COUNT (44)	EXTERNAL DEFECTS (47) PULP	(49) SAW	INTERNAL DEFECT (51) DEFECT TYPE ____ DECAY LEVEL 1	(57) DEFECT TYPE ____ DECAY LEVEL 2	(63) DEFECT TYPE ____
S	0 1	.	.	.	.	.				.	.	.
S	0 2	.	.	.	.	.				.	.	.
S	0 3	.	.	.	.	.				.	.	.
S	0 4	.	.	.	.	.				.	.	.
S	0 5	.	.	.	.	.				.	.	.
S	0 6	.	.	.	.	.				.	.	.
S	0 7	.	.	.	.	.				.	.	.
S	0 8	.	.	.	.	.				.	.	.
S	0 9	.	.	.	.	.				.	.	.
S	1 0	.	.	.	.	.				.	.	.
S	1 1	.	.	.	.	.				.	.	.
S	1 2	.	.	.	.	.				.	.	.
S	1 3	.	.	.	.	.				.	.	.
S	1 4	.	.	.	.	.				.	.	.
S	1 5	.	.	.	.	.				.	.	.
S	1 6	.	.	.	.	.				.	.	.
S	1 7	.	.	.	.	.				.	.	.
S	1 8	.	.	.	.	.				.	.	.
S	1 9	.	.	.	.	.				.	.	.
S	2 0	.	.	.	.	.				.	.	.

All defects must be measured and sketched.

All stain, rot and defect type must be chased.

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STUMP

SEC NO. _____

SEC NO. _____

SEC NO. _____

SEC NO. _____

SEC NO. _____

SEC NO. _____

SEC NO. _____

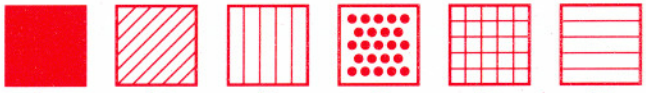
SEC NO. _____

SEC NO. _____

SEC NO. _____

SEC NO. _____

SEC NO. _____



HARDWOOD DEFECT TYPE

SOFTWOOD

Comments _____

_____