MEASURING LOG DIMENSIONS 10

10.0 Measuring Log Dimensions

Following consistent and recognised procedures for measuring log diameters and lengths is one of the most rigorous tasks of the scaler. It is important to develop identical ways of taking measurements throughout the Yukon so that meaningful data is provided for users on an equitable basis.

10.1 Measuring Log Diameters

The objective of measuring log diameters is to record the single rad class that most closely represents the end area of a log, while avoiding excessive measurement. With the use of a Yukon Metric Scale Stick, radii for the purpose of volume calculations are found by:

- Measuring, in rads, across the diameter, along a plane perpendicular to the longitudinal axis, inside the bark of each end,
- If a log has an elliptical or oval (egg shaped) cross section, measuring two diameters at right angles to one another, through both the short and long axis of each end, averaging the diameter measurements, and rounding the result to the nearest even number where the averaged measurement falls exactly half-way between two radius classes,
- If a log has an irregular cross section, determining the approximate area of the cross section by measuring two or more axes of the cross section and determining the radius of a circle with an equivalent area, and
- Recording the rounded, average measurement (this measurement, if expressed as a diameter in rads is the same as the radius in centimetres).

10.1.1 Measuring Round and Out of Round Log Ends

The following illustration shows where measurements are taken on elliptical and oval logs and how they are averaged.

Diameter measurements are taken through the "centre of gravity" rather than the growth ring centre or geometric centre. This centre is found by first measuring at the widest point of the short axis and then measuring the long axis at right angles to the short axis.
Voids or abnormal protuberances are not considered when measuring diameters. Voids are accounted for in firmwood deductions (deduction section) as holes or missing wood and protuberances are outside of the normal line of taper. Abnormal protuberances occur when logs are bucked through a knot, burl, or goitre.

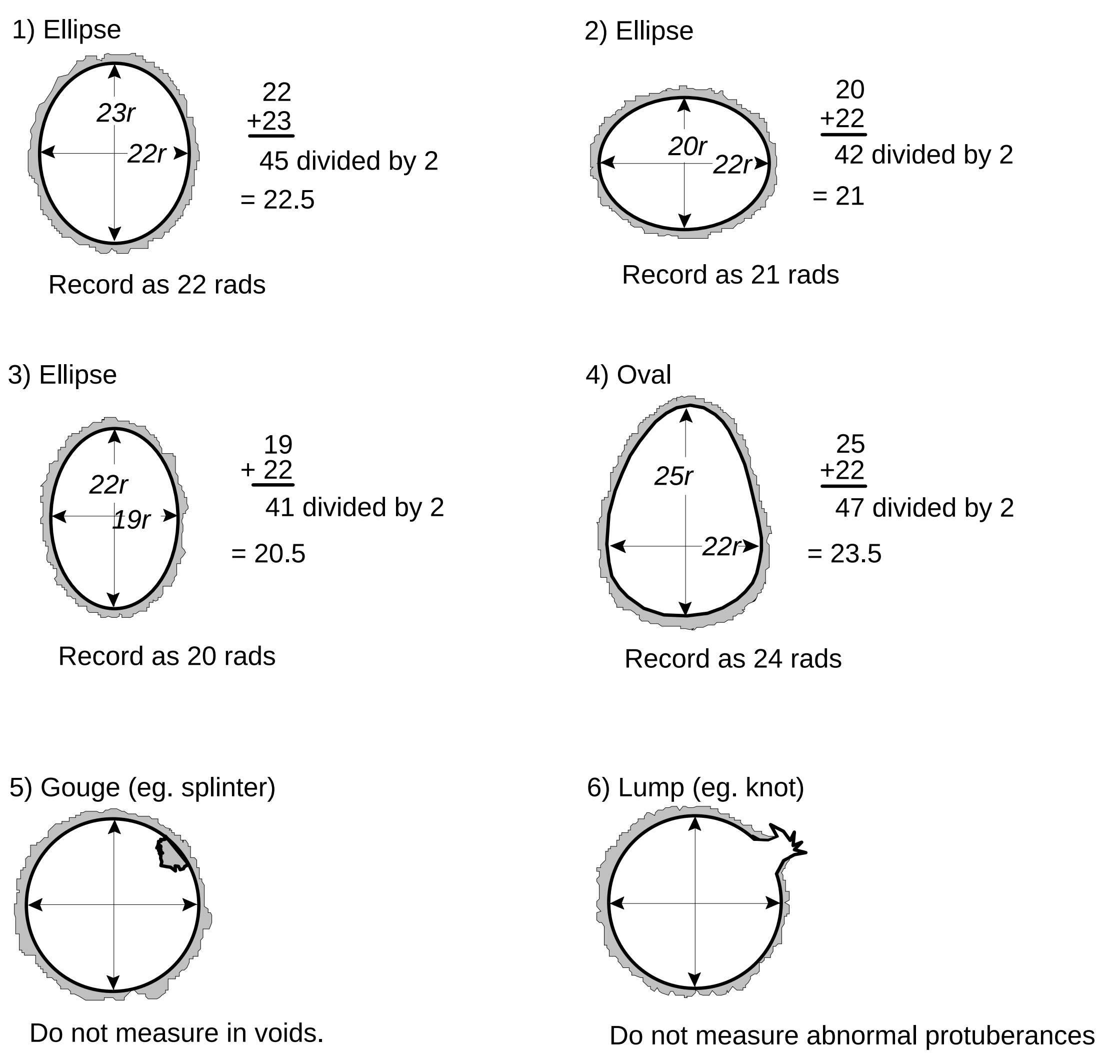
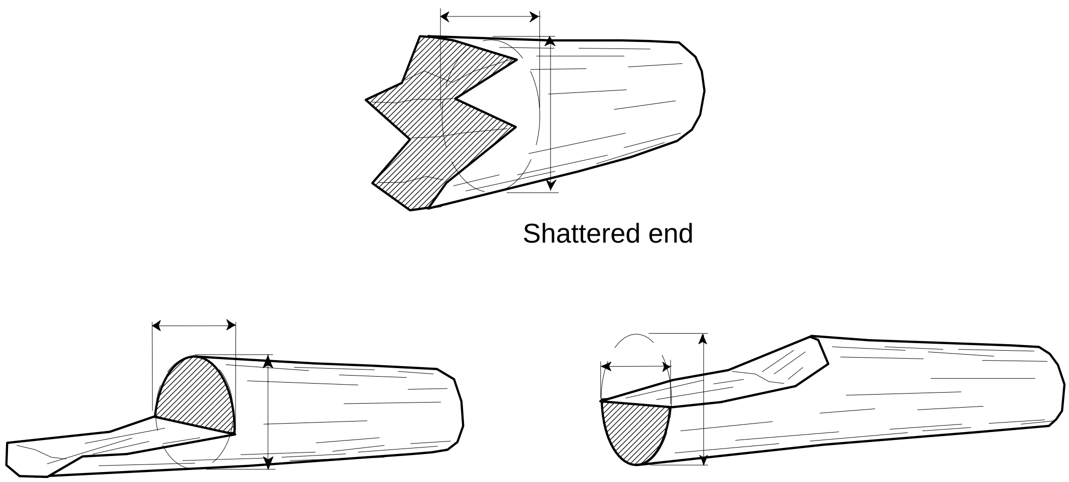


Figure 10.1 Methods for measuring and averaging diameters of log ends

10.1.2 Measuring Shattered and Split-back End Diameters

It is often difficult to measure across the end of a log with a shattered or split back end. They are measured by calipering the log at a point where the diameter of the log is obtainable, at a point as close as possible to the end (allowing for bark). If calipering at some distance from a top end, it may be necessary to reduce the calipered diameter to account for tapering down. If calipering some distance from a butt end, it may be necessary to increase the calipered diameter to account for tapering up.



Split back (sniped) ends

Figure 10.2 The method for measuring shattered and split back ends.

In all cases, the diameter is envisaged as if the wood was there, and if there is a significant amount of missing wood, a length deduction for missing wood should be taken as described in the firmwood deductions section.

10.1.3 Measuring Irregular End Diameters

Irregular ends are difficult to measure in the normal manner because it is not often easy to choose the points to measure from. You must envisage a circle, ellipse, or other shape, which best represents the firmwood volume of the irregular shape. Normally, irregular and fluted logs will fit in a circular or elliptical shape, where the widest part of the short axis can be found by taking sufficient measurements and the widest part of the long axis found by taking more measurements, then averaging the two. Flared *and* fluted logs must also have the flare accounted for. That is, any flutes or portions of flutes, which are outside of the normal line of taper, are not included in the assessment

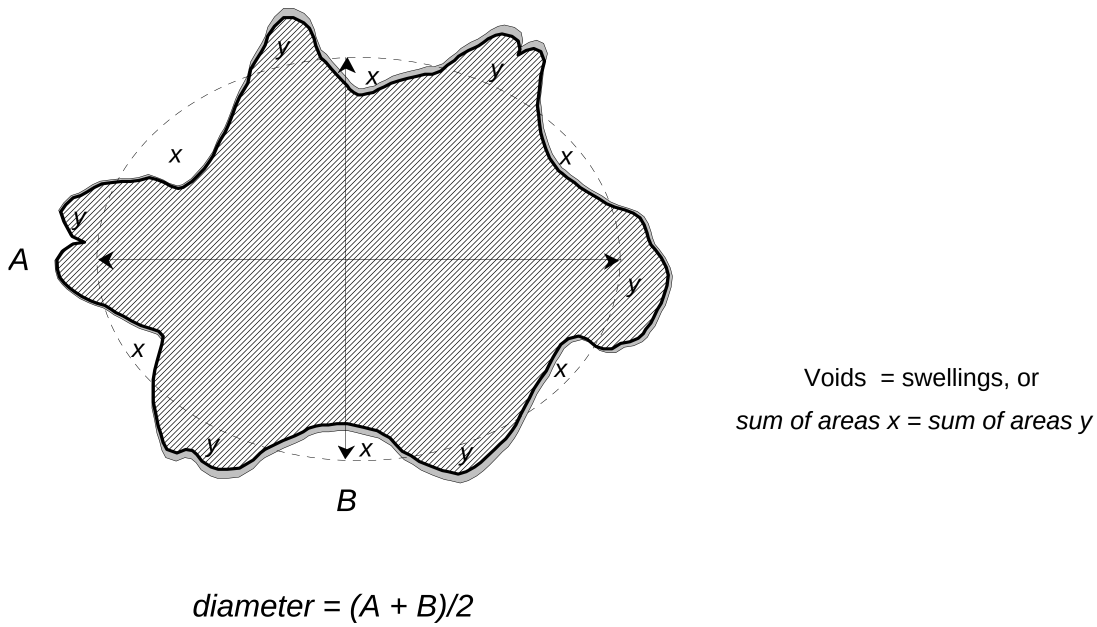


Figure 10.3 The method for measuring irregular diameters-except flared butts

10.1.4 Measuring Forked End Diameters

Logs are often forked and normally come into a scaling yard already bucked off at or very near the juncture (crotch). The scaler is presented with a range of shapes depending on where the buck occurred, and not only is challenged to obtain a diameter, but also to find a length when forks are bucked at different lengths.

If the buck is located:

- Just below the crotch of the fork, the shape is most likely oval or elliptical, and is measured as such. That is, across the widest part of the short axis and at the widest part of the long axis. The log may be calipered further down the log to confirm the measurement,
- At the crotch of the fork, the shape is evolving into distinctly separate stems, showing bark in between the two, but the adjoining faces are still in contact and quite flattened, and will not present enough of the individual cylinders to provide a diameter measurement from each segment. The face is measured as an oval or ellipse, but the measurement may have to be reduced to compensate for additional swell. Calipering further down the log is more reliable in these cases, and
- Above the crotch of the fork, the individual stems become distinctly circular in form. In these cases, the log should be calipered further down the log where the main stem is cylindrical and an adjustment made to account for normal taper. If both forks are of similar size (where the large diameter is no more than 1.5 times the smaller diameter), find the average diameter in rads of each stem, add the unit volumes for the two diameters, and locate a radius class unit closest to the sum. If the forks are of unequal length, an adjustment must be made to the log length to place it half way between the long and short fork.

Figure 10.4 This log was bucked below the crotch of the fork

10.2 Measuring Flared Butt Diameters

The bottom of many trees is buttressed by way of a flared, swollen or fluted portion that develops in response to wind stress and degree of root spread. Logs bucked from this area (i.e., butt logs) are typically neiloidic in shape

> Smalian's formula tends to overestimate the volumes of neiloids. Therefore, it is important that scalers compensate by reducing the actual end measurement to compensate for any swell, flare, or fluting. Failure to do so is the single largest cause of overscaling.

There are two methods of finding flared butt diameters - calipering and projecting the normal line of taper. Although calipering is by far the commonest method, it is good practice for scalers to use both methods on the same log from time to time, comparing the results to develop confidence and confirm technique.

10.2.1 Calipering

"Calipering" a log means to measure the diameter at a point other than at the cut face by placing the scale stick across the log and projecting two perpendicular sight lines to the points where the measurement is read. The novice scaler may practice calipering by first selecting a log without flare and directly measuring across its end in the normal manner callipering this log at a point close to the same end (allowing for bark) should give the same measurement. Practice will build confidence in callipering.
The larger the log, the more skill and care is required to get accurate dimensions and the greater the potential to overscale if the technique is not well developed.

Some points to remember when callipering are:

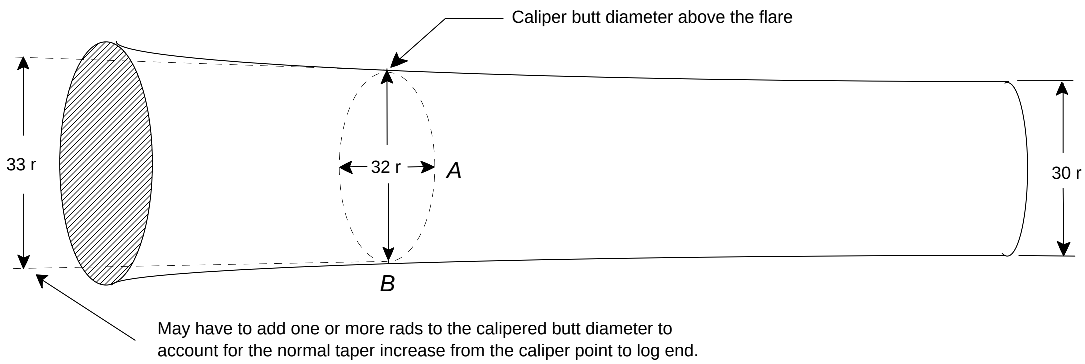
- Select a spot just above the flare,
- Keep sight lines perpendicular to the scale stick,
- Take two measurements on out of round logs,
- Caliper inside bark or subtract bark thickness,
- Project the normal line of taper from the calliper point to the butt end face and add one or more rads (if required), and
- Practice and compare results to the other method from time to time.

10.2.2 Projecting the Normal Line of Taper

The other method for measuring flared butts is for the scaler to stand behind the flared end and project the normal line of log taper through the flare to the cut face as in the following illustration
Novice scalers will find it helpful to use a logger's tape to project the line of taper: hook the tape at the top end of the log on one side, bring it back down the log and drape it over the flare. When pulled taut, the tape can be made to follow the taper and a mark can be placed upon the butt face. The process is repeated on the opposite side, and the projected diameter is measured between the two marks. This is not only a good way to learn the technique (which, when mastered, can be done by line of sight) but also can be useful, even to the expert, on the more challenging flared logs.

Where logs are out of round, they most frequently lie with their larger diameter, or long axis, in the horizontal plane. While it is easy enough to project the line of taper along both sides and top of a log, it is nearly impossible to project a line of taper along the bottom of a log because it is on the ground. Therefore, when scaling out of round logs, scalers should consider measuring the narrow diameter, or short axis, by callipering.

Projecting the normal line of taper is most commonly used on larger logs where callipering may be awkward or hazardous. On smaller flared logs it is generally expedient to calliper.



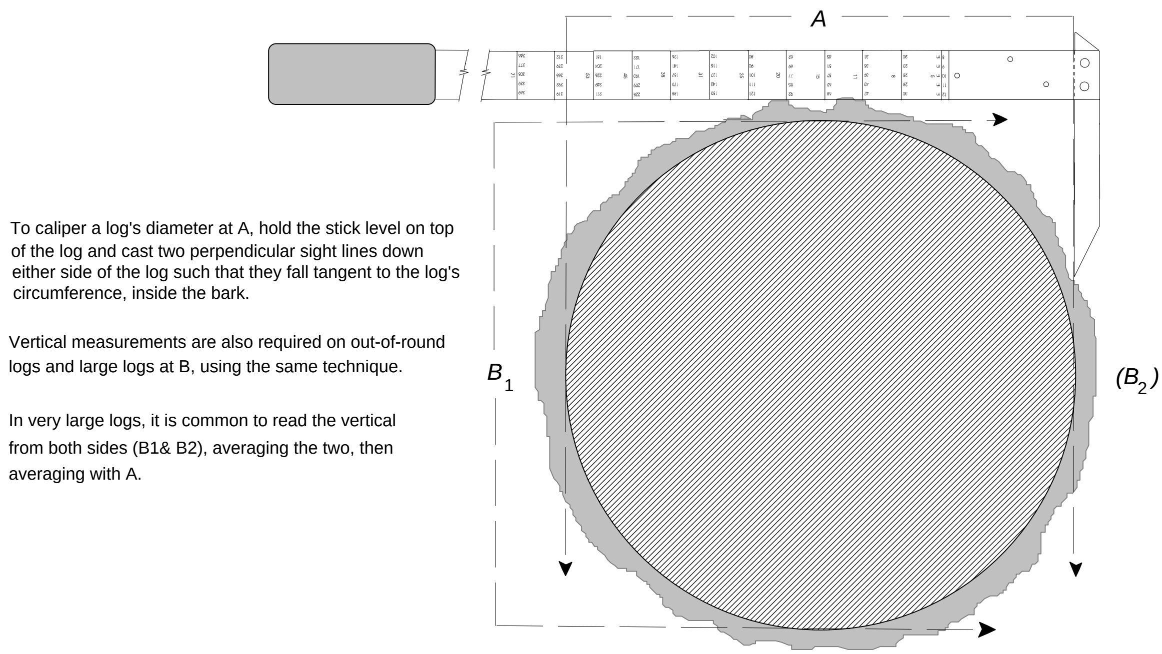
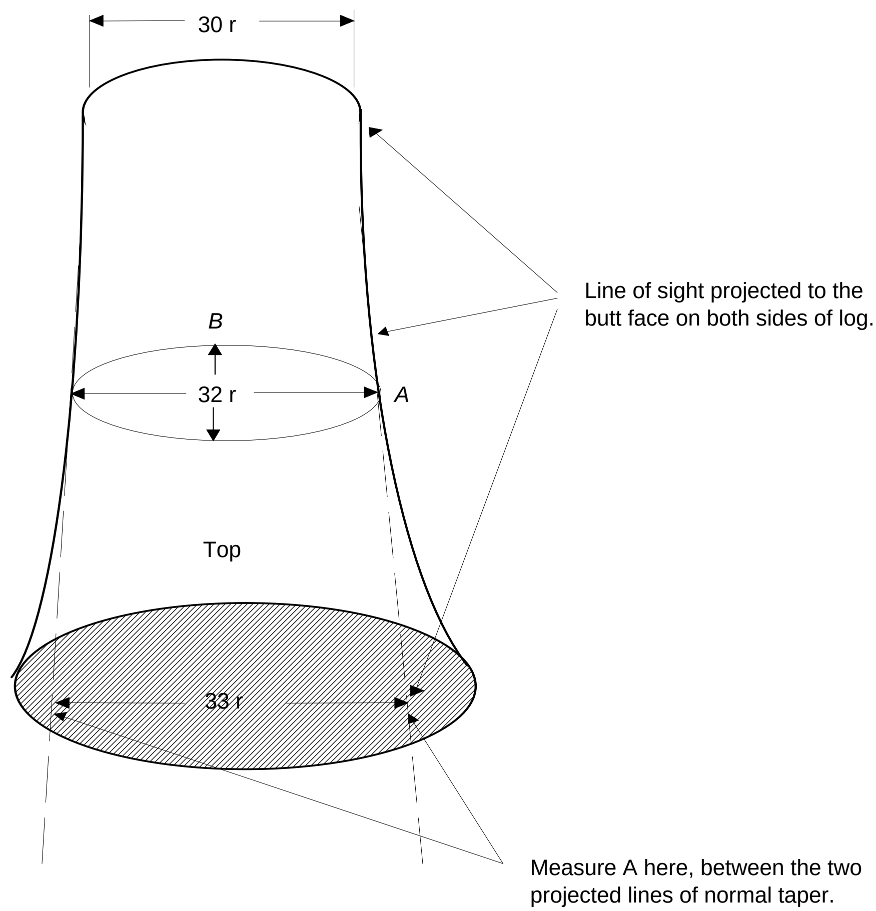


Figure 10.5 The method of measuring butt diameter by Callipering

Scalers should become adept at both methods.

Points to remember when projecting the line of taper:

- Stand back from the butt end (approximately 1.5 to 3 m),
- Project the normal line of log taper to the butt end face,
- Measure, at the butt face, between points where the projected lines of taper intersect the butt face, and
- Exercise caution on out of round logs.



Scaler stands 1.5 to 3 m back from the butt and projects the normal lines of taper through the flare.

The vertical measurement B for out-of-round logs is found by calipering.

Figure 10.6 Method of measuring butt diameter by projecting the normal log taper

10.3 Measuring Slab Ends

In scaling jargon, a slab is a piece of timber that has fractured along a plane that is roughly parallel to the longitudinal axis of the original log. The shapes of slabs are quite variable, ranging from nearly "plank-like" to virtually perfect semicylinders; however, most fall between the ideals. Even so, they can be seen as roughly triangular (three sided), quadrilateral (four sided), or semicircular in end view, and may be classified as *external*, or those having part of the outside circumference of the log in their shape, and *internal*, or those having no part of their outside circumference in their shape.

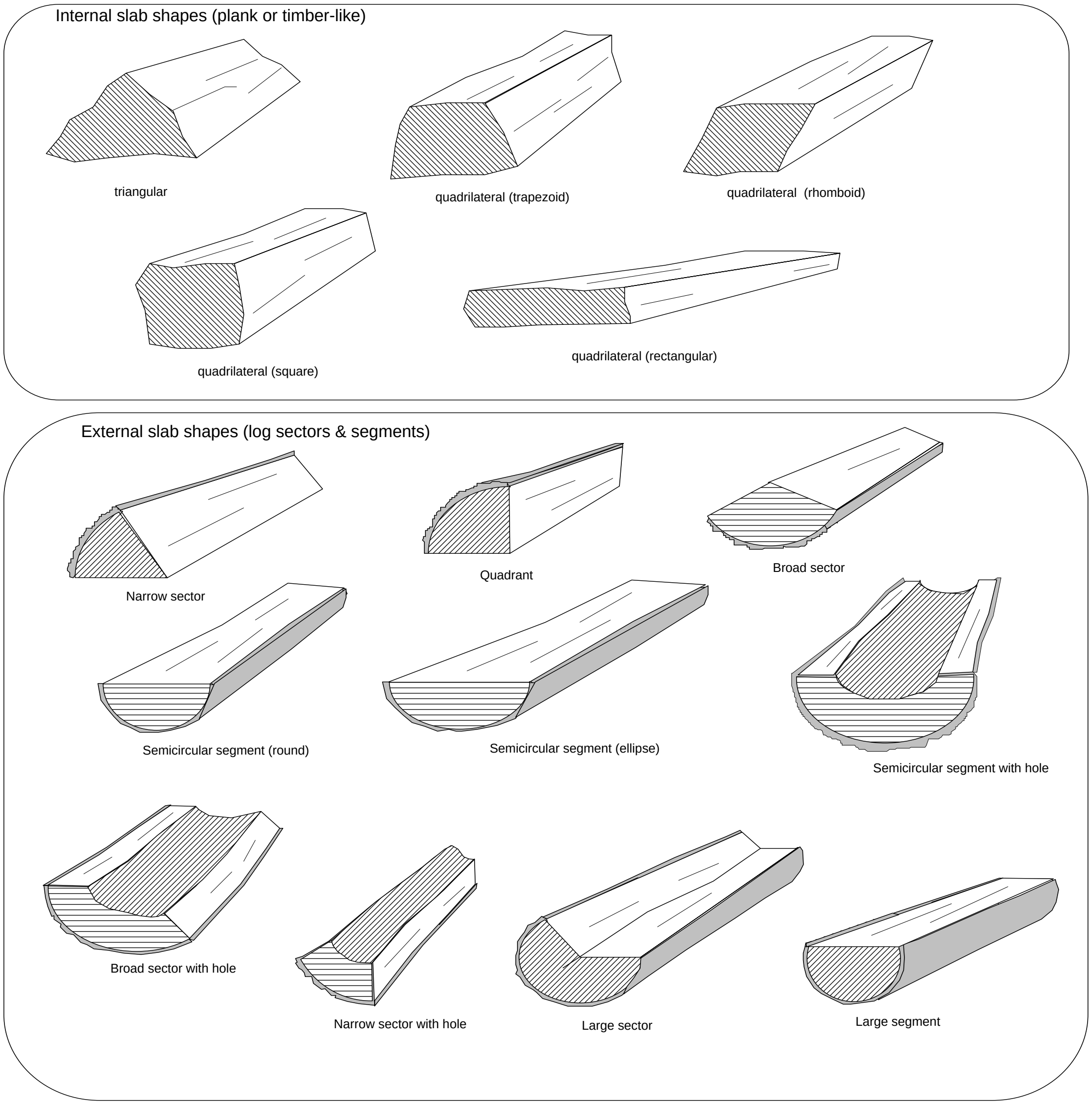


Figure 10.7 Typical slab shapes

As stated previously, Smalian's formula uses an average of the two end areas projected over the length of the piece to determine the volume. It follows that the challenge to the scaler measuring a slab is to record the two radius class units which fairly represent the areas of both slab ends and which, when inserted into Smalian's formula, will yield the firmwood volume. This derived or "effective" radius can be determined either by enclosing the end area with one of a "semicircle", a "pie wedge", a quadrilateral (four sided) or a triangle (three sided) shape, depending upon which most nearly matches the slab end. Regardless of the shape, measurements are always taken at right angles (90 degrees) to one another. Internal slab shapes, which are quite irregular, may require more than one measurement on an axis to arrive at an average width or average thickness.

10.3.1 Measuring Semicircular Slab Ends

The most frequently encountered external slab shape has a "semicircular" end profile. A true semicircle is exactly one half the original circle. Normally logs are not perfect circles and rarely

do they fracture exactly in the middle. Therefore, what we are calling a semicircle is more properly termed a segment, or the area transcribed by the intersection of a circle and a chord. Although not usually perfect semicircles, these shapes may be viewed, for scaling purposes, as being half of a whole or "parent" log of round, oval or elliptical shape.

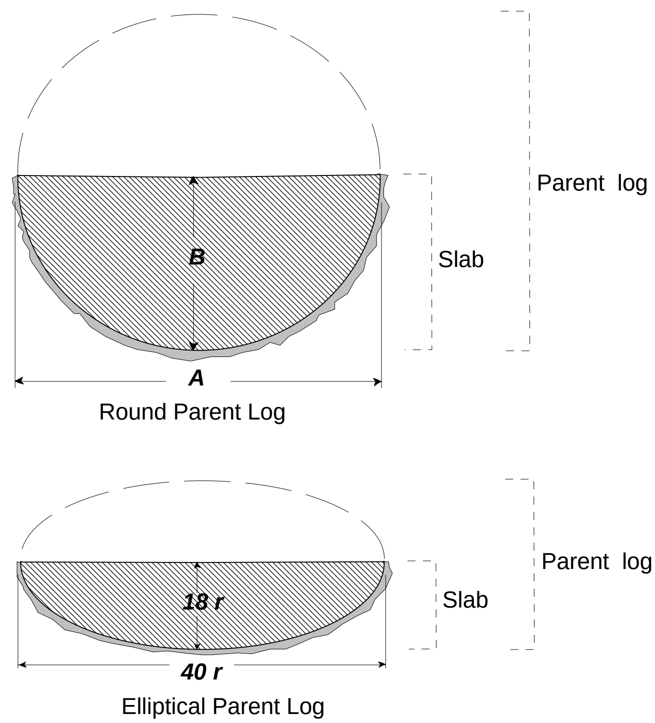


Figure 10.8 Measurement of a semicircular slab end

To find the volume of a semicircular slab it is necessary to:

- first derive the average diameter of an end of the parent log, from two measurements of the end of its segment,
- find the unit volume of the end of the parent log,
- divide the unit volume in two to find the unit volume of the end of the segment,
- record the radius class unit, which is closest to the segment's unit volume,
- repeat the above process for the other end of the slab, and
- record the length of the slab so that a volume may be calculated.

The scaling method to find a radius class representing the unit volume of the slab in previous illustration is as follows.

The measurements are taken across the width and thickness of the semicircular slab. The long-standing convention is to term the dimension, "**A**" which falls across what is, more or less, the parent log's diameter as the width. The other dimension "**B**", perpendicular to "**A**", and which is, more or less, the parent log's radius is termed the thickness. The width is measured at the point of

maximum width and the thickness is measured at the point of maximum depth at right angles to the width, ignoring any minor irregularities.

Then, the average diameter of one end of the parent log is derived from the measurements taken of its slab. The formula for determining the average diameter of one end of the parent log from the measurements of its semicircular slab is:

$$Parent\ \log\ diameter = \frac{A + 2B}{2}$$

For example, if $A = 40$ rads and $B = 18$ rads,

$$Parent\ \log\ diameter = \frac{40 + 2x18}{2}$$

$$Parent\ \log\ diameter = \frac{76}{2}$$

$$Parent\ \log\ diameter = 38\ rads$$

Next, the unit volume for 38 is located on the scale stick (454) and divided by 2. Finally, the unit volume nearest to that resulting unit volume (227) is located on the scale stick, and the corresponding radius class unit is recorded. In this case, the closest unit volume is 229, which corresponds to 27 rads. The process is repeated at the other end of the slab.

10.3.2 Measuring a Semicircular Slab End with Hole

Logs with advanced heart rot or hole may split into slab sectors or segments. To scale a semicircular slab with a hole, the dimensions for the parent log and the hole are derived, and the unit volume of the hole is subtracted from the unit volume of the parent log before division by 2.

To find the volume of a semicircular slab with a hole, it is necessary to:

- First derive the average diameter of an end of the parent log, from two measurements of the end of its segment,
- Find the unit volume of the end of the parent log,
- Derive the average diameter of an end of the "parent hole", from two measurements of the end of its segment,
- Find the unit volume of the end of the parent hole,
- Subtract the unit volume of the parent hole from the unit volume of the parent log,
- Divide the result in two to find the unit volume of the end of the slab,

- Locate and record the radius class unit, which is closest to the segment's unit volume,
- Repeat the above process for the other end of the slab, and
- Record the length of the slab so that a net volume may be calculated.

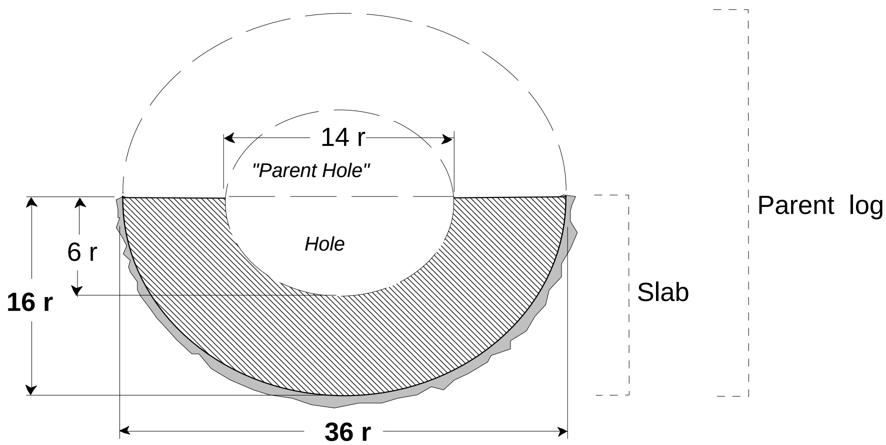


Figure 10.9 Measurement of a semicircular slab end with hole

The scaling method to find a radius class representing the unit volume of the slab in the previous illustration is:

The measurements are taken across the width and thickness of the semicircular slab. Then, the average diameter of one end of the parent log is derived from the formula:

$$Parent\ \log\ diameter = \frac{A + 2B}{2}$$

$$Parent\ \log\ diameter = \frac{36 + 2x16}{2}$$

$$Parent\ \log\ diameter = \frac{68}{2}$$

$$Parent\ \log\ diameter = 34\ rads$$

The unit volume for 34 rads is located on the scale stick (363).

Next, the average diameter of one end of the parent hole is derived in the same manner:

$$Parent\ hole\ diameter = \frac{14 + (2x06)}{2}$$

$$Parent\ hole\ diameter = \frac{26}{2}$$

$$Parent\ hole\ diameter = 13\ rads$$

The unit volume for 14 rads is located on the scale stick (53) and is subtracted from the unit volume of the parent log and divided by 2 to arrive at the unit volume of the slab.

$$Slab\ unit\ volume = \frac{parent\ \log\ unit\ volume - parent\ hole\ unit\ volume}{2}$$

$$Slab\ unit\ volume = \frac{363 - 53}{2}$$

$$Slab\ unit\ volume = \frac{310}{2}$$

$$Slab\ unit\ volume = 155$$

Finally, the unit volume nearest to the slab unit volume is located on the scale stick, and the corresponding radius class unit is recorded. In this case, the closest unit volume is 152, which corresponds to 22 rads. The process is repeated at the other end of the slab.

10.3.3 Measuring a Slab Sector with Hole

Slab sectors less than a semicircle with a hole are measured differently because it is virtually impossible to derive the dimensions of the parent log as shown in the previous example. There is not enough "meat" to reconstruct the parent log. The problem is similar with an attempt to apply the measurement technique of pie wedges as described in the next section.
The alternative is to "flatten out" these types of slabs to form a rectangular shape and measure across their width and thickness. The net dimension may then be found as described in detail in the *Measuring Four Sides Slab Ends* section.

Where:

$$\text{Four-sided slab Unit volume} = A \times B \times 0.4$$

The unit volume nearest to the slab unit volume is located on the scale stick, and the corresponding radius class unit is recorded.

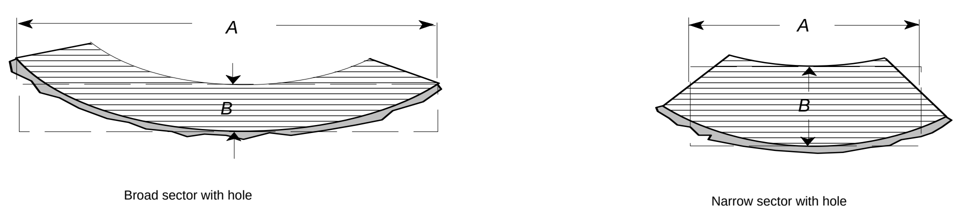


Figure 10.10 Measurement of a Sector Slab End with Hole

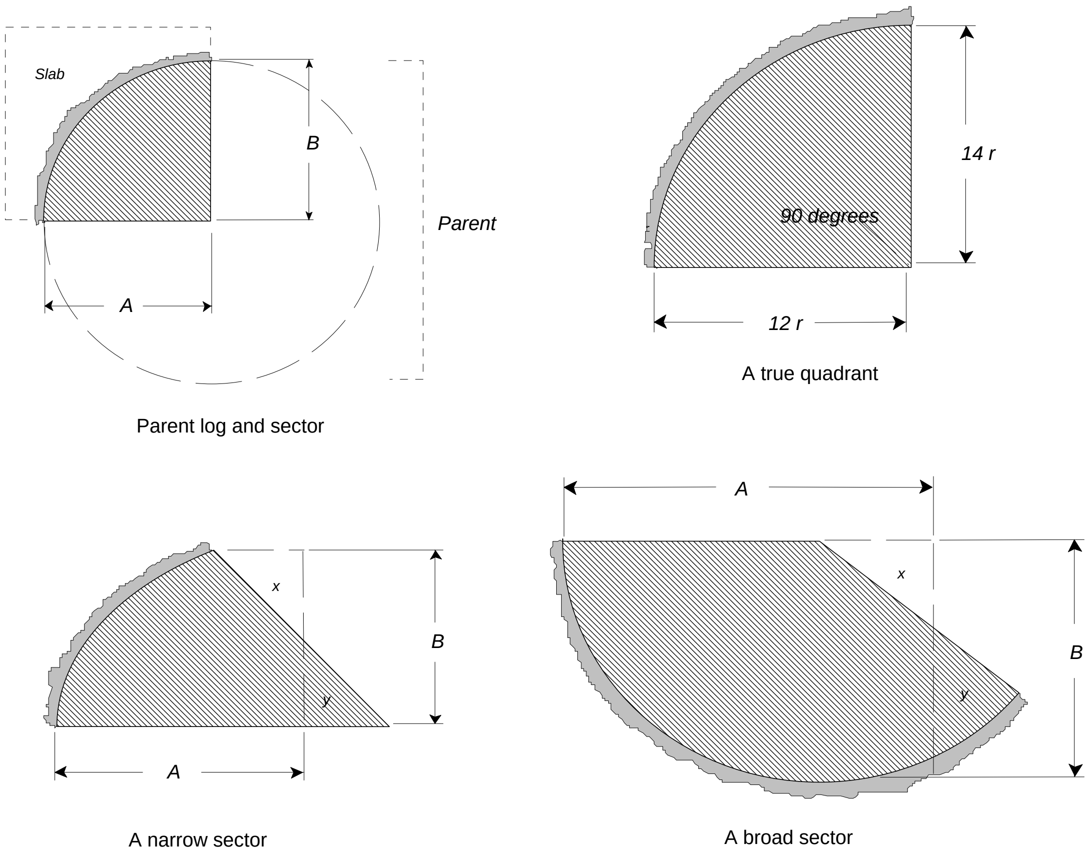
This illustration depicts broad and narrow slab ends with holes. The width “A” is the average of the inner and outer circumference of the slab sector, and the thickness “B” is the average thickness of the slab. The dashed lines represent the shape if they were envisioned to be rectangular to square in profile. The difficulty in measuring the width “A” is to arrive at the average of the inner and outer circumference by the use of a scale stick. As the arc of the slab exceeds 90 degrees (1/4 of a parent log) as shown in the example on the left, the width is best represented by a measurement across the full width of the slab. If less than that, the width is best represented by a measurement on the midpoint of each flat face as shown in the example on the right. More than one measurement “B” may be required if the thickness is uneven, to arrive at an average thickness.

Although not illustrated here, accomplished scalers will bypass this step by converting irregular shapes like these directly into a circle with a diameter closest to the area of the "square". This technique requires a great deal of practice to be able to understand the relationship of rectangular and square shapes to circular shapes well enough to produce good results. A circle with the same diameter as the side of a square will have about 78.5 percent of the area of the square; to produce a circle of the same area as a square of a given area, the circle's diameter must be increased by about 13 percent. In addition, the more out of square the slab, the more difficult it is to visualise a circle enclosing the area of the slab.

10.3.4 Measuring Sectors (Pie Wedge Slab Ends) Smaller than a Semicircle

Sometimes logs will conveniently split into quarters or thirds of their original end profile. Other times a less convenient fraction will result. This slab type may be categorised as being a sector less than a semicircle, roughly a pie wedge in shape, and external, or having a portion of the original circumference of the log remaining.

Examples for scaling with different methods follow.



$$\text{Average Diameter} = \frac{A + B}{2}$$

Figure 10.11 Measurement of Sectors (Pie Wedge Slab Ends)

10.3.5 Measuring Small Sectors by Averaging the Dimensions

The illustration on the previous page illustrates various sectors smaller than a semicircle. These shapes may be scaled by direct measurement without using a factor relating to a proportion of a "parent" log as described next. This method, called the "quarter-round" method, is preferred for slabs, which do not break into convenient fractions. Illustrated are quadrants, narrow sectors and broad sectors. As with the factored method, the measurements are taken at “A” and “B” and averaged to arrive at an effective radius class unit for recording.

The average diameter in rads of the end of a sector slab is derived from the measurement of its two faces. The measurement of a quadrant allows both measurements to be taken directly off each face because they are at 90 degrees to each other. Broad and narrow sectors must be measured with *A* being "drawn in" to the point where the void *x* is about equal to the projection *y* as shown on the examples so that *the two measurements are taken at 90 degrees to each other*. Overstatement of volume will result if this is not done.

To find the volume of a sector slab by averaging it is necessary to:

- First average the two measurements of an end of the slab,
- Record the average,
- Repeat the above process for the other end of the slab, and
- Record the length of the slab so that a volume may be calculated.

The scaling method to find a radius class representing the unit volume of end of the sectors in the previous illustration is as follows.

The formula for determining the average diameter of a slab sector is:

$$Average\ diameter = \frac{A + B}{2}$$

Replace the variables *A* and *B* with the measurements given. (*A* = 12 and *B* = 14).

$$Average\ diameter = \frac{12 + 14}{2}$$

$$Average\ diameter = 13\ rads$$

The radius class unit is recorded, and the process is repeated for the other end of the slab.

10.3.6 Measuring a True Quadrant and Other Sectors by Applying a Factor

The previous illustration also includes a quadrant (i.e., 1/4 of a circle) of an external slab end. This example is 1/4 of an elliptic log with a measurement of A = 12 rads and B = 14 rads. The distances “A” and “B” (in cm) are actually two radii of the parent log's end. Therefore, if the parent log is a true circle, “A” and “B” will be identical. If the parent log end is elliptic, as in this example, the two radii will differ and the parent log's radius is their average.

When the two radii and the faces are at 90 degrees to each other as in this example, then the volume will be 1/4 of the volume of the parent log. Because the radius of the parent log is measurable, its volume is obtainable, and so the volume of any sector may be derived using a factor or ratio of the sector to the circle. As long as a slab of this type is in convenient fractions of the parent log, a factor can be applied directly to the parent volume to obtain the volume of the slab. However, without another measurement, the factor remains as an estimate and is subject to systematic errors. One way is to find the arc of the sector and divide it by the circumference of the parent log. Good judgement gained through practice and experience will reduce these errors to within tolerance.

Finding the volume of a sector slab by applying a factor requires the following steps:

- First derive the average diameter of an end of the parent log, from two measurements of its sector,
- Find the unit volume of the end of the parent log,
- Apply a factor to find the unit volume of the end of the segment,
- Record the radius class unit, which is closest to the sector's unit volume,
- Repeat the above process for the other end of the slab, and
- Record the length of the slab so that a volume may be calculated.

The scaling method to find a radius class representing the unit volume of the quadrant in the same illustration is as follows.

The average diameter of one end of the parent log is derived from the measurements taken of its sector. The formula for determining the average diameter of one end of the parent log from the measurements of its slab sector is:

$$Parent \log diameter = \frac{2A + 2B}{2}$$

Replace the variables *A* and *B* with the measurements given. (*A* = 12 and *B* = 14).

$$Parent \log diameter = \frac{(12\ x\ 2) + (14\ x\ 2)}{2}$$

$$Parent \log diameter = \frac{24 + 28}{2}$$

$$Parent \log diameter = \frac{52}{2}$$

$$Parent \log diameter = 26\ rads$$

The unit volume for 26 rads is 212 dm³. Since this slab is a true quadrant (i.e., 1/4 of the original circular end or 90/360), 1/4 of the parent volume is 53 dm³.
Finally, the unit volume nearest to that resulting unit volume (53) is located on the scale stick, and the corresponding radius class unit is recorded. In this case, the closest unit volume is the same, which corresponds to 13 rads.

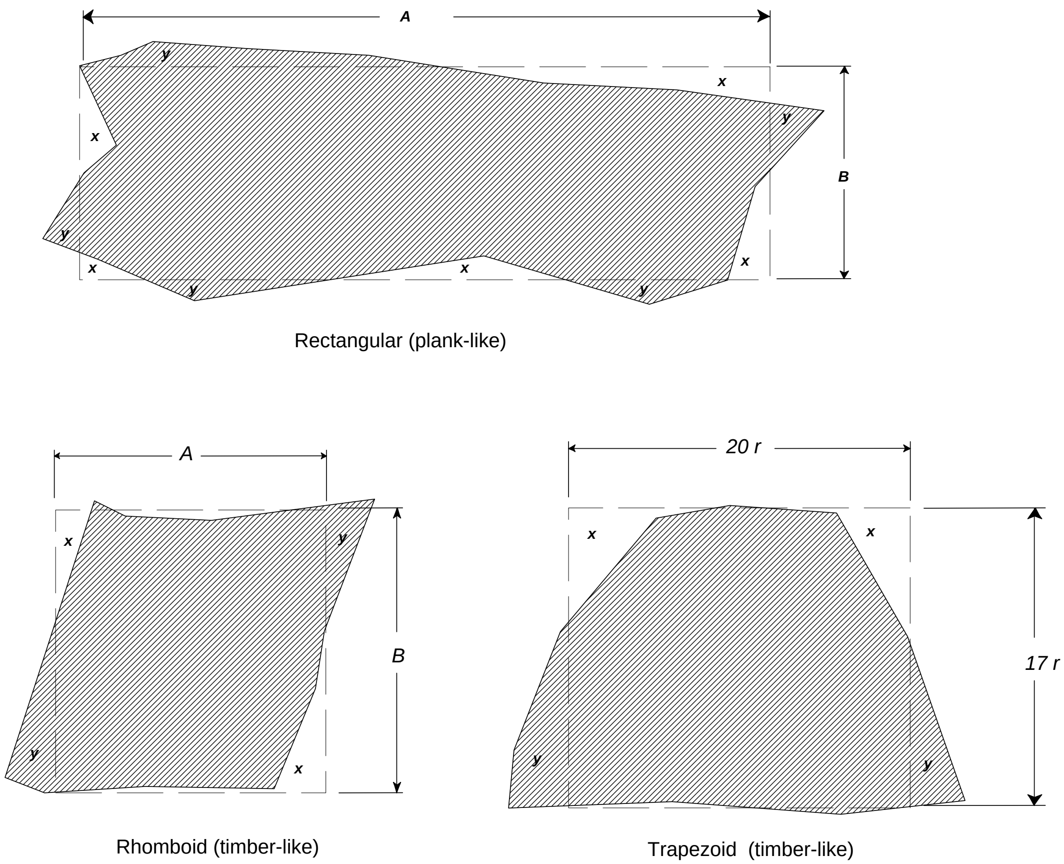
10.3.7 Measuring Slab Sectors and Segments Greater than a Semicircle

Sectors and segments greater than a semicircle (i.e., sectors or segments which contain more than half of the volume of its "parent" log and contain enough of their outer circumference to permit reliable measurement through the centre of the log), are classed as logs with missing portions, rather than as slabs.

Logs with missing portions are normally scaled by first measuring the diameter of the log and then making a firmwood deduction for the missing portion. The volume of the missing portion is determined in the same way that the volumes of sectors and segments are found. The volume of the missing sector or segment is found by an appropriate method described in this section and subtracted from the gross volume of the log to arrive at a net volume

10.3.8 Measuring Four Sided (plank-like, timber-like) Slab Ends

Although logs rarely break up into truly rectangular or square cross-sections unless a sawmill is involved, slab ends can be more or less four sided and are all scaled in the same manner. Scalers often refer to them as "planks" or "timbers".



Slab Unit Volume = A x B x 0.4

Figure 10.12 Measurement of Four-Sided (Quadrilateral) Slab Ends

The following depicts such slab ends. As suggested in the diagram, the width and thickness measurements are taken so that the voids (areas **x**) balance the protuberances (areas **y**). Of the quadrilateral shapes, they can be more or less square, rectangular (plank-like), trapezoid, or rhomboid (timber-like). The measurements are taken in the same way for all of them, through the width and thickness, and at 90 degrees to each other. Shapes, which are quite irregular, may require more than one measurement on an axis to arrive at an average width or average thickness.

To find the volume of a four-sided slab it is necessary to:

- First derive a unit volume of an end of the slab, from the two measurements of its width and thickness,
- Record an equivalent radius class unit, which is close to the unit volume,
- Repeat the above process for the other end of the slab, and
- Record the length of the slab so that a volume may be calculated.

The scaling method to find a radius class unit representing the unit volume of the slab end in the previous illustration is as follows:

The area of a four-sided slab end is its average width times its average thickness. To arrive at an effective radius class, the calculation is different from circular shapes, because, unlike circular shapes, in which two measurements are averaged, the two are multiplied, which produces a different ratio, or factor, of dimension to unit volume. To obtain the unit volume of a rectangular slab end in order to locate an equivalent effective radius on the scale stick, a factor must be applied to the product of the slab's width and thickness in rads to convert to unit volumes (cubic decimetres per metre). This factor, which is constant, simply provides a shorter way of doing the calculation; similar to the way Smalian's formula is shortened. The full formula for finding the unit volume for one end of a rectangular slab is:

$$\text{Four}-\text{sided slab Unit volume} = \frac{(Width\,in\,Rads\,x\,2)\,x\,(Thickness\,in\,Rads\,x\,2)\,x100}{1000}$$

Multiplication of the two measurements in rads by 2 converts rads to centimetres. Multiplication by 100 gives the volume in cubic centimetres for one metre of length. Division by 1 000 gives the volume in cubic decimetres for one metre, or the unit volume.

By naming the width and thickness of the slab as *A* and *B* the formula shortens to:

$$\text{Four}-\text{sided slab Unit volume} = \frac{(2\text{A})\ \text{x}\ (2\text{B})\ \text{x}\ 100}{1000}$$

By transposing *A* and *B* to combine the constants the formula becomes:

$$\text{Four}-\text{sided slab Unit volume} = \text{A x B x}\left(\frac{2\ \text{x}\ 2\ \text{x}\ 100}{1000}\right)$$

And by calculating the combined constants, the formula is simplified to:

$$\text{Four}-\text{sided slab Unit volume} = \text{A x B x 0.4}$$

Where:

A	=	Width in rads
B	=	Thickness in rads
0.4	=	The constant

By substituting the slab dimensions from the example into the formula,

$$\text{Rectangular slab Unit volume} = 20 \; x \; 17 \; x \; 0.4$$
$$\text{Rectangular slab Unit volume} = 136 \; dm^3$$

Finally, the unit volume nearest to 136 is located on the scale stick, and the corresponding radius class is recorded. In this case, the closest unit volume is 139, which corresponds to 21 rads. The process is repeated at the other end of the slab.

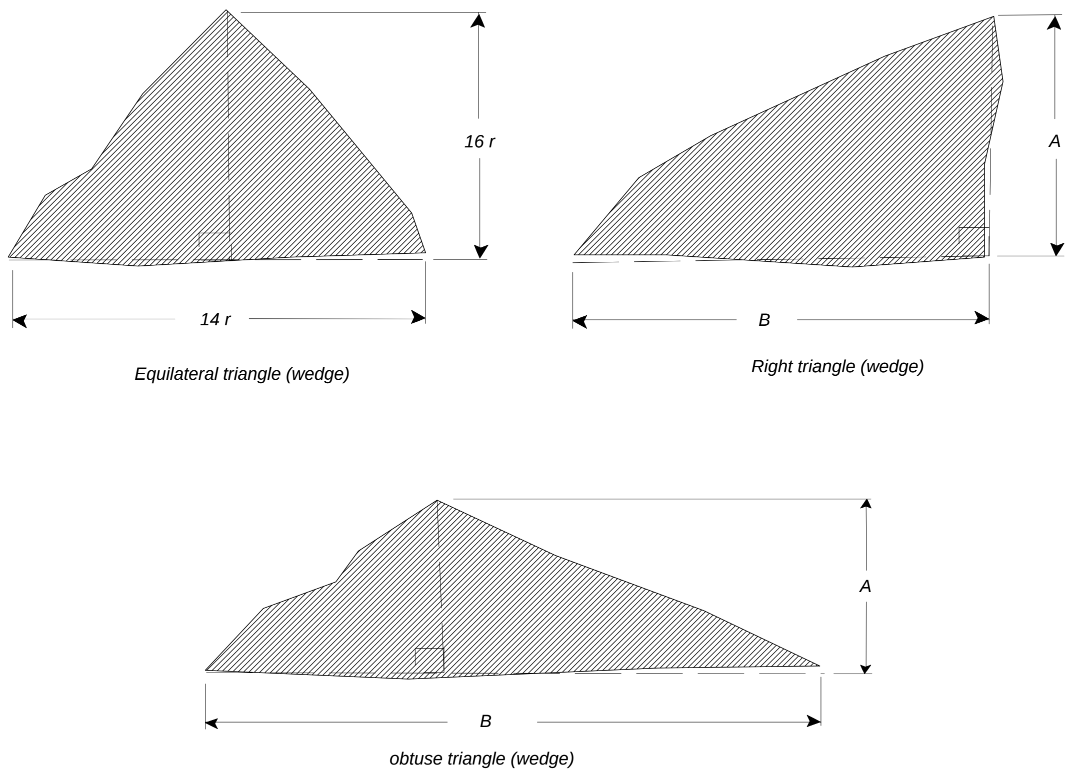
Accomplished scalers will bypass this step by converting irregular shapes like these directly into a circle with a diameter closest to the area of the "square". This technique requires a great deal of practice to be able to understand the relationship of rectangular and square shapes to circular shapes well enough to produce good results. A circle with the same diameter as the side of a square will have about 78.5 percent of the area of the square; to produce a circle of the same area as a square of a given area, the circle's diameter must be *increased* by about 13 percent. Of course, when the relationship is understood, a scaler will not have to do the following calculation each time:

- Square up the slab by finding the square root of its area; it becomes a square measuring 18.4 by 18.4, and
- Then the side dimension of the square is increased by 13 percent. 18.5 times 1.13 (113 percent) is equal to 20.8, or 21 rads.

Although the above exercises both produce the same results, the more plank-like a slab becomes, the more difficult it is to visualise a circle with the same area. It is not practical to average the width and thickness of a plank-like slab to square it up. A square having sides 20 units by 20 units has an area of 400 square units and the average of its two sides is 20 units. A rectangle 10 units by 40 units has the same area but the average of its two sides is 25 units.

10.3.9 Measuring Triangular (three sided) Slab Ends

Logs can break into roughly triangular shapes, and although not perfectly shaped, may be enclosed in a triangle for purpose of measurement, similar to four-sided slab shapes.
This illustration depicts such slab ends. As suggested in the diagram, the width and thickness measurements are taken across the base and height of the triangle, accounting for minor imperfections in the shape. Of the triangular shapes, they can be more or less equilateral, right, or obtuse. The measurements are taken in the same way for all of them, through the base and height, and always at 90 degrees to each other.



Slab Unit Volume = A x B x 0.2

Figure 10.13 Measurement of triangular or wedge-shaped slab ends

To find the volume of a triangular slab (wedge) it is necessary to:

- First derive a unit volume of an end of the slab, from the two measurements of its base and height,
- Record a corresponding radius class unit, which is close to the unit volume,
- Repeat the above process for the other end of the slab, and
- Record the length of the slab so that a volume may be calculated.

The scaling method to find a radius class representing the unit volume of the slab in the previous illustration is:

The area of a triangle is one half its base times its height. To arrive at an effective radius class, the calculation is different from circular shapes, because, unlike circular shapes, in which two measurements are averaged, the one measurement is first halved, then the two are multiplied, giving a different ratio, or factor, of dimension to unit volume. To obtain the unit volume of a triangular slab end in order to find an effective radius class on the scale stick, a factor must be applied to the product of 1/2 of the slab's base and its height in rads to convert to unit volumes (cubic decimetres per metre). This factor, which is constant, simply provides a shorter way of doing the calculation, similar to the way Smalian's formula is shortened. The full formula for finding the unit volume of an end of a triangular slab is:

$$\text{Triangular slab Unit volume} = \left(\frac{(\text{height in Rads x 2}) \text{ x } \frac{(\text{Base width in Rads x 2})}{2} \text{ x } 100}{1000} \right)$$

Multiplication of the two measurements in rads by 2 converts rads to centimetres. Division of the base width by two is a requirement of the formula of the area of a triangle. Multiplication by 100 gives the volume in cubic centimetres for 1 m of length. Division by 1 000 gives the volume in cubic decimetres for 1 m, or the unit volume.

By naming the height and base of the slab as “A” and “B” the formula shortens to:

$$\text{Triangular slab Unit volume} = \frac{(2\text{A}) \text{ x} \left(\frac{(2\text{B})}{2} \right) \text{ x } 100}{1000}$$

By transposing “A” and “B” to combine the constants the formula becomes:

$$\text{Triangular slab Unit volume} = \text{A x B x} \left(\frac{2 \text{ x} \left(\frac{2}{2} \right) \text{ x } 100}{1000} \right)$$

And by calculating the combined constants, the formula is simplified to:

$$\text{Triangular slab Unit volume} = \text{A x B x 0.2}$$

Where:

A	=	Height in rads
B	=	Base in rads
0.2	=	the constant

By substituting the slab dimensions from the example into the formula,

Triangular slab Unit volume = $16 \times 14 \times 0.2$
Triangular slab Unit volume = $44.8\ dm^3$

Finally, the unit volume nearest to 44.8 is located on the scale stick, and the corresponding radius class is recorded. In this case, the closest unit volume is 45, which corresponds to 12 rads. The process is repeated at the other end of the slab.

10.4 Measuring Lengths

The length of a log or slab is the distance between two planes that are perpendicular to the longitudinal axis of the piece and situated at the geometric centre of each end face.
To locate an end face, all logs are deemed to be "bucked" for scaling purposes. There are three kinds of bucking; real, pencil, and conceptual. These terms apply to practices which are separate from each other, and will affect recorded log lengths in the scaling and grading process.

"Real bucking" is the point where the log is cut with a saw, and in the great majority of cases, it is the point where measurements are taken. Most logs are bucked perpendicular to the longitudinal axis, or "bucked off square", so it is only necessary to measure from the edge of one face to the edge of the other end face. Logs cut on the bias are measured from face to face through the geometric centre.

"Pencil bucking" refers to the act of recording one piece as two or more pieces (with a *pencil* and paper), as in the case of diameters less than 5 rads (10 cm). Scalers often mark the log at the point where the log becomes 5 rads in diameter, so that check scalers, and others, can confirm the recorded measurement.

"Conceptual bucking" is used where a scaler will think of a log as being segmented when assessing a log's volume and value, but does *not* record one piece as two or more pieces. In exercising the *grading concept* as it applies to crook and sweep for example, a scaler will view the log as being bucked into two or more pieces. In determining volume, a scaler will often "visually fold in" a portion of a log to fill in a void, and measure a length from the point of the "buck". This section provides examples for determining length. Different terms are used for this type of bucking, depending on locale. "Visual bucking" and "mental bucking" are common expressions of the concept, and as computer usage increases in scaling, other similar terms such as "virtual bucking".

The following illustrations and sub-sections demonstrate length measurement principles.

10.4.1 Length Rounding Conventions and Measuring Tools

Lengths are measured in metres to the nearest tenth of a metre (0.1 m or 1 dm) by using a scale stick or a steel tape calibrated to 0.05 m divisions. The steel tape is more accurate and preferred. Tapes *must* be used for measuring weight scale sample logs.

Where the measurement is 0.05 m or 0.5 dm from the nearest tenth of a metre, the length is rounded to the nearest even tenth of a metre.

Examples: 12.34 is recorded as 12.3

12.35 is recorded as 12.4

12.25 is recorded as 12.2

10.4.2 Finding the Geometric Centre of a Log for Length Measurement

Most logs are bucked perpendicular to their longitudinal axis and measuring from the edge of one end face to the matching edge of the other end face gives the same result. On bias cut ends, however, the scaler must estimate where the geometric centres are and then measure to these points as shown.

The geometric centre of a log is the point, which is equidistant from the outer edges. It can be different from the "centre of gravity", which is found by the intersection of a line through the widest and narrowest points when measuring diameters. On round and elliptic logs, the centre of gravity is also at the geometric centre, but on oval and irregular shapes, it is not.

10.4.3 Measuring Lengths of Butt Logs with Undercut

Undercuts are not considered in length measurement, nor is the felling hinge. However, in the determination of net volume, a deduction for missing wood may be required, but normally undercuts are not a significant volume loss because they tend to fall outside of the line of taper as shown by the dashed line in the diagram below. It is also necessary to consider bias as shown in the previous illustration, if present.

10.4.4 Measuring Lengths of Logs with Portions Under Ten Centimetres

The length of a log or slab is measured from where the log diameter or slab thickness first becomes 10 cm or greater when measuring from the smaller end, or top. Lengths for log diameters or slab thickness less than 5 rads must be recorded separately as firmwood rejects. These are instances where a single physical log is recorded as two separate scale data entries, or "pencil bucked". The log should be marked with crayon or paint at this point, to substantiate the point of measurement.

10.4.5 Measuring Lengths of Logs with Shattered Ends

Logs with shattered ends offer another challenge. Shatter occurs when a log is stressed beyond its breaking point, and may or may not be "trimmed up" in the bucking process. The scaler must "visually fold in" the projections to compensate for the missing wood in the voids.

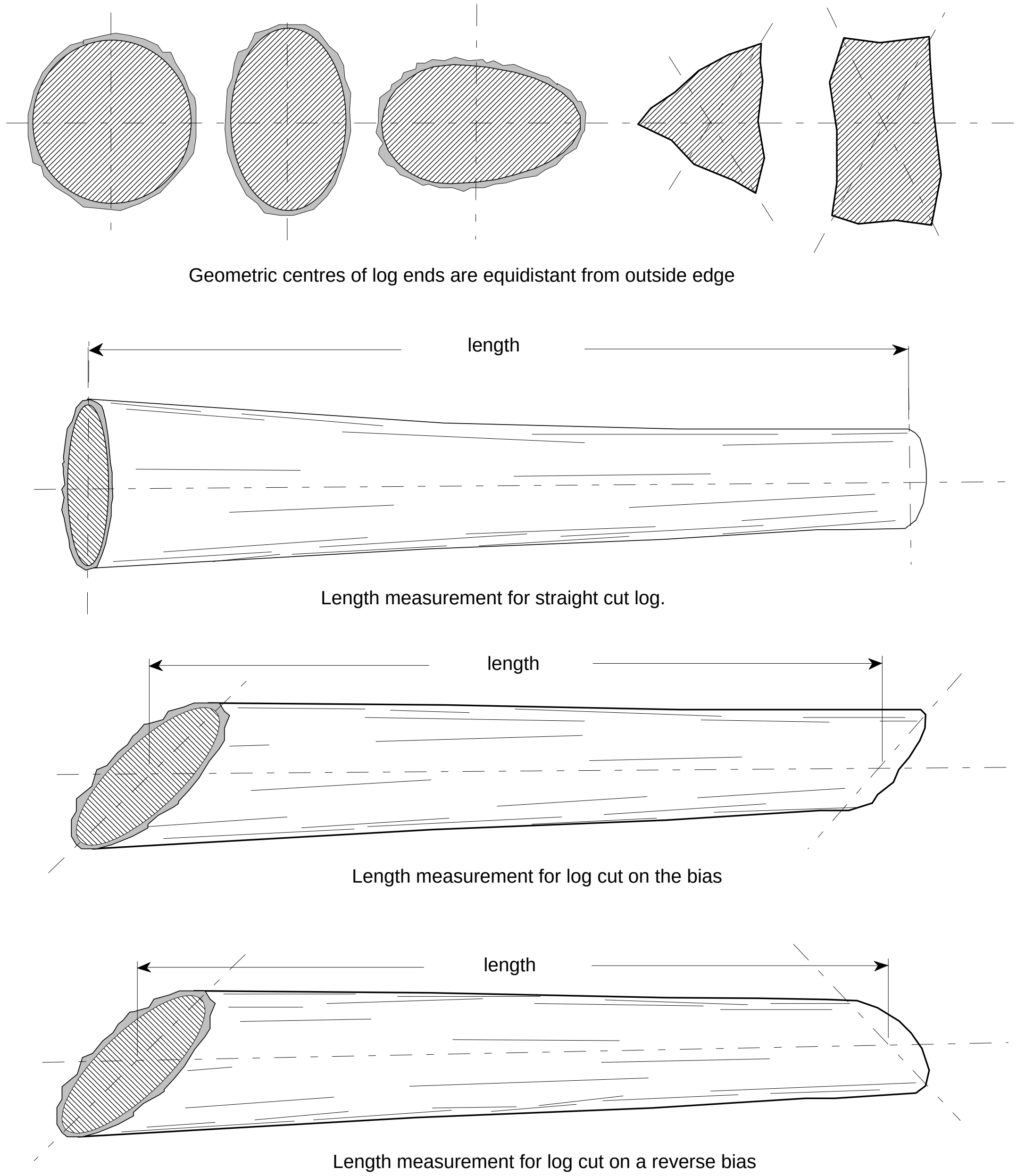


Figure 10.14 Length Measurement of Logs through the Geometric Centre

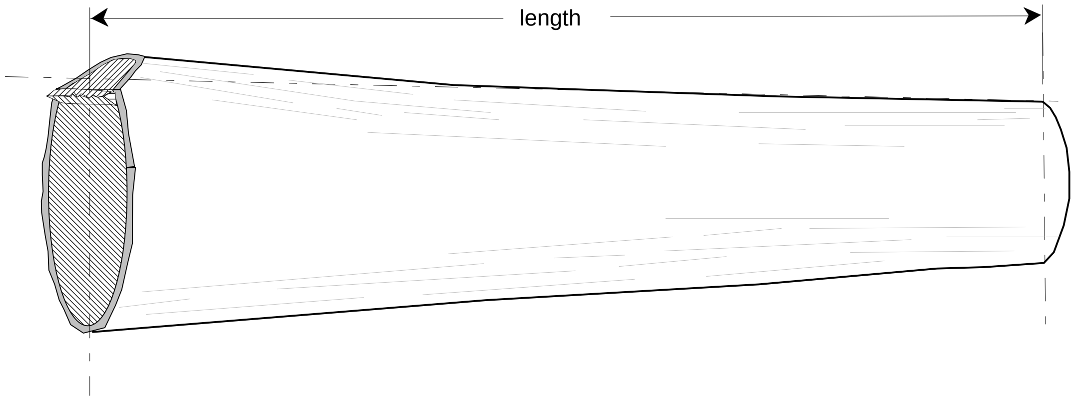


Figure 10.15 Length Measurement of Logs with Undercut

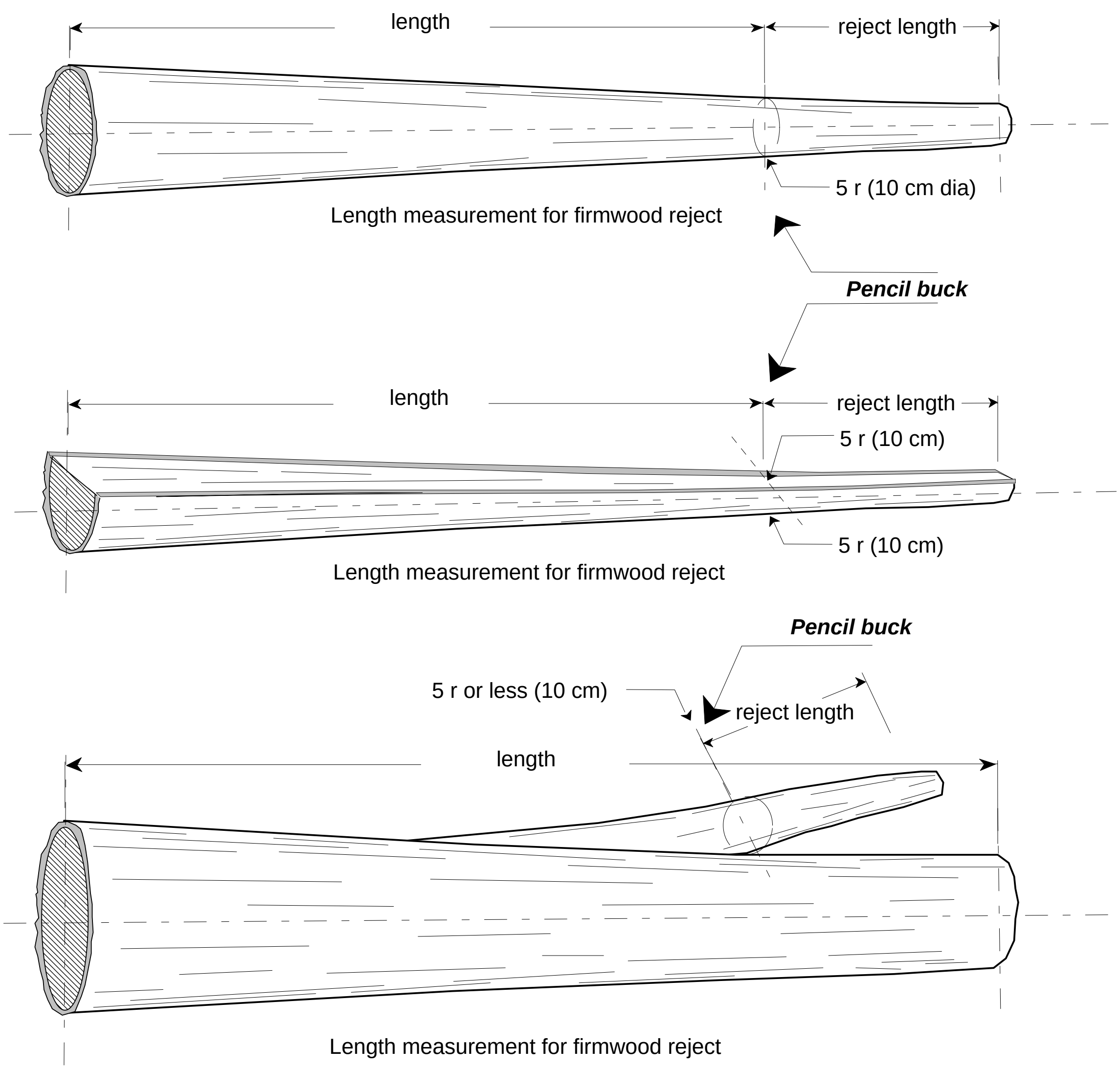


Figure 10.16 Length Measurement of Logs and Slabs with Segment under 10 cm

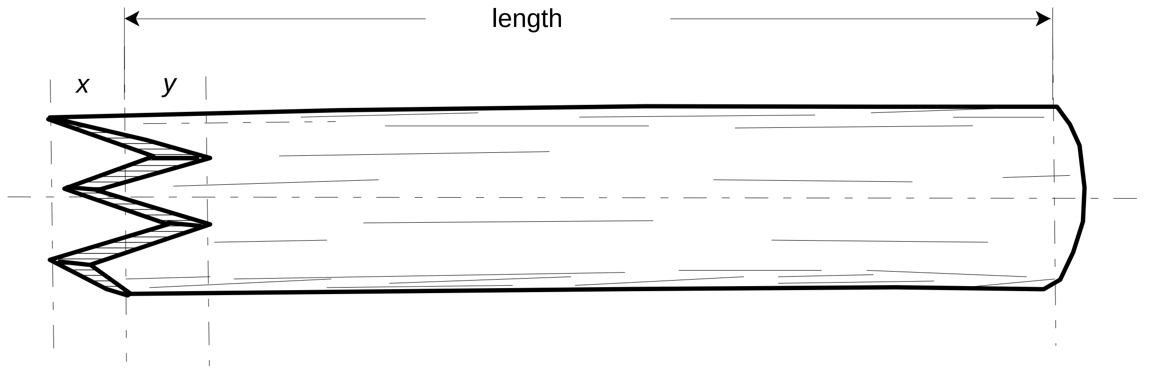


Figure 10.17 Length Measurement of Logs with Shattered Ends

10.4.6 Measuring Lengths of Logs with Sniped Ends

Logs are often split off or "sniped" at one or both ends. Bending stresses cause the log to split before the buck is completed. Unlike shattered ends, where the scaler "folds back" protrusions to fill the voids and measures from that point, this type of log requires a firmwood deduction to account for the missing wood.

Lengths are measured according to the following examples, starting at the point where the sniped end first becomes 10 cm thick. Measure the firmwood reject length from the "sniped" end to a point where the snipe first becomes 10 cm thick. A "pencil buck" occurs at this point, and the portion less than 10 cm must be recorded as a separate firmwood reject.

The following illustration shows two forms of sniping.

10.4.7 Measuring Lengths of Logs with Missing Chunks

Sometimes a scaler will encounter logs with burned saddles or missing chunks in the central portion of the log. On such logs measure the gross length to the cut ends and make a firmwood deduction for the missing volume between the ends.

10.4.8 Measuring Lengths of Logs with Forks

Logs are often forked and normally come into a scaling yard already bucked off at or very near the juncture (crotch). The scaler is presented with a range of shapes depending on the relative fork sizes and where the bucks occurred, and not only is challenged to obtain a length, but also to find a diameter when forks are bucked at different lengths and different points.

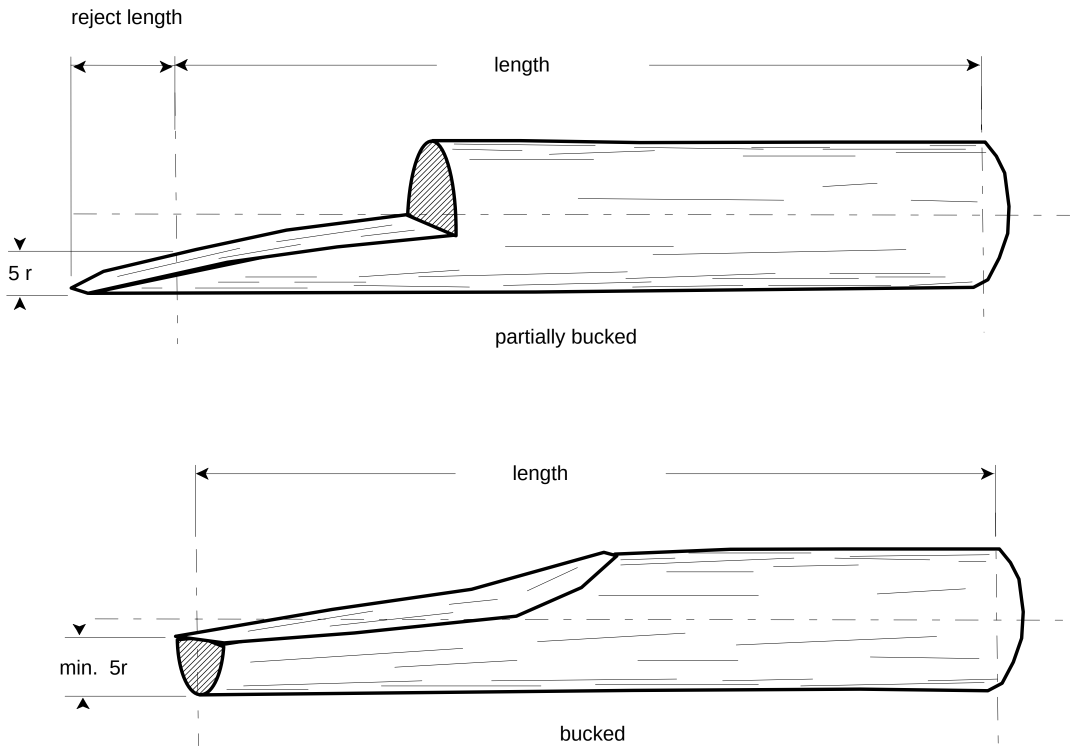


Figure 10.18 Length Measurement of a Partially Bucked Split-Back (Sniped) End

In general:

Logs with forks bucked off at or near the crotch are scaled as one piece. The diameter or length may need adjustment in order to get a fair and accurate dimension for the log. See the section on diameter measurement for information on obtaining a diameter.

Logs with one fork remaining are scaled as one piece. If the attached fork approaches the size and taper of the main stem, the top diameter of the fork will serve as the top diameter of the log. If the fork is stunted in relation to the main stem, an increase in the top diameter may be required.

Logs with more than one fork remaining may be scaled as one piece if both forks are of similar size (30 percent) and the crotch occurs near the mid-point of the log length. Under these circumstances, it is possible to find the average diameter in rads of each stem, locate the unit volumes that correspond to the measurements, add the unit volumes, and locate a radius class unit closest to the sum. If the forks are of unequal length, an adjustment must be made to the log length to place it half way between the long and short fork.

If the forks are not similar in diameter and the crotch is not near the mid-point log length, they may be scaled as two or more pieces. Forks or portions less than 10 cm in diameter are also recorded as separate firmwood reject.

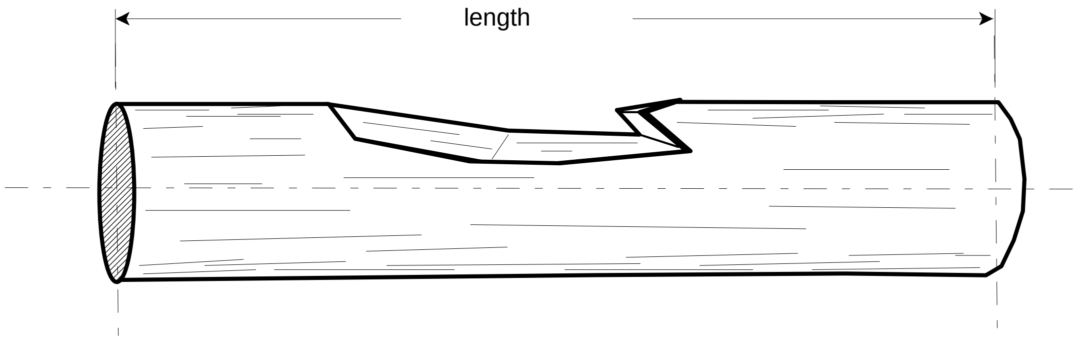


Figure 10.19 Length Measurement of a Log with Missing Chunks

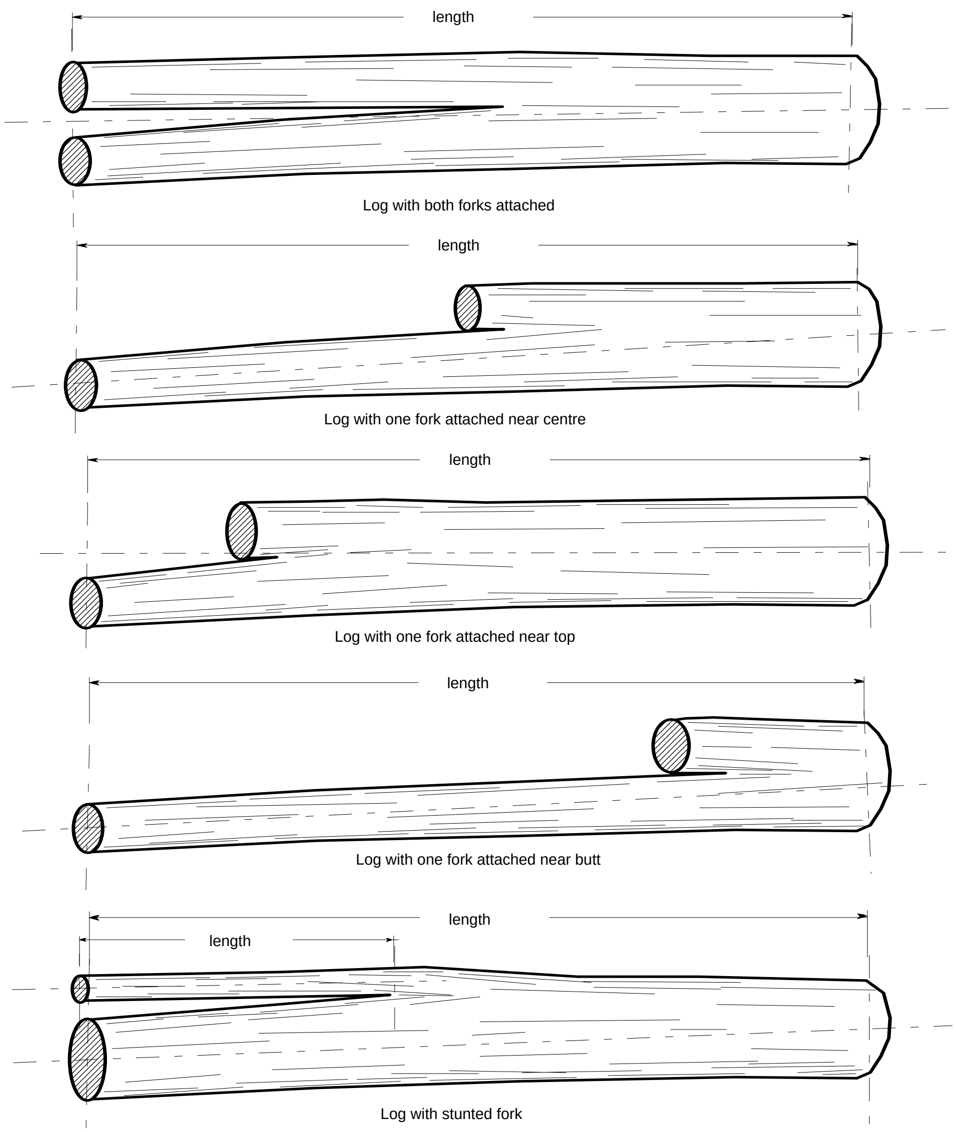


Figure 10.20 Length measurement of forked logs

Figure 10.21 This log was bucked above the crotch, with the separate stems cut at an even length

10.22 This log was bucked so the top two stems can be scaled as separate pieces

10.4.9 Measuring Lengths of Logs with Sweep

The length measurement for a log with sweep follows the contour through the geometric centre of the log (as shown in figure 10.23).

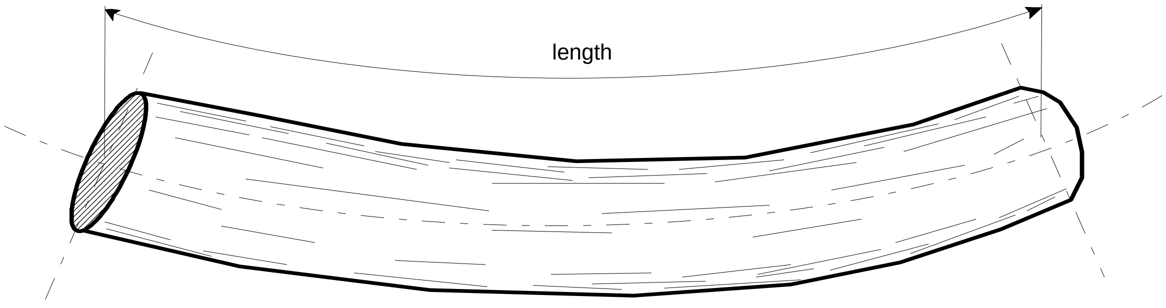


Figure 10.23 Length Measurement of Logs with Sweep

10.4.10 Measuring Lengths of Logs with Crook

The length measurement for a log with crook (such as the log shown in figure 10.24) follows the contour through the geometric centre of the log (as shown in figure 10.25).

Figure 10.24 Balsam log with a crook

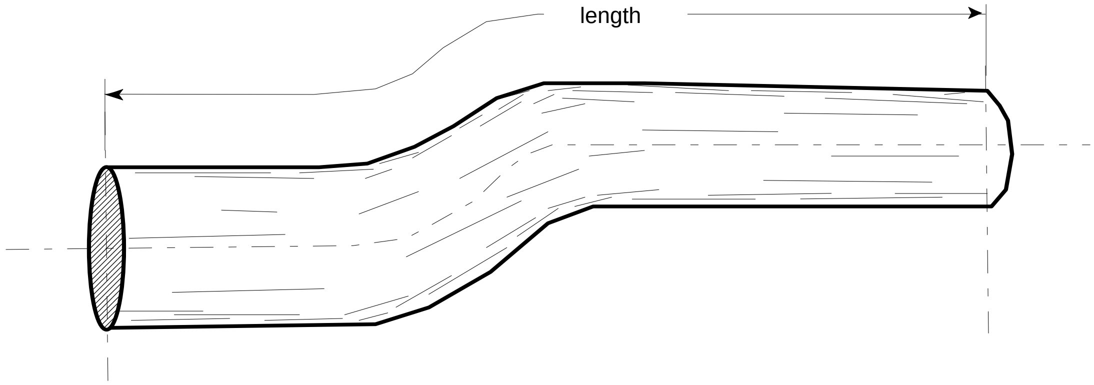


Figure 10.25 Length Measurement of Logs with Crook