CUBIC SCALE PROGRAM
VERSION 4.1

OPERATIONS MANUAL

This document and the companion CUBIC SCALE PROGRAM are complete to the best of our knowledge. The document is undergoing review and will change in content and format as a result of the review. The CUBIC SCALE PROGRAM and the associated calculation methodology presented in this document will change only when:

1) A discrepancy is found with the NATIONAL FOREST CUBIC SCALING HANDBOOK (FSH 2409.11a)
2) The Cubic Rules are changed by the National Cubic Rules Committee.

If you have questions or concerns about this document or the companion program, or find an error in either please contact Ron Briggs or Brad Jones.

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I. INTRODUCTION

Welcome to the Cubic Scale Program. Although the program was designed to be as self-explanatory as possible, this documentation will hopefully fill in the blanks. This program was developed with several purposes in mind: implementing the most recent standards of cubic scaling techniques along with advice and hints from imminently qualified scalers; increasing productivity by providing a fast, easy-to-learn interface; automating as much of the data entry process as possible. The data entry effort has been minimized by keeping the amount of work the user has to exert to a minimum. In other words, the less time the user spends pressing keys, the better. For example, all of the menus that ask for an option require only one key press as opposed to pressing a key and then pressing the <ENTER> key.

The program uses a text-based interface. We have shied away from a graphic interface because experiments with graphic screens resulted in a data entry process that slowed down considerably after many logs had been recorded.

Several quantitative restrictions have been placed on certain types of records. The maximum number of logs per load that can be entered is 250. The maximum number of cubic defects that can be entered per log or segment is 20. There are other restrictions that will be explained later in this documentation.

II. SCREEN SIZE MENU

Upon starting the program for the first time, you will be prompted for a screen size. The screen size you select will then be saved in a data file called CUBIC.DAT. From that point on, you will not have to select the screen size again unless CUBIC.DAT is deleted or otherwise removed from the working directory. If you would like to change the screen size then you must change the character in CUBIC.DAT. This can be accomplished using any ASCII text editor on the file CUBIC.DAT or by deleting the file and entering the screen size information the next time the Cubic Scale Program is used. Use the following table to determine which character to use if you are editing the CUBIC.DAT file:

CHARACTER IN 'CUBIC.DAT'	SCREEN SIZE (column x row)	COMPUTER TYPE
0 (zero)	21 x 16	DAP PC9000 OR OMNIDATA
1	40 x 8	HUSKY HUNTER 16 OR HUSKY FS/2
0 or 1	21 x 16 or 40 x 8	any IBM PC OR PARAVANT

III. MAIN MENU

This is the hub of the Cubic Scale Program. From this point you can: go to data entry to process new loads; create reports from finished loads; display volumes from finished loads; create the scale records to be used with the National Cruise Program for Fall, Buck and Scale volume determinations; or perform various file management functions. Following are examples of the Main Menu screen:

SCREEN = 21 chars by 16 lines

```
+--------------------+
|USDA FOREST SERVICE |
|CUBIC SCALE PROGRAM |
|VERSION 4.1         |
|                    |
| MAIN MENU          |
|                    |
|1  DATA ENTRY       |
|2  REPORTS          |
|3  VOLUMES          |
|4  CRUISE DATA      |
|5  FILE MANAGEMENT  |
|                    |
|CHOICE?             |
|                    |
|(ESC TO QUIT)       |
|                    |
+--------------------+
```

SCREEN = 40 chars by 8 lines

```
+----------------------------------------+
|USDA FOREST SERVICE   1 DATA ENTRY      |
|CUBIC SCALE PROGRAM   2 REPORTS         |
|VERSION 4.1           3 VOLUMES         |
|                      4 CRUISE DATA     |
|M A I N  M E N U      5 FILE MANAGEMENT |
|                                        |
|                                        |
|(ESC TO QUIT)           CHOICE?         |
+----------------------------------------+
```

A. DATA ENTRY

If there is no work file in progress (a work file is a load that has not been completed) after selecting this option, then you will be prompted for the cruise type, region, and header information. If you selected cruise type '3P', then you will also be prompted for KZ values by species and product code. Following are examples of the preliminary screens:

Upon selecting 'DATA ENTRY' from the Main Menu, you will see this:

```
 SCALE MENU

1  100%
2  3P

CHOICE?

(ESC TO QUIT)
```

Select the scale type you want.

If you selected '100%' then skip this section on KZ Values.
If you selected '3P' then you will see one of these screens:

SCREEN = 21 chars by 16 lines

```
+--------------------+
| KZ ENTRY           |
|                    |
|PRODUCT?            |
|                    |
|                    |
|                    |
|(ESC TO QUIT)       |
|                    |
|                    |
|PROD KZ    PROD KZ  |
|--------------------|
|                    |
|                    |
|                    |
|                    |
+--------------------+
```

SCREEN = 40 chars by 8 lines

```
+----------------------------------------+
| KZ ENTRY          PROD KZ    PROD KZ   |
|                   ---------------------|
|PRODUCT?                                |
|                                        |
|                                        |
|                                        |
|(ESC TO QUIT)                           |
+----------------------------------------+
```

Enter the KZ information and press 'ESC' to exit.

You will now see the Region screen which looks like this:

```
ENTER REGION:  __
(ESC TO CANCEL)
```

Enter the region and press 'ENTER' to continue. You will see the Boundary Values screen which looks like this:

```
 BOUNDARY VALUES

Minimum Length:    _8
Maximum Length:    50
Minimum Diameter:  _5
Maximum Diameter:  60

 Press <ESC> to quit
```

As you can see, the defaults are already entered into the screen. The Boundary Values are used by the program to warn the user if the lengths or diameters entered exceed the acceptable range. You can change these values if you desire and then press 'ESC' to continue.

You will now see the header screen which looks like the following:

SCREEN = 21 chars by 16 lines

```
+____________________+
|   HEADER SCREEN    |
|              MM DD YY|
|Scale Date:  __-__-__|
|Scale Time:    __:__|
|Scaler:        _____|
|Location:  __________|
|Sale Name:  _________|
|Load Receipt:  _____|
|Purchaser: __________|
|Contract:   _________|
|Sample Group:      __|
|Forest:            __|
|District:          __|
|Merch Spec (saw):  __|
|Merch Spec (pulp): __|
| Press ESC when done |
+____________________+
```

SCREEN = 40 chars by 8 lines

```
+________________________________________+
| HEADER SCREEN     Press ESC when done  |
|Scale Date:  __-__-__ (MM-DD-YY)        |
|Scale Time:    __:__  Contrct: ________|
|Scaler:        _____  Smp Grp:       __|
|Location:  __________  Forest:       __|
|Sale Name:  _________  District:     __|
|Load Receipt:  _____  Merch (S):     __|
|Purchaser: __________  Merch (P):     __|
+________________________________________+
```

After entering the header information, pressing ESC will bring up the log data entry screen. If there is a work file in progress, then you will go straight to the log screen and not be prompted for any of the above preliminary information. Refer to Appendices A & B to see which commands you can use while in data entry mode.

Whenever you go from one screen to another, or from one record to another, the record you were previously working on is saved in memory but not to permanent storage. It is recommended that you periodically save your data to permanent storage by using the CTRL-O command. This will ensure that if your data recorder powers down or freezes up, then your data will be safe. Be careful that you do not save the current load as a 'FINISHED' file until you are done with the data entry for the current load. You will not be able to edit a file saved with the 'FINISHED' option. Always use the 'NOT FINISHED' option unless you are sure you are done. To exit from data entry, press ESC repeatedly until you reach the exit screen.

1. LOG SCREEN - 100%

Upon entering the 100% log screen, You will see this title bar at the top of the screen:

LOG SP S LN LD SD PGB

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
LOG	Log Number	3	Numeric
SP	Species	2	Alphanumeric
S	Split	1	Numeric
LN	Log Length	2	Numeric
LD	Large End Diam.	2	Numeric
SD	Small End Diam.	2	Numeric
P	Product	1	Numeric
G	Grade	1	Numeric
B	Butt	1	Y or N

You will then be ready to enter data under the title bar. You can enter up to a maximum of 250 log records per load.

If you have finished entering data for a log and you want to start a new log, press the down arrow or press the enter key until the cursor moves down. The log number

will then be incremented by one and the previous species will be copied. Even if you do not enter any other data (Length, LED, etc.) this record is now a valid record. Make sure you do not leave any records that have only a log number and species code. These records will show up on the reports and be identified as errors in the edit. You can delete these records by pressing the DEL key.

2. LOG SCREEN - 3P

Upon entering the 3P log screen, You will see this title at the top of the screen:

LOG SP S P KPI RND#H

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
LOG	Log Number	3	Numeric
SP	Species	2	Alphanumeric
S	Split	1	Numeric
P	Product	1	Numeric
KPI	KPI (Prediction)	4	Numeric
RND#	Random Number	4	N/A
H	Hit Code	1	N/A

If you press ALT-N, then you will see this title bar at the top of the screen:

LOG SP S P LN LD SD H

NOTE: The ALT-N key combination means to switch to next screen.

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
LOG	Log Number	3	Numeric
SP	Species	2	Alphanumeric
S	Split	1	Numeric
P	Product	1	Numeric
LN	Log Length	2	Numeric
LD	Large End Diam.	2	Numeric
SD	Small End Diam.	2	Numeric
H	Hit Code	1	N/A

You will now be ready to enter data under the title bar. You can enter up to a maximum of 250 log records per load.

If you have finished entering data for a log and you want to start a new log, press the down arrow or press the enter key until the cursor moves down to the next line. The log number will then be incremented by one and the previous species and product will be copied. Even if you do not enter any other data (Length, LED, etc.) this record is now a valid record. Make sure you do not leave any records that have only a log number and species code. You can delete these records by pressing the DEL key. If you delete a record after you have envoked the Random Number, then the record will not be removed from the screen and a 'd' will appear in the H field. This record's data, even though it shows on the screen, will not figure into the volume calculations.

After you have entered a log number, species, product code, and Estimate (KPI), press the <ENTER> key while you are in the KPI field to generate the Random Number. After you have generated the Random Number you will not be allowed to change the product code, KPI, or Random Number. If you have a hit, then you will see an asterisk in the hit field and you will automatically go to the measurements screen to begin entering the measurements. You can override a hit record by pressing ALT-V. This will cause the record's volumes to be zeroed out in the reports. To enter a sure-to-measure tree, press ALT-M. An 'm' in the H field will indicate the record aa sure-to-measure.

3. SEGMENT SCREEN

Upon entering the segment screen, The current log will be displayed at the top of the screen and you will see this title bar below it (# - denotes some number):

SEG # P # LD ## SD ##

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
SEG	Segment Number	1	N/A
P	Product	1	Numeric
LD	Large End Diam.	2	N/A
SD	Small End Diam.	2	N/A

The only field you can enter data on this screen is in the PRODUCT field. The segment number, large end diameter, and small end diameter are determined by the

log data and are only displayed for informational purposes.

4. CUBIC DEFECT SCREEN

If you want to enter cubic defects for the entire log, then you must be in the log screen before you go to the cubic defect screen. If you want to enter cubic defects for a segment of the current log, then you must be in the segment screen before you go to the cubic defect screen. You can also go directly to the segment cubic defect screen from the log screen by using the shortcut command: ALT-Y. See Appendix E for a complete list of the cubic defect codes.

If you select this screen while you are currently on the log screen, then the current log will be displayed at the top and underneath you will see this title bar:

M T M1 M2 M3 M4 LN %%

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
M	Defect Method	1	Numeric
T	Defect Type	1	Alphanumeric
M1	Measurement 1	2	Numeric
M2	Measurement 2	2	Numeric
M3	Measurement 3	2	Numeric
M4	Measurement 4	2	Numeric
LN	Length Deduct.	2	Numeric
%%	Percent Deduct.	2	Numeric

If you are currently on the segment screen then the above title bar will be shown beneath the segment title bar.

If you press ALT-N, then you will see this title bar on the screen:

M T %F

NOTE: The ALT-N key combination means to switch to next screen.

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
M	Defect Method	1	Numeric
T	Defect Type	1	Alphanumeric
%F	% Fiber Loss	2	Numeric

You can enter up to 20 cubic defect records per log or segment.

5. BOARD DEFECT SCREEN

If you want to enter board defects for the entire log, then you must be in the log screen before you go to the board defect screen. If you want to enter board defects for a segment of the current log, then you must be in the segment screen before you go to the board defect screen. You can also go directly to the segment board defect screen from the log screen by using the shortcut command: ALT-Z.

If you select the board defect screen while you are currently on the log screen, then the current log will be displayed at the top and underneath it you will see this title bar:

BdDef L ## D ## V ###

Description:

LABEL	FIELD	LENGTH	VALID ENTRY
L	Length Cut	2	Numeric
D	Diameter Cut	2	Numeric
V	Volume Deduct.	3	Numeric

If you are currently on the segment screen then the above title bar will be beneath the segment title bar.

Because there can only be one board defect per log or segment, the fields are to the right of the titles.

B. REPORTS

This option creates five types of reports: comprehensive, cubic segment, board segment, cubic log, and board log. It is assumed there are finished load files in the current directory. You can also create reports of the work file at any point during data entry (See the CTRL-R item in Appendices A & B). You have the option of sending the report to a file or a printer. If you send the report to a file, then the load receipt number is used as the file name with the report type as the extension. For example, if the load receipt number is 808666 and you selected the cubic foot log-level report, then the report will be in a file called '808666.CLG'. Following is an explanation of each type of report:

COMPREHENSIVE REPORT

A detailed listing of all of the logs in the load. It reports log data, segment data, and defects associated with the log or segment. This report shows both cubic and board foot volumes. The comprehensive report does **not** contain volume sums for 3P scaling, but does contain volume sums for 100% scaling. In order to display all of the relevant information, the comprehensive report is in legal landscape format (132 characters wide by 44 lines long).

CUBIC FOOT LOG REPORT

Displays cubic foot log data only. This report contains volume sums for **both** 3P scaling and 100% scaling. The log report is in letter portrait format (80 characters wide by 58 lines long).

BOARD FOOT LOG REPORT

Displays board foot log data only. This report contains volume sums for **both** 3P scaling and 100% scaling. The log report is in letter portrait format (80 characters wide by 58 lines long).

CUBIC FOOT SEGMENT REPORT

Similar to the comprehensive report, but does not show as much defect information and shows only cubic foot information. This report does **not** contain volume sums for 3P scaling, but does contain volume sums for 100% scaling. The segment report is in letter portrait format (80 characters wide by 58 lines long).

BOARD FOOT SEGMENT REPORT

Similar to the comprehensive report, but does not show as much defect information and shows only board foot information. This report does **not** contain volume sums for 3P scaling, but does contain volume sums for 100% scaling. The segment report is in letter portrait format (80 characters wide by 58 lines long).

C. VOLUMES

Displays totals of a load's cubic and board foot volumes only. This option assumes there are finished load files in the current directory. You can also display volumes of the current work file at any point during data entry. Also refer to the CRTL-L, CTRL-S, and CTRL-T items in Appendices A & B.

D. CRUISE DATA

Creates a file containing records that can be used in the National Cruise Program for Fall, Buck and Scale volume determination. This option assumes there are finished load files in the current directory.

E. FILE MANAGEMENT

Allows the user to delete, rename, print, or catalog files in the current directory. The delete option allows the user to use a wildcard ('*') to delete multiple files. However, you cannot use '*.*' to delete all of the files as this would cause the program to be deleted if it were in the currect directory. You can also access the File Management option at any point during data entry. See the CTRL-F item in Appendices A & B.

IV. VOLUME CALCULATIONS

This section of the documentation is designed for those interested in how the calculations are preformed by the computer program.

A. SEGMENTATION RULES

The number of segments, segment lengths, and segment positions within the log are calculated from the recorded length by using the rules in the National Forest Cubic Scaling Handbook (FSH 2409.11a, 1991).

NOTE: The rules mentioned above were extended to determine values for lengths up to 99 feet. Only lengths up to 99 feet can be recorded.

B. HOW TAPER IS ASSIGNED

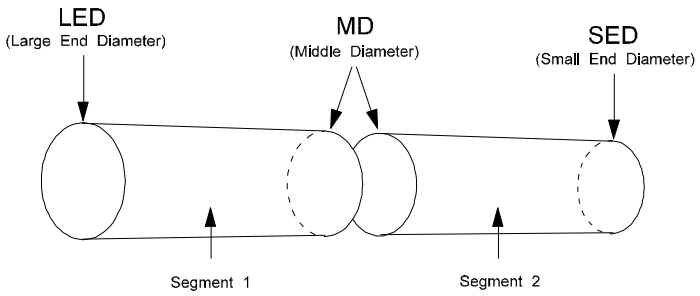
DEFINITION: Taper is defined as the progressive change in a measurement from one end, or point on its length, to another.

NOTES: * For additional information on how taper is assigned, see the sections on distributing even/uneven taper in the National Forest Cubic Scaling Handbook (FSH 2409.11a).
* TAPER is EVEN when it can be apportioned in an equal amount to each segment and UNEVEN when it cannot.

TAPER = LARGE END DIAMETER - SMALL END DIAMETER

1. EVEN TAPER

a. TWO-SEGMENT LOG (EVEN TAPER)



The taper is divided by two (the number of segments) and the result is added to the Small End Diameter (SED) to obtain the Middle Diameter (MD).

An example: (refer to Figure 1)

Let: LED (Large End Diameter) = 16
SED (Small End Diameter) = 10

LOG TAPER = LED - SED = 16 - 10 = 6

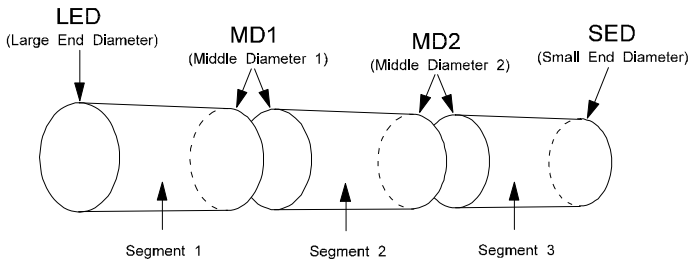
Divide LOG TAPER by two (the number of segments) to get TAPER PER SEGMENT:

TAPER PER SEGMENT = LOG TAPER / 2 = 6 / 2 = 3

So:

MD (Middle Diameter) = SED + TAPER PER SEGMENT
= 10 + 3 = 13

b. THREE-SEGMENT LOG (EVEN TAPER)



The total taper is divided by three (the number of segments) and the result is the amount of taper assigned to the top segment. The remainder of the taper is distributed as in a two-segment log. As a check, the top diameter of the bottom segment will differ from the large end diameter (LED) by the taper per segment.

An example: (refer to Figure 2)

Let: LED (Large End Diameter) = 20
SED (Small End Diameter) = 14

LOG TAPER = LED - SED = 20 - 14 = 6

Divide LOG TAPER by three (the number of segments) to get TAPER PER SEGMENT:

TAPER PER SEGMENT = LOG TAPER / NUMBER OF SEGMENTS
= 6 / 3 = 2

So:

MD2 (Middle Diameter 2) = SED + TAPER PER SEGMENT
= 14 + 2 = 16

MD1 (Middle Diameter 1) = MD2 + TAPER PER SEGMENT
= 16 + 2 = 18

c. LOGS OF FOUR OR MORE SEGMENTS (EVEN TAPER)

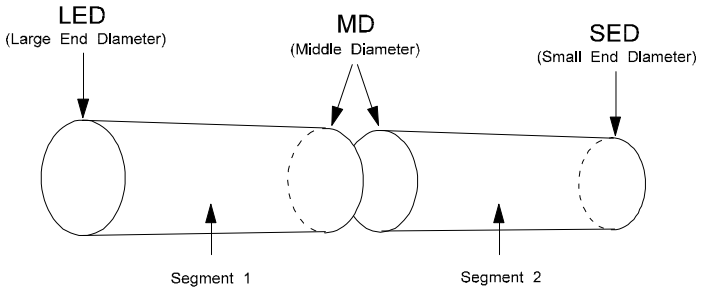
The total taper is divided by the number of segments and the resulting taper per segment is added to the small end diameter to obtain the top diameter of the second segment. The taper per segment is then added, in turn, to each top diameter until all top diameters are calculated. As a check, the top diameter of the bottom segment will differ from the large end diameter by the taper per segment.

2. UNEVEN TAPER

The excess or largest amount of taper is always applied to the top segment (small end). The rules for distribution of uneven taper in multi-segment logs are as follows:

a. TWO-SEGMENT LOG (UNEVEN TAPER)

An inch is added to the total taper and the result is divided by two (the number of segments). The result of the division is the amount of taper assigned to the top segment. This taper is then subtracted from the total taper to get the taper of the bottom segment.



An example (refer to Figure 3):

Let: LED (Large End Diameter) = 30
SED (Small End Diameter) = 25
TAPER FOR LOG = LED - SED = 30 - 25 = 5 (uneven taper)

An inch is added to the LOG TAPER to make it divisible by two (the number of segments):

TAPER PER SEGMENT = LOG TAPER + 1 / NUMBER OF SEGMENTS
= (5 + 1) / 2 = 6 / 2 = 3

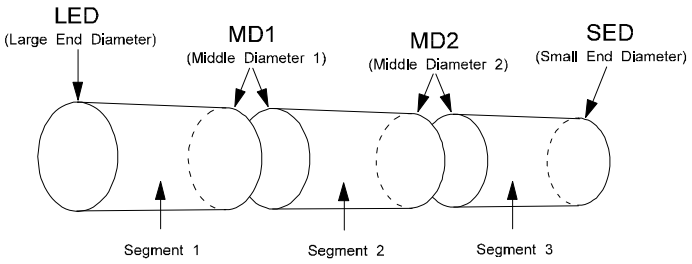
TAPER FOR SEGMENT 1 = LOG TAPER - TAPER PER SEGMENT
= 5 - 3 = 2

So:

MD (Middle Diameter) = SED + TAPER PER SEGMENT
= 25 + 3 = 28

b. THREE-SEGMENT LOGS (UNEVEN TAPER)

The total taper is raised to a number divisible by three (the number of segments) and divided. The result is the amount of taper assigned to the top segment. The remainder of the taper is distributed as in a two-segment log.



An example (refer to Figure 4):

Let: LED (Large End Diameter) = 30
SED (Small End Diameter) = 23

TAPER FOR LOG = LED - SED = 30 - 23 = 7 (uneven taper)

We add 2 inches to the LOG TAPER to make the result divisible by three (the number of segments):

TAPER FOR SEGMENT 3 = (7 + 2) / 3 = 3
REMAINING TAPER = 7 - 3 = 4

Now we distribute the remaining taper as in a two-segment log:

$$\text{TAPER FOR SEGMENT 2} = \frac{\text{REMAINING TAPER}}{\text{NUMBER OF SEGMENTS REMAINING}}$$

= 4 / 2 = 2

```
TAPER FOR SEGMENT 1 = REMAINING TAPER -
                      TAPER FOR SEGMENT
                    = 4 - 2 = 2
```

So:

```
MD2 (Middle Diameter 2) = SED + TAPER FOR SEGMENT 3
                        = 23 + 3 = 26

MD1 (Middle Diameter 1) = MD2 + TAPER FOR SEGMENT 2
                        = 26 + 2 = 28
```

c. LOGS OF FOUR OR MORE SEGMENTS

For four-segment logs, the total taper is raised to a number divisible by four (the number of segments) and divided. The result is the amount of taper assigned to the top segment. The taper in the top segment is subtracted from the total taper and the remaining taper is distributed as in a three-segment log. The same procedure is used for logs with more than four segments. Divide by the number of segments, working with one segment at a time, until a three-segment log is reached. The excess (greatest) taper is always applied to the top segment (small end).

C. CUBIC FOOT CALCULATIONS

NOTES:

* All length measurements are in whole feet.
* All diameter measurements are in whole inches.

Rounding Rule

Volumes are rounded to nearest tenths of a cubic foot as follows:

Step 1: Multiply the cubic foot volume by 10.
Step 2: Add 0.5 to the new volume.
Step 3: Drop the fraction.
Step 4: Divide by 10 to get back to cubic feet.

An example: 10.58 cubic feet

Step 1: 10.58 * 10 = 105.8
Step 2: 105.8 + 0.5 = 106.3
Step 3: drop the fraction of 106.3 = 106
Step 4: 106 / 10 = 10.6

So, 10.58 cubic feet rounded to the nearest tenth of a cubic foot is 10.6 cubic feet.

RND_TENTHS = will be used in the following examples to mean round to the nearest tenth of a cubic foot at this time.

A few examples:

RND_TENTHS (1.04) = 1.0
RND_TENTHS (1.049) = 1.0
RND_TENTHS (1.05) = 1.1
RND_TENTHS (1.95) = 2.0

1. CUBIC FOOT GROSS VOLUME

$$\text{CUFT GROSS VOLUME} = \text{RND\_TENTHS}\ (0.002727 * (\text{LED}^2 + \text{SED}^2) * \text{LENGTH})$$

where: LED = Large End Diameter of Log or Segment (Inches)
SED = Small End Diameter of Log or Segment (Inches)
LENGTH = Length of Log or Segment (Feet)
NOTE - Length cannot exceed 20 feet for volume determinations.

An example:
Let: LED = 18 inches
SED = 16 inches
LENGTH = 20 feet

$$\text{CUFT GROSS VOLUME} = \text{RND\_TENTHS}(0.002727*(18^2 + 16^2)*20)$$
$$= \text{RND\_TENTHS}\ (31.6332) = 31.6 \text{ cuft}$$

2. CUBIC FOOT DEFECT VOLUME

Gross, net, and defect volumes are always determined for logs or log segments that are 20 feet or less in length. If a log is over 20 feet in length and defects that are recorded on the log ends extend the length of the log, then section 2b has the procedures to distribute the log defect measurements to each segment in the log. Subsequently, the procedures in section 2a are used to determine the defect volume in each section of the log.

Defects are identified by a primary method for purposes of volume calculation. In addition to the primary defect method calculation to be used, additional constraints can be placed on the defect amount. For example, it might be necessary to take a diameter deduction of 2 inches for a log segment, but that diameter deduction may only apply to 8 feet of the log and for half the circumference of that 8 feet. In this case, the defect deduction would be recorded as a diameter deduction of 2 inches for a length of 8 feet and only 50% of that amount. The following table shows the allowable combinations of measurements that may be applied to each defect method for a log or log segment 20 feet or less in length.

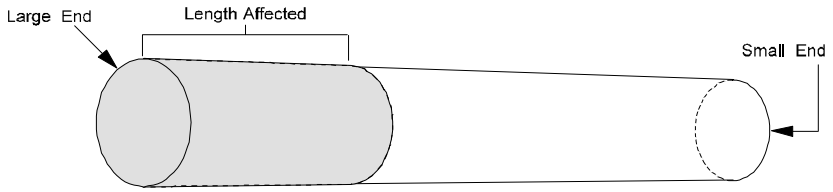
Table 1. DEFECT MEASUREMENT COMBINATIONS

METHOD	CODE	M1	M2	M3	M4	LENGTH	PERCENT
Length Cut	1	N	N	N	N	Y	N
Diameter Cut	2	Y	N	N	N	Y*	Y*
Squared Area	3	Y	Y*	Y*	Y*	Y*	Y*
Percent Ded.	4	N	N	N	N	Y*	Y
Rings	5	Y	Y*	Y*	Y*	Y*	Y*

where: Y = Yes
N = No
* = Optional
** = Optional, can be entered in place of M1

a. ONE-SEGMENT LOG (Length <= 20)

i. LENGTH DEDUCTION (Defect Method 1)



NOTE: The shaded area is the defect Area

```
CUFT DEFECT VOLUME = CUBIC GROSS VOLUME *
         (LENGTH DEDUCTION / TOTAL LENGTH)

If CUFT DEFECT VOLUME is less than 0.2 cubic feet then:
   CUFT DEFECT VOLUME = 0
otherwise:
   CUFT DEFECT VOLUME is rounded to nearest tenths of a cubic
   foot.
```

An example (refer to Figure 5):

Let LED = 18 inches
SED = 16 inches
LENGTH = 20 feet
LENGTH DEDUCTION = 6 feet

```
CUFT GROSS VOLUME = 31.6 cuft (given in above example)

CUFT DEFECT VOLUME = 31.6 * (6 / 20) = 31.6 * 0.3
                   = 9.48 cuft
```

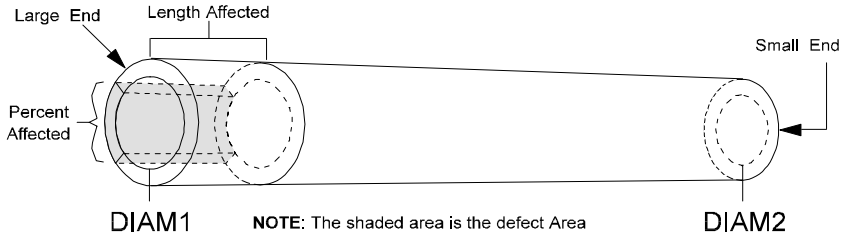
Because the CUFT DEFECT VOLUME is greater than 0.2 we round it to the nearest tenth of a cubic foot:

```
CUFT DEFECT VOLUME = RND_TENTHS (9.48) = 9.5 cuft
```

ii. DIAMETER DEDUCTION (Defect Method 2)

A DIAMETER DEDUCTION applies to both the large end and small end diameters as follows:

```
LED2 = LARGE END DIAMETER - M1 (Diameter Deduction)
SED2 = SMALL END DIAMETER - M1 (Diameter Deduction)
```



If a length affected by the diameter deduction was entered, then convert the length affected to a percentage of the log length:
   LP (LENGTH PERCENT) = LENGTH DEDUCTION / TOTAL LENGTH
otherwise:
   LP = 1

If a percent of the area affected by the diameter deduction was entered, then convert the percent affected to a decimal value:
   DP (DEFECT PERCENT) = PERCENT OF AREA AFFECTED * 0.01
otherwise:
   DP = 1

CORE VOLUME = RND_TENTHS (0.002727 * ($DIAM1^2$ + $DIAM2^2$) *

TOTAL LENGTH)

CUFT DEFECT VOLUME = (CUFT GROSS - CORE) * LP * DP

If CUFT DEFECT VOLUME is less than 0.2 cubic feet then:
   CUFT DEFECT VOLUME = 0
otherwise:
   CUFT DEFECT VOLUME is rounded to nearest tenths of a cubic foot

An example (refer to Figure 6):

   Let: LED (Large End Diameter) = 18 inches
         SED (Small End Diameter) = 16 inches
         TOTAL LENGTH = 20 feet
         DIAM1 (DIAMETER DEDUCTION) = 2 inches
         LENGTH AFFECTED = 3 feet
         PERCENT OF AREA AFFECTED = 25%

   CUFT GROSS VOLUME = 31.6 cuft (given in examples above)

   DIAM1 = LED - DIAMETER DEDUCTION = 18 - 2 = 16
   DIAM2 = SED - DIAMETER DEDUCTION = 16 - 2 = 14

   LP (LENGTH PERCENT) = LENGTH AFFECTED / TOTAL LENGTH
                       = 3 / 20 = 0.15

DP (DEFECT PERCENT) = PERCENT DEDUCTION * 0.01
= 25 * 0.01 = 0.25

CORE VOLUME = RND_TENTHS (0.002727 * (16^2 + 14^2) * 20)
= RND_TENTHS (24.6528) = 24.7 cubic feet

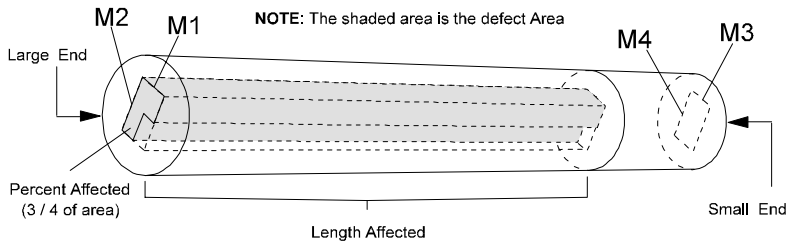
CUFT DEFECT VOLUME = (31.6 - 24.7) * 0.15 * 0.25
= 0.25875 cuft

Because the CUFT DEFECT VOLUME is greater than 0.2 we round it to the nearest tenth of a cubic foot:

CUFT DEFECT VOLUME = RND_TENTHS (0.25875) = 0.3 cuft

iii. SQUARED AREA (Defect Method 3)

M1 = Large End Defect Width
M2 = Large End Defect Height
M3 = Small End Defect Width
M4 = Small End Defect Height



If a length affected by the squared area was entered:
LE = LENGTH DEDUCTION
otherwise:
LE = TOTAL LENGTH

If a percent of the area affected by the squared area was entered, then convert the percent affected to a decimal value:
DP (DEFECT PERCENT) = PERCENT OF AREA AFFECTED * 0.01
otherwise:
DP = 1

Table 1. LOG SQUARED AREA MEASUREMENTS - ONE SEG.

Measurements Recorded	How variables are set for the defect formula	
	WD	**HT**
M1	M1	M1
M3	M3	M3
M1 & M2	M1	M2
M3 & M4	M3	M4
M1 & M3	RE ((M1+M3)/2)	RE ((M1+M3)/2)
M1,M2,M3, & M4	RE ((M1+M3)/2)	RE ((M2+M4)/2)

where: RE = Rounded to nearest even integer for values containing a fraction

CUFT DEFECT VOLUME = ((WD * HT * LE) / 144)* DP

If CUFT DEFECT VOLUME is less than 0.2 cubic feet then:
   CUFT DEFECT VOLUME = 0
otherwise:
   CUFT DEFECT VOLUME is rounded to nearest tenths of a cubic foot

An example (refer to Figure 7):

   Let: TOTAL LENGTH = 20 feet
        LENGTH AFFECTED = 16 feet
        M1 (Large End Defect Width) = 10 inches
        M2 (Large End Defect Height) = 14 inches
        M3 (Small End Defect Width) = 5 inches
        M4 (Small End Defect Height) = 8 inches
        PERCENT OF SQUARED AREA AFFECTED = 75%

   Calculate the average defect width by adding M1 and M3 together and dividing by two:

   WIDTH = (10 + 5) / 2 = 15 / 2 = 7.5 (round to nearest even number)
        = 8 inches

   Calculate the average defect height by adding M2 and M4 together and dividing by two:

   HEIGHT = (14 + 8) / 2 = 22 / 2 = 11 inches
   LENGTH = LENGTH AFFECTED = 16 feet

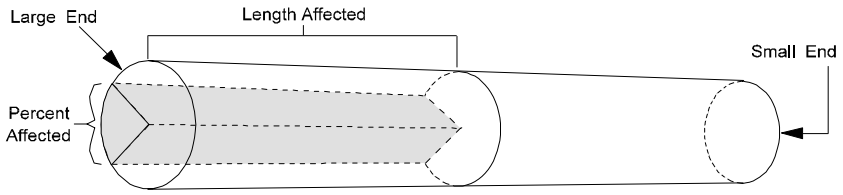
```
DP (DEFECT PERCENT) = PERCENT DEDUCTION * 0.01
                    = 75 * 0.01 = 0.75

CUFT DEFECT VOLUME = ((8 * 11 * 16) / 144) * 0.75
                   =  7.333... cuft
```

Because the CUFT DEFECT VOLUME is greater than 0.2 we round it to the nearest tenth of a cubic foot:

```
CUFT DEFECT VOLUME = RND_TENTHS (7.333...) = 7.3 cuft
```

iv. PERCENT DEDUCTION (Defect Method 4)



NOTE: The shaded area is the defect Area

If a length affected by the percent deduction was entered, then convert the length affected to a percentage of the log length:

```
   LP (LENGTH PERCENT) = LENGTH DEDUCTION / TOTAL LENGTH
otherwise:
   LP = 1

Convert the percent deduction to a decimal value:
DP = DEFECT PERCENT = PERCENT DEDUCTION * 0.01
CUFT DEFECT VOLUME = CUFT GROSS VOLUME * LP * DP

If CUFT DEFECT VOLUME is less than 0.2 cubic feet then:
   CUFT DEFECT VOLUME = 0
otherwise:
   CUFT DEFECT VOLUME is rounded to nearest tenths of a cubic
   foot
```

An example (refer to Figure 8):

```
   Let:  LED (Large End Diameter) = 18 inches
         SED (Small End Diameter) = 16 inches
         TOTAL LENGTH = 20 feet
         LENGTH AFFECTED = 10 feet
         PERCENT DEDUCTION = 25%

   LP (LENGTH PERCENT) = 10 / 20 = 0.5

   DP (DEFECT PERCENT) = 25 * 0.01 = 0.25
```

CUFT GROSS VOLUME = 31.6 cuft (given in above examples)

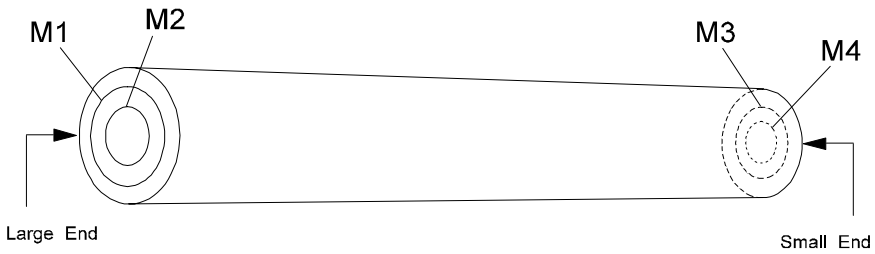
CUFT DEFECT VOLUME = 31.6 * 0.5 * 0.25 = 3.95 cuft

Because the CUFT DEFECT VOLUME is greater than 0.2 we round it to the nearest tenth of a cubic foot:

CUFT DEFECT VOLUME = RND_TENTHS (3.95) = 4.0 cuft

v. RINGS (Defect Method 5)

M1 = Diameter of Large End Outside Ring
M2 = Diameter of Large End Inside Ring
M3 = Diameter of Small End Outside Ring
M4 = Diameter of Small End Inside Ring



If a length affected by the rings was entered:
   LENGTH = LENGTH DEDUCTION
otherwise:
   LENGTH = TOTAL LENGTH

If a percent of the area affected by the squared area was entered, then convert the percent affected to a decimal value:
   DP (DEFECT PERCENT) = PERCENT OF AREA AFFECTED * 0.01
otherwise:
   DP = 1

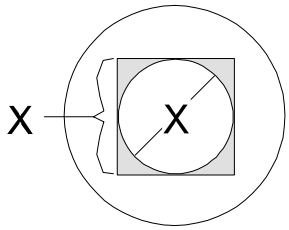
Table 2. LOG RING MEASUREMENTS - ONE SEGMENT

Measurements Recorded	How variables are set for formula			
	DIAM1	**DIAM2**	**DIAM3**	**DIAM4**
M1	M1*M1	N/A	M1*M1	N/A
M3	M3*M3	N/A	M3*M3	N/A
M1 & M3	M1*M1	N/A	M3*M3	N/A
M1,M2,M3, & M4	M1*M1	M2*M2	M3*M3	M4*M4

For the first three cases in table 2:

```
CUFT DEFECT VOLUME = RND_TENTHS [(DIAM1 + DIAM3) *
                                        LENGTH * 0.002727
                    ] *
                                        0.273 * DP
```

where: The constant 0.273 is used to determine the difference in area between a square with side X and a circle with diameter X. See Fig. 10.



NOTE:
Total shaded area is equal to
0.273 times area of inner circle

If CUFT DEFECT VOLUME is less than 0.2 cubic feet then:
CUFT DEFECT VOLUME = 0
otherwise:
CUFT DEFECT VOLUME is rounded to nearest tenths of a cubic foot

An example (refer to Figure 9):

Let: LED (Large End Diameter) = 18 inches
SED (Small End Diameter) = 16 inches
TOTAL LENGTH = 20 feet
M1 (Ring at Large End) = 8 inches
M3 (Ring at Small End) = 5 inches

DIAM1 = M1 * M1 = 8 * 8 = 64

DIAM3 = M3 * M3 = 5 * 5 = 25

LENGTH = 20 feet

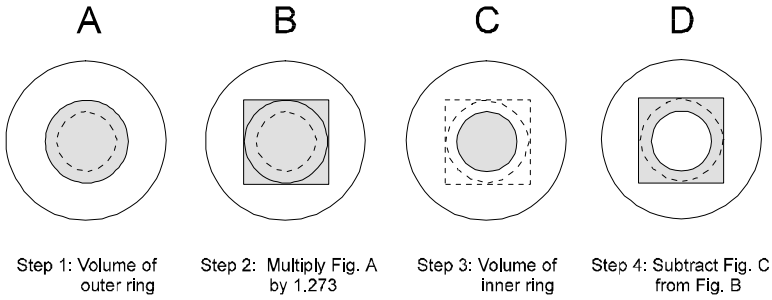
DP (DEFECT PERCENT) = 1

```
CUBIC DEFECT VOLUME = RND_TENTHS [(64 + 25) * 20 *
                                  0.002727] * 0.273
                    = RND_TENTHS (4.85406) * 0.273
                    = 4.9 * 0.273 = 1.3377 cuft
```

Because the CUBIC DEFECT VOLUME is greater than 0.2 we round it to the nearest tenth of a cubic foot:

CUBIC DEFECT VOLUME = RND_TENTHS(1.3377) = 1.3 cuft

For the last case in table 2:



Step 1: The core volume of the outer ring:

```
CORE VOLUME 1 = RND_TENTHS ((DIAM1 + DIAM3) * LENGTH *
                                        0.002727)
```

Step 2: The volume of the square of the outer core:

```
   SQUARE VOLUME = CORE VOLUME 1 * 1.273
```

Step 3: The core volume of the inner ring:

```
CORE VOLUME 2 = RND_TENTHS ((DIAM2 + DIAM4) * LENGTH *
                                        0.002727)
```

Step 4: The defect volume is calculated:

```
CUFT DEFECT VOLUME = (SQUARE VOLUME - CORE VOLUME 2)
                                    * DP
```

If CUFT DEFECT VOLUME is less than 0.2 cubic feet then:
   CUFT DEFECT VOLUME = 0
otherwise:
   CUFT DEFECT VOLUME is rounded to nearest tenths of a cubic foot

An example (refer to Figure 9):

Let: LED (Large End Diameter) = 18 inches
SED (Small End Diameter) = 16 inches
TOTAL LENGTH = 20 feet
M1 (Outside Ring at Large End) = 8 inches
M2 (Inside Ring at Large End) = 5 inches
M3 (Outside Ring at Small End) = 4 inches
M4 (Inside Ring at Small End) = 3 inches

```
DIAM1 = M1 * M1 = 8 * 8 = 64
DIAM2 = M2 * M2 = 5 * 5 = 25
DIAM3 = M3 * M3 = 4 * 4 = 16
DIAM4 = M4 * M4 = 3 * 3 = 9
```

```
LENGTH = 20 feet

DP (DEFECT PERCENT) = 1

CORE VOLUME 1 = RND_TENTHS((64 + 16)*20 * 0.002727)
              = RND_TENTHS (4.3632) = 4.4 cuft

SQUARE VOLUME = 4.4 * 1.273 = 5.6012

CORE VOLUME 2 = RND_TENTHS((25 + 9)*20 * 0.002727)
              = RND_TENTHS (1.85436) = 1.9 cuft

CUFT DEFECT VOLUME = (5.6012 - 1.9) * 1 = 3.7012

Because the CUFT DEFECT VOLUME is greater than 0.2 we
round it to the nearest tenth of a cubic foot:

CUFT DEFECT VOLUME = RND_TENTHS (3.7012) = 3.7 cuft
```

b. MULTI-SEGMENT LOG (Length > 20)

NOTES: * LENGTH CUT and PERCENT DEDUCTION are not allowed under multi-segment logs.
* If a defect measurement exceeds the segment end diameter, then the defect measurement is set equal to the segment end diameter.

i. DIAMETER DEDUCTION (Defect Method 2)

For a diameter deduction, the recorded deduction will be applied to the end diameter of each log segment and the defect will be determined as described in section IV.C.2.a.ii., page 19.

ii. SQUARED AREA (Defect Method 3)

For squared area, defect for each segment in a multi-segment log will be calculated by employing the following taper rules to find the defect measurements on each segment end and then the defect for each segment will be calculated as described in section IV.C.2.a.iii., page 21.

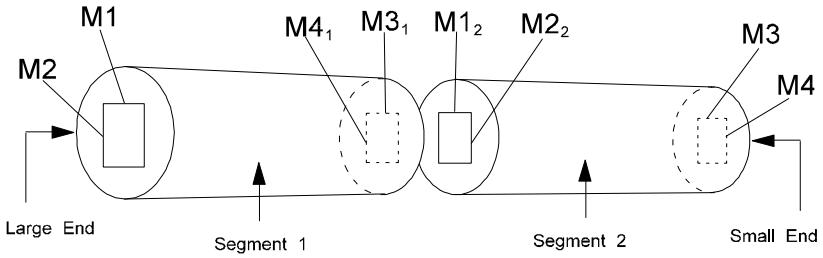
(1) TAPER FOR SQUARED AREA DEFECT

The taper for squared area defect is assigned by using the same rules that apply in determining diameters as detailed in section IV.B., page 12.

NOTE: When determining taper for squared area, always start with the smallest measurement and work toward the larger measurement. This procedure is irrespective of log diameters. This procedure will assign the most taper to the end of the defect with the smallest measurement when defect taper is uneven.

(a) TWO-SEGMENT LOG

M1 = Large End Defect Width, Segment 1
M2 = Large End Defect Height, Segment 1
$M3_1$ = Small End Defect Width, Segment 1
$M4_1$ = Small End Defect Height, Segment 1
$M1_2$ = Large End Defect Width, Segment 2
$M2_2$ = Large End Defect Height, Segment 2
M3 = Small End Defect Width, Segment 2
M4 = Small End Defect Height, Segment 2



Subtract small end measurements from large end measurements and take the absolute value of the result. This gives the taper for the measurement through the log. If the taper is even, divide the taper by two (the number of segments) and the result is the taper per segment. If the taper is odd, add one to the taper and then divide by two to get the taper per segment. Add the taper per segment to the small end of the defect to get the middle measurement.

An example (refer to Figure 12):

Let: M1 (Large End Defect Width, Segment 1) = 8
M2 (Large End Defect Height, Segment 1)=7
M3(Small End Defect Width, Segment 2)=5
M4(Small End Defect Ht, Segment 2)=5

Subtract the small end width from the large end:

$M1 - M3 = 8 - 5 = 3$

The result is odd so we add one and divide by two:

$WIDTH\ TAPER\ PER\ SEGMENT = 3 + 1 = 4 / 2 = 2$

Now, we do the same for heights:

$M2 - M4 = 7 - 5 = 2$

The result is even so we divide by two:

$HEIGHT\ TAPER\ PER\ SEGMENT = 2 / 2 = 1$

We add the tapers to the small end of the defect to yield the middle measurements:

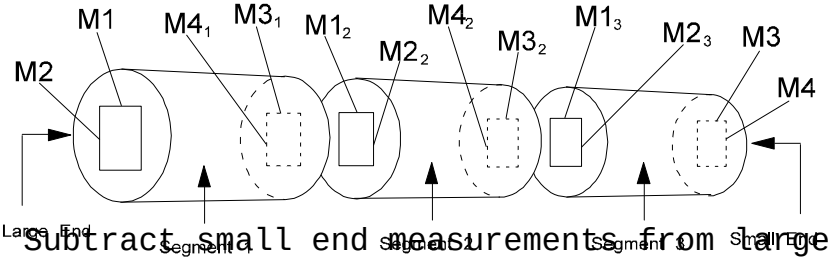
$M3_1 = M1_2 = M3 + 2 = 5 + 2 = 7$

$M4_1 = M2_2 = M4 + 1 = 5 + 1 = 6$

Note that the small end of segment one has the same measurements as the large end of segment two.

(2) THREE-SEGMENT LOG

$M1$ = Large End Defect Width, Segment 1
$M2$ = Large End Defect Height, Segment 1
$M3_1$ = Small End Defect Width, Segment 1
$M4_1$ = Small End Defect Height, Segment 1
$M1_2$ = Large End Defect Width, Segment 2
$M2_2$ = Large End Defect Height, Segment 2
$M3_2$ = Small End Defect Width, Segment 2
$M4_2$ = Small End Defect Height, Segment 2
$M1_3$ = Large End Defect Width, Segment 3
$M2_3$ = Large End Defect Height, Segment 3
$M3$ = Small End Defect Width, Segment 3
$M4$ = Small End Defect Height, Segment 3



Subtract small end measurements from large end

measurements and take the absolute value of the result. This gives the taper for the measurement through the log. If the taper is divisible by three (the number of segments), then divide the taper and the result is the taper per segment. Otherwise, the taper is raised to a number that is divisible by three and divided. The result is the taper per segment. Add the taper per segment to the small end of the defect to get the measurement of the top end of the middle segment. The remainder of the taper is distributed as in a two-segment log.

An example (refer to Figure 13):

Let: M1 (Large End Defect Width, Segment 1) = 8
M2 (Large End Defect Height, Segment 1) = 7
M3 (Small End Defect Width, Segment 2) = 5
M4 (Small End Defect Height, Segment 2) = 5

First we subtract the small end width from the large end width:

M1 - M3 = 8 - 5 = 3

The result is evenly divisable by the number of segments:

WIDTH TAPER PER SEGMENT = 3 / 3 = 1

Now, we do the same for heights:

M2 - M4 = 7 - 5 = 2

The result is not divisable by three (the number of segments) so we add one and then divide by three:

HEIGHT TAPER PER SEGMENT = (2+1) / 3 = 3 / 3 = 1

We add the tapers to the small end of the defect to yield the middle measurements:

$M3_2 = M1_3 = M3 + 1 = 5 + 1 = 6$

$M4_2 = M2_3 = M4 + 1 = 5 + 1 = 6$

Note that the small end of segment two has the same measurements as the large end of segment three.

(3) LOGS OF FOUR OR MORE SEGMENTS

The procedures used to calculate taper for three-segment logs are used to calculate taper for logs of four or more segments. The exception is that the division factor is four or five (the number of segments) instead of three.

iii. RINGS (Defect Method 5)

For rings, defect for each segment in a multi-segment log will be calculated by applying the taper rules used to find log diameters to each ring to find the ring dimension on each segment end (section IV.B., page 12). The ring dimensions for each segment will then be used to determine the defect for that segment as described in section IV.C.2.a.v., page 24.

D. BOARD FOOT CALCULATIONS

NOTE: - All volumes are represented in DECIMAL C.
- RND_TENS = a function that rounds to the nearest tens.
- SCRIB = a procedure that calculates the Scribner volume using length and small end diameter.

1. BOARD FOOT GROSS VOLUME

BDFT GROSS VOLUME = RND_TENS [SCRIB (LN, DI)]

where:
LN = Length of the log or segment (feet).
DI = Small end diameter of the log or segment (inches).

2. BOARD FOOT DEFECT VOLUME

a. ONE-SEGMENT LOG (Length <= 20)

Table 7. LOG BOARD FOOT DEFECT MEASUREMENTS

Defect Type Recorded	How variables are set for calculations	
	LN	DI
LENGTH DEDUCTION	Total Length - Length Ded.	Small End Diam.
DIAMETER DEDUCTION	Total Length	Small End Diam. - Diameter Ded.
VOLUME DEDUCTION	N/A	N/A
LENGTH DED. & DIAMETER DED.	Total Length - Length Ded.	Small End Diam. - Diameter Ded.

where: N/A = Not Applicable

FOR ALL DEFECTS EXCLUDING VOLUME DEDUCTIONS

BDFT DEFECT VOLUME = BDFT GROSS VOLUME - RND_TENS [SCRIB (LN, DI)]

VOLUME DEDUCTION ONLY

BDFT DEFECT VOLUME = VOLUME DEDUCTION

b. MULTI-SEGMENT LOG (Length > 20)

NOTE: No LENGTH DEDUCTION or VOLUME DEDUCTION for a multi-segment log is allowed under the Log Defect level.

DIAMETER DEDUCTION

LN = Length of the log or segment (feet).
DI = Resulting small end diameter of the log or segment after the diameter deduction is subtracted from the small end diameter of the log or segment (inches).

BDFT DEFECT VOLUME = BDFT GROSS VOLUME - RND_TENS [SCRIB (LN, DI)]

3. BOARD FOOT SEGMENT DEFECT VOLUME

Table 8. SEGMENT BOARD FOOT DEFECT MEASUREMENTS

Defect Type Recorded	How variables are set for calculations	
	LN	DI
LENGTH DEDUCTION	Segment Length - Segment Length Cut	Segment SED
DIAMETER DEDUCTION	Segment Length	Segment SED - Segment Diam. Cut
VOLUME DEDUCTION	N/A	N/A
LENGTH DED. & DIAMETER DED.	Segment Length - Segment Length Cut	Segment SED - Segment Diam. Cut

where: N/A = Not Applicable
SED = Small End Diameter

FOR ALL DEFECTS EXCLUDING VOLUME DEDUCTIONS

BDFT DEFECT VOLUME = BDFT GROSS VOLUME - [RND_TENS (SCRIB (LN, DI)]

VOLUME DEDUCTION ONLY

BDFT DEFECT VOLUME = VOLUME DEDUCTION

4. BOARD FOOT NET VOLUME

BDFT NET VOLUME = BDFT GROSS VOLUME - BDFT DEFECT VOLUME

APPENDIX A

DATA ENTRY COMMANDS FOR CUBIC SCALE PROGRAM VERSION 4.1

COMMAND	PURPOSE
CURSOR CONTROL	
Left and Right arrow	Move the cursor left or right
Up and Down arrow	Move the cursor up or down
Backspace	Same as Left arrow key
Tab and Backtab	Move cursor to next respective field
Delete	Delete a record
Page Up	Move up one screen
Page Down	Move down one screen
Home	Move to beginning of data
End	Move to end of data
SCREEN CONTROL	
Alt-B	Go to board defect screen
Alt-C	Go to cubic defect screen
Alt-E	Display error codes and descriptions
Alt-H	Go to header screen
Alt-K	Display KZ Values (3P only)
Alt-L	Go to log screen
Alt-M	Sure-to-measure (3P only)
Alt-N	Switch screen to Right/Left
Alt-R	Go to remarks field
Alt-S	Go to segment screen
Alt-V	Go to boundary values screen
Alt-Y	Go to segment cubic defect screen
Alt-Z	Go to segment board defect screen
?	Go to help screen
Esc	Exit program
OUTPUT CONTROL	
Ctrl-D	Delete current work file
Ctrl-F	File management
Ctrl-L	Display segment and total volumes for current log
Ctrl-O	Create output files
Ctrl-R	Create volume reports
Ctrl-S	Display defect volumes for each segment of the current log
Ctrl-T	Display total load volumes
Ctrl-V	Override volume (3P only)

NOTE: All of the above commands only apply in data entry mode

APPENDIX B

NOTE: The following commands only apply in data entry mode.

CURSOR CONTROL KEYS

COMMAND	RESULT
LEFT/RIGHT ARROW	Move the cursor left or right within a field or from one field to another.
UP/DOWN ARROW	Move the cursor from one record to another.
BACKSPACE	Same as Left arrow key
TAB AND BACKTAB	Move the cursor to next respective field.
DELETE or DEL	Delete a record. You will be prompted for a 'Y' or 'N'.
PAGE UP or PgUp	Scroll up one page in log records or cubic defect records. Has no effect in segment or board defect screens.
PAGE DOWN or PgDn	Scroll down one page in log records or cubic defect records. Has no effect in segment or board defect screens.
HOME	Move to beginning of log or cubic defect records. Has no effect in segment or board defect screens.
END	Move to end of log records or cubic defect records. Has no effect in segment or board defect screens.

APPENDIX B (continued)

SCREEN CONTROL KEYS

COMMAND	RESULT
ALT-B	Go to board defect screen.
ALT-C	Go to cubic defect screen.
ALT-E	Display error codes and respective descriptions.
ALT-K	Display the current KZ values.
ALT-L	Go to log screen.
ALT-M	Enter a sure-to-measure tree.
ALT-N	Switch screen to right or left screen. Only works in 3P log screen and any cubic defect screen.
ALT-R	Go to remarks field.
ALT-S	Go to segment screen.
ALT-V	Go to boundary values screen.
ALT-Y	Go to segment cubic defect screen. This option only works from the log screen.
ALT-Z	Go to segment board defect screen. This option only works from the log screen.
?	Go to help screen.
ESC	Go to previous screen. If the current screen is log screen, then this key will exit the program.

APPENDIX B (continued)

OUTPUT CONTROL KEYS

COMMAND	RESULT
CTRL-D	Delete current work file. WARNING! This will erase the data you are currently working on from memory and from the disk.
CTRL-F	Bring up the File Management menu. You can rename, delete, print, or catalog files in the current directory on the hard disk (or RAM disk).
CTRL-L	Display segment cuft and bdft volumes and total cuft and bdft volumes for the current log.
CTRL-O	Create output file. Will create files as follows: NOT FINISHED - makes file called 'WORK'. File can be changed anytime within this program after using this option. FINISHED - Uses log receipt number as filename and '.OUT' as extention. File cannot be changed within this program after using this option.
CTRL-R	Create one of three types of volume reports: COMPREHENSIVE - shows all information including log and segment data, cuft and bdft defects, and volumes. Does not show volume totals SEGMENT - shows log and segment data. Does not show volume totals. LOG - shows only log data. Shows volume totals.
CTRL-S	Display defect data and volumes for each segment of the current log
CTRL-T	Display total cuft and bdft volumes for the load.
CTRL-V	Override volume. Removes log from volume output.

APPENDIX C

DESCRIPTION OF OUTPUT RECORDS FOR THE CUBIC SCALE PROGRAM VERSION 4.1

HEADER RECORD (Record Type - 1A)

FIELDS ASSOCIATED WITH A HEADER RECORD	REC SIZE	REC LOCATION
RECORD TYPE	2	1:2
SCALE DATE	8	3:10
SCALER	5	11:15
LOCATION	10	16:25
SALE NAME	8	26:33
LOAD RECEIPT	6	34:39
CONTRACT	8	40:47
SAMPLE GROUP	2	48:49
FOREST	2	50:51
DISTRICT	2	52:53
MERCH. SPECS. (SAW)	2	54:55
MERCH. SPECS. (PULP)	2	56:57

LOG RECORD (Record Type - 2A)

FIELDS ASSOCIATED WITH A LOG RECORD	REC SIZE	REC LOCATION
RECORD TYPE	2	1:2
SALE NAME	8	3:10
LOAD RECEIPT	6	11:16
LOG NUMBER	3	17:19
SPLIT	1	20:20
SPECIES	2	21:22
LOG LENGTH	2	23:24
LARGE END DIAMETER	2	25:26
SMALL END DIAMETER	2	27:28
PRODUCT	1	29:29
GRADE	1	30:30
BUTT LOG (Y/N)	1	31:31
ESTIMATE (KPI)	4	32:35
RANDOM NUMBER	4	36:39
HIT	1	40:40
REMARKS	10	41:50

APPENDIX C (continued)

LOG CUBIC DEFECT RECORD (Record Type - 2B)

FIELDS ASSOCIATED WITH A LOG CUBIC DEFECT RECORD	REC SIZE	REC LOCATION
RECORD TYPE	2	1:2
SALE NAME	8	3:10
LOAD RECEIPT	6	11:16
LOG NUMBER	3	17:19
DEFECT METHOD	1	20:20
DEFECT TYPE	1	21:21
MEASUREMENT ONE	2	22:23
MEASUREMENT TWO	2	24:25
MEASUREMENT THREE	2	26:27
MEASUREMENT FOUR	2	28:29
LENGTH DEDUCTION	2	30:31
PERCENT DEDUCTION	2	32:33
PERCENT FIBER LOSS	2	34:35

LOG BOARD DEFECT RECORD (Record Type - 2C)

FIELDS ASSOCIATED WITH A LOG BOARD DEFECT RECORD	REC SIZE	REC LOCATION
RECORD TYPE	2	1:2
SALE NAME	8	3:10
LOAD RECEIPT	6	11:16
LOG NUMBER	3	17:19
LENGTH CUT	2	20:21
DIAMETER CUT	2	22:23
VOID DEDUCTION	3	24:26

SEGMENT RECORD (Record Type - 3A)

FIELDS ASSOCIATED WITH A SEGMENT RECORD	REC SIZE	EC LOCATION
RECORD TYPE	2	1:2
SALE NAME	8	3:10
LOAD RECEIPT	6	11:16
LOG NUMBER	3	17:19
SEGMENT NUMBER	1	20:20
SEGMENT LENGTH	2	21:22
SEG LARGE END DIAMETER	2	23:24
SEG SMALL END DIAMETER	2	25:26
PRODUCT	1	27:27

APPENDIX C (continued)

SEGMENT CUBIC DEFECT RECORD (Record Type - 3B)

FIELDS ASSOCIATED WITH A SEGMENT CU DEFECT RECORD	REC SIZE	REC LOCATION
RECORD TYPE	2	1:2
SALE NAME	8	3:10
LOAD RECEIPT	6	11:16
LOG NUMBER	3	17:19
SEGMENT NUMBER	1	20:20
DEFECT METHOD	1	21:21
DEFECT TYPE	1	22:22
MEASUREMENT ONE	2	23:24
MEASUREMENT TWO	2	25:26
MEASUREMENT THREE	2	27:28
MEASUREMENT FOUR	2	29:30
LENGTH DEDUCTION	2	31:32
PERCENT DEDUCTION	2	33:34
PERCENT FIBER LOSS	2	35:36

SEGMENT BOARD DEFECT RECORD (Record Type - 3C)

FIELDS ASSOCIATED WITH A SEGMENT BD DEFECT RECORD	REC SIZE	REC LOCATION
RECORD TYPE	2	1:2
SALE NAME	8	3:10
LOAD RECEIPT	6	11:16
LOG NUMBER	3	17:19
SEGMENT NUMBER	1	20:20
LENGTH CUT	2	21:22
DIAMETER CUT	2	23:24
VOID DEDUCTION	3	25:27

APPENDIX D - General Formulas For Computing Volumes

NOTE: These abbreviations apply for all of the equations below:

LED = LARGE END DIAMETER
SED = SMALL END DIAMETER
LENGTH = LENGTH OF LOG OR SEGMENT

GROSS VOLUME IN CUBIC FEET

$$VOLUME = 0.002727 * (LED^2 + SED^2) * LENGTH$$

LENGTH DEDUCTION DEFECT VOLUME IN CUBIC FEET

VOLUME = GROSS VOLUME * (LENGTH DEDUCTION / LENGTH)

DIAMETER DEDUCTION DEFECT VOLUME IN CUBIC FEET

DIAM1 = LARGE END DIAMETER - DIAMETER DEDUCTION
DIAM2 = SMALL END DIAMETER - DIAMETER DEDUCTION

$$VOLUME = 0.002727 * (DIAM1^2 + DIAM2^2) * LENGTH$$

SQUARED AREA DEFECT VOLUME IN CUBIC FEET

VOLUME = (WIDTH * HEIGHT * LENGTH) / 144

where:
WIDTH = WIDTH OF DEFECT (Inches)
HEIGHT = HEIGHT OF DEFECT (Inches)
LENGTH = LENGTH OF DEFECT (Feet)

PERCENT DEDUCTION DEFECT VOLUME IN CUBIC FEET

VOLUME = GROSS VOLUME * PERCENT DEDUCTION

RINGS DEFECT VOLUME IN CUBIC FEET

VOLUME = VOLUME OF CORE * 0.273

APPENDIX E - TABLE OF CUBIC DEFECT CODES

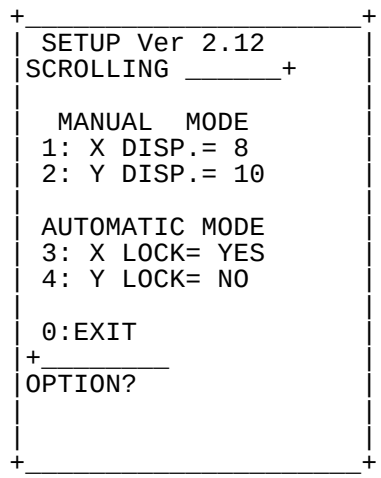
CODE	DEFECT METHOD
1	LENGTH CUT
2	DIAMETER CUT
3	SQUARED AREA
4	PERCENT DEDUCTION
5	RINGS

APPENDIX F - DAP PC9000

SCREEN SETUP

The PC9000 needs to be set with a certain screen configuration to work properly. The following steps will show you how to set the screen for the PC9000.

1) After turning the PC9000 on, move to the C drive.
2) Type "SETUP" and press <ENTER>.
3) Select menu option 3. The screen should look like the following figure:



If the options on your PC9000 are different from the ones in the above figure, then set them so they match.

COMMUNICATIONS

The PC9000 has two communications ports, a 15-pin serial port, COM1, on the bottom of the unit, and a 25-pin serial port, COM2/LPT1, on the top. WARNING! The PC9000 has been burned out a few times before it was discovered that the COM2 port is a serial port and not a parallel port. Do not use COM2 for any form of parallel communications unless you have the special adapter provided by DAP Technologies.

FILE TRANSFER: IBM PC --> DAP PC9000

1) Use the cable that came with the PC9000 and attach the 15-pin connector to the bottom of the PC9000 and attach the 25-pin connector to a serial port, COM1 or COM2, on your IBM PC.

2) Execute the COM program on the PC9000 and on the PC. The order or interval of execution is not important.

3) If you are using a port other than COM1 on the IBM PC, then you will need to change the port by selecting number 6. Also you need to make sure that the baud rate is the same on both machines. It is recommended that you use 38400 bauds as this will result in the fastest file transfer. The ports of both machines should be configured as follows:

OPTION	SETTING
Speed	38400
Length	8
Parity	Even
Stop bits	1
Retry	N

4) Once the setup is complete, press 2 on the IBM PC. This will put the PC into 'MASTER' mode and the PC9000 into 'SLAVE' mode. You will see the 'MASTER' menu on the PC.

5) On the IBM PC, press 1 to select the 'SEND' option. You will then be prompted for the name of the file to send.

6) Enter the name of the file that you want to send to the PC9000. If the file is not located in the directory you were in before you executed the COM program, then you will have to enter the full path name. If you are not sure, just enter the full pathname. Example: C:\DATA\999.LOG **NOTE:** You can use wildcards ('*') to send multiple files. For example, to send to the IBM PC all of the files that have a '.OUT' extension, just type: '*.OUT'.

7) You will then be prompted for the name of the destination file. Enter the name you want the file to be called on the PC9000. Example: NEWDATA.LOG **NOTE:** If you used a wildcard, just press <ENTER>.

NOTE: For steps 6 and 7 follow the rules of MS-DOS just like you were copying a file from one drive or directory to another.

8) When the file has been successfully sent, you will briefly see this message on the PC: 'Command

Complete' The program will then go back to the 'MASTER' menu. If you have more files to send then go to step 5, else press 0 to quit.

9) Press 0 on the DAP and PC to quit the COM programs.

FILE TRANSFER: DAP PC9000 --> IBM PC

1) Do steps 1-4 in 'FILE TRANSFER: IBM PC --> DAP PC9000' on page 8.

APPENDIX F (continued)

2) On the IBM PC, press 2. You will then be prompted for the name of the file to retrieve.

3) Enter the name of the file that you want to reveive from the PC9000. If the file is not found, then you may need to enter the full path name of the DAP file. If you are not sure then just enter the full pathname. Example: 999.LOG
NOTE: You can use wildcards ('*') to send multiple files. For example, to send to the IBM PC all of the files that have a '.OUT' extension, just type: '*.OUT'.

4) You will then be prompted for the name of the destination file. The PC screen will look like FIG. 7. Enter the name you want the file to be called on the IBM PC.
Example: C:\DATA\NEWDATA.LOG
NOTE: If you used a wildcard, just press <ENTER>.

NOTE: For steps 3 and 4, follow the rules of MS-DOS commands just af if you were copying a file from one drive or directory to another on your IBM PC.

5) When the file has been successfully retrieved, you will briefly see this message on the PC: 'Command Complete' The COM program running on the PC will then go back to the 'MASTER' menu. If you have more files to retrieve then go to step 2, otherwise press 0 to quit.

6) Press 0 on the DAP and PC to quit the COM programs.

APPENDIX G - HUSKY HUNTER 16

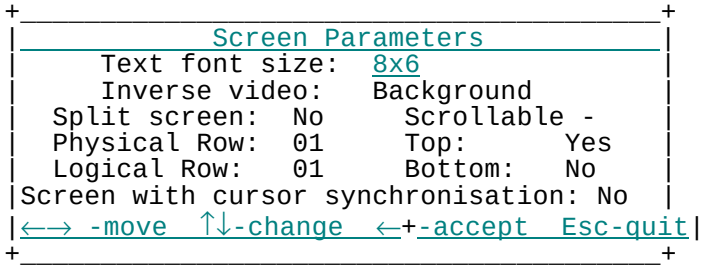
SCREEN SETUP

The HUNTER needs to be set with a certain screen configuration to work properly. The following steps will show you how to set the screen for the HUNTER.

1) Turn the HUNTER on.

2) Go to the HELP screen by pressing the "paw" key (on the lower-right of the screen) and the "H" key simultaneously.

3) Select menu item "Screen." The screen should look like the following figure:



If the options on your HUNTER are different from the ones in the above figure, then set them so they match.

NOTE: After setting the screen options, you must press <ENTER> to save the changes.

COMMUNICATIONS

The HUNTER has one communication port, a 25-pin serial port, COM1, on the right side of the unit. The communications cable for moving files between the HUNTER and PC is a simple 'crossed cable' and has to be wired as follows:

IBM PC HAS 25-PIN PORT

HUNTER 16 (25-pin)	IBM PC (25-pin)
2	3
3	2
4	6
5	4
6	5
6	20
7	7

IBM PC HAS 9-PIN PORT

HUNTER 16 (25-pin)	IBM PC (9-pin)
2	2
3	3
4	6
5	7
6	8
6	4
7	5

APPENDIX G (continued)

FILE TRANSFER: IBM PC --> HUSKY HUNTER 16

1) Execute the PCCOM program on the IBM PC and the PCCOM16 program on the HUNTER. These programs differ only in the format of their screens. They are identical in function. Press any key twice to get past the title screens.

2) Press the F3 key on the PC to set the port and baud rate (On the HUNTER you will need to hold down the paw print key (PAW) located at the bottom right part of the keyboard and then press 3. Select the serial ports that the cable is attached to and then select baud rate 9600.

3) Press PAW-2 on the HUNTER and then select drive C to put it in 'RECEIVE' mode and then press F1 on the PC to put it in 'SEND' mode.

4) On the PC, enter the name of the file you want to send to the HUNTER. The file you want to send must be located in the current directory on the PC. If the file transfer is working, you should see, on both the HUNTER AND PC, a count of records being sent.

5) If the transfer is successful, you will be get messages on the machines to that effect. Press any key on the HUNTER and on the PC to get back to main menu. If you have more files to transfer, go to step 3.

6) To quit the programs on both machines press ESC.

FILE TRANSFER: HUSKY HUNTER 16 --> IBM PC

1) Do steps 1-2 in 'FILE TRANSFER: IBM PC --> HUSKY HUNTER 16' on this page.

2) Press F2 on the PC and then select drive C to put it in 'RECEIVE' mode and then press PAW-1 on the HUNTER to put it in 'SEND' mode.

3) On the HUNTER, enter the name of the file you want to send to the PC. The file you want to send must be located in the current directory on the HUNTER. If the transfer is working, you should see, on both the HUNTER AND PC, a count of records being sent.

4) If the transfer is successful, you will be get messages on the machines to that effect. Press any key on the HUNTER and on the PC to get back to main menu. If you have more files to transfer go to step 2.

5) To quit the programs on both machines press ESC.