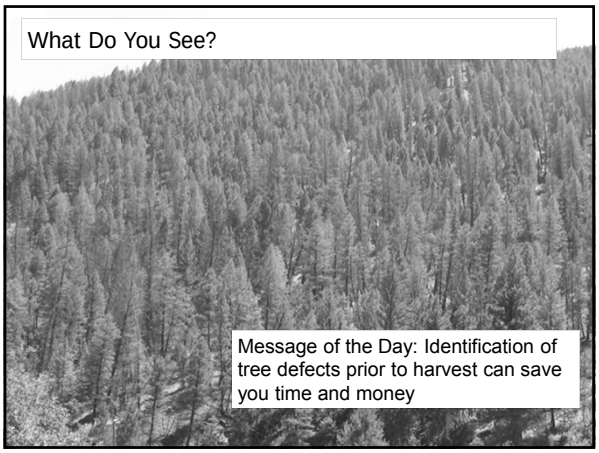
What Do You See?



Message of the Day: Identification of tree defects prior to harvest can save you time and money

FOR 274: Defects

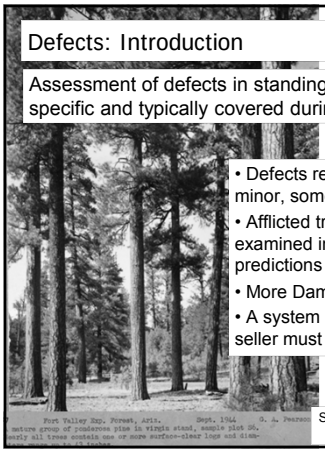
Defects

- Prominent Features
- Rots, Borers
- Stem Rusts and Cankers
- Wounds
- Animal Damage and Insects
- Log Grading

For More Information:
FOR 468: Forest and Plant Pathology
PS&ES: Forest Entomology and Insect Ecology

Defects: Introduction

Assessment of defects in standing timber are highly site specific and typically covered during on the job training.

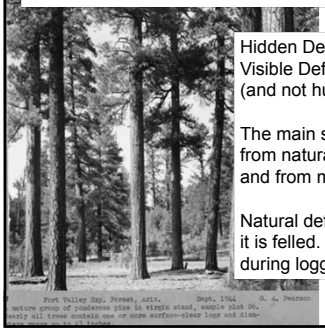


- Defects result in timber loss; some minor, some complete.
- Afflicted trees and logs need to be examined in order to adjust output predictions accordingly.
- More Damage = Less Products
- A system common to both buyer and seller must be used.

Source: Partridge et al. A handbook of defect estimators for standing timber, USFS

Defects: Introduction

It is common to classify deductions made for defects into hidden and visible.



Hidden Defects: Lack external indicators
Visible Defects: Based on visual evidence (and not hunches!)

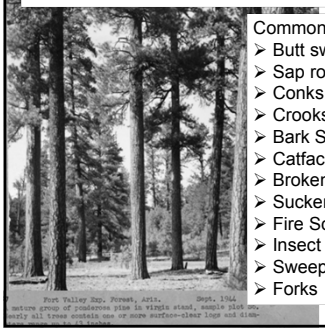
The main sources of visible defects are from natural defects (rots, insects, etc) and from mechanical / logging damage.

Natural defects exist within the tree before it is felled. Mechanical defects can occur during logging, felling, and processing.

USDA FS Region 6 Cruising Manual

Defects: Introduction

Visible abnormalities that inform us of potential defects are called defect indicators.



Common defect indicators include:

- Butt swell
- Sap rot
- Conks
- Crooks
- Bark Seams
- Catface
- Broken Tops
- Sucker Limbs
- Fire Scare
- Insect Damage
- Sweep
- Forks

USDA FS Region 6 Cruising Manual

Defect Indicators: Prominent Features

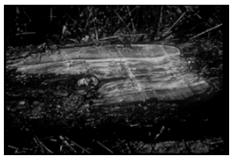
Swelling: A swelling is a bulge, mound, lump, or knob typically found under the bark

Rusts only occur on live trees.

Western Gall Rust

Depressions: Examples include cankers, which are sunken areas on the stems

Cankers are defined as “expanding patched of dead or dying bark and cambium”

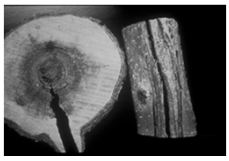


Atropellis Canker

Defect Indicators: Prominent Features

Wound or Scars: Can be the result of mechanical damage or falling trees, such as broken or snapped-off branches. Lightning and fires can also cause scars

Cracks or Splits: Examples can include splits caused by rapidly changing temperatures



Defect Indicators: Prominent Features

Holes and Cavities: Insects and birds can leave behind holes on the stems. Frequently Wood Chips can be found at the base of affected trees.

Fungus Parts: It is common to find signs of fungus such as conks, mushrooms, and toadstools.

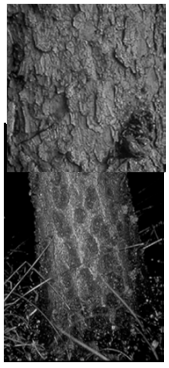
Defect Indicators: Prominent Features

Frass: This is fine powdering material that insects leave as waste after digesting plants.

It also can refer to excavated wood shavings that ants and other borers (that do no eat the wood) remove as part of mining

Pitch: Excessive amounts of pitch present with frass is a good indicator of insects

Sweep or Crooks: This is when the stem is not straight



Defect Indicators: Prominent Features

Broken Tops and Bases: When broken tops are present without decay, only the broken area +2' below is culled. Various rots will often be present in these tops and bases.

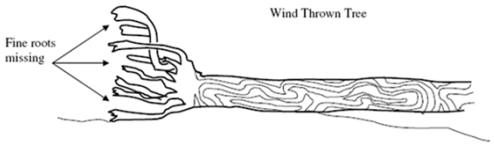
Bark Eaten or Ripped: Bears, deer, and elk commonly scratch or rip bark from stems. Generally these do not remove wood volume unless the tree does not heal.

Defect Indicators: Prominent Features

Brooms: Often associated with mistletoe.

Defects: Root Rots

Different types of rots can be identified by several visual indicators. Root rots kill fine roots in trees often resulting in wind thrown trees.



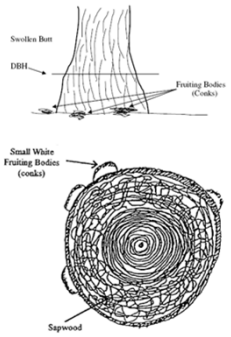
In the Pacific Northwest, common root rots include:
- Laminated root rot (*Phellinius weirii* & *Porta werii*)
- Shoestring rot (*Armillaria ostoyae*)
- White spongy rot (*Fomes annosus*)

Defects: Butt and Sap Rots

Butt rots occur near the tree base, often resulting in butt swell. The volume loss in these trees are usually limited to the base of the butt log.

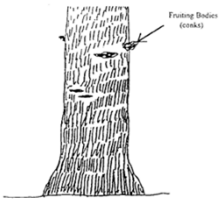
Sap rots affect the outer edge of the tree stems. Snags are common hosts.

In the Pacific Northwest, common sap rots include:
- Purple conk (*Polyporus volvatrus*)



Defects: Butt and Heart Rots

Heart rots affect the tree's heartwood. Generally the size of the conks are a good indicator of the degree of damage.



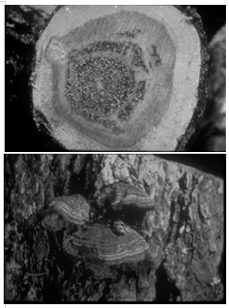
In the Pacific Northwest, common heart rots include:
- White speck (*Phellinus pini*)
- Indian paint conk (*Echinodontium tinctorium*)
- Light brown cubical rot (*Fomitopsis cajenderi*)

Defects: Rots – Some Local Suspects

Red Ring Rot
Caused by *Phellinus pini*
Targets larch and white pine

What to Look For:
Conks: 1-12" across, hard to touch, conks are layered and usually yellow-brown color

Defect:
• Single conks on larch indicate total heartwood los
• Multiple conks usually indicate total heartwood cull.
• Single conks on non larch are culled 2-4 feet up and 4-5 feet down from conks



Red Ring Rot

Defects: Rots – Some Local Suspects

Fibrous White Rot and Stem Rot
Caused by *Armillaria mellea*
Targets planted trees

What to Look For:
Fungus: white fans appears under bark at tree bases
Rhizomoprhs: black fungus appears in and on the roots
Mushrooms: light brown/honey color around tree bases in late fall

Defect:
• Generally decay extends upwards from base up to 5 feet

Fibrous White Rot

Defects: Rots – Some Local Suspects

Stringy Heart Rot
Caused by *Echinodontium tinctorium*
Targets hemlock and grand fir – major source of hardwood decay of true firs in the Northwest

What to Look For:
Hollow Trunks and decayed heartwood: fibrous, yellow, and circular
Conks: large and hard below branches. Dark colored with bright red interior
Knots: containing bright-red fungus

Defect:
• Single conk equates to 16-50 feet of heartwood loss.

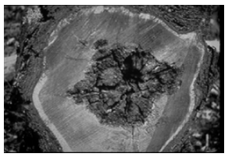
Stringy Heart Rot

Defects: Rots – Some Local Suspects

Red-Brown Root and Butt-Rot
Caused by *Phaeolus schweinitzii*
Targets Douglas fir and pines

What to Look For:
Conks: rare on trees, is present on duff beneath the trees. These area 6-18” and are dark brown.
Increment bore: use at DBH

Defect:
• Single conk on or near the tree indicates 8-12 feet of tapered decay in the first log.
• Ants or dry habitats can cause decay to extend to above 32 feet.



Red-Brown Root

Defects: Borers – Some Local Suspects

Ponderous Borer
Caused by *Ergates spiculatas*
Targets standing dead Douglas fir and ponderosa pine

What to Look For:
Frass packed tunnels: observed in penetrated wood

Defect:
• Usually localized to lowest part of 1st log.

Ponderous Borer

Defects: Borers – Some Local Suspects

Carpenter Ants – *Campanotus spp.*
Targets conifer and hardwood heartwood in live trees

What to Look For:
Boring dust: dust piles appear below holes at the base of trees
Tunnels: These are vertical and can be up to 1cm wide and several feet long.
Decay: These insects are usually associated with decay

Defect:
• frass indicates heavy damage and loss extended 10-32 feet up tree.

Carpenter Ants

Defects: Rusts and Cankers – Some Local Suspects

Western Gall Rust
Caused by *Endocronartium harknessii*
Targets most 2 and 3 needles pines, including ponderosa, Scots, lodgepole

What to Look For:
Galls: Large galls form on stems and branches
Orange spores masses: In spring these appear from the living galls
Dead branches: Broken bark leads to branch and gall death

Defect:
• 3 feet in each direction of gall

Western Gall Rust

Defects: Rusts and Cankers – Some Local Suspects

White Pine Blister Rust
Caused by *Cronartium ribicola*
Targets most 5 needle pines, including white, limber, whitebark, etc

What to Look For:
Cankers: Old cankers will exhibit many cracks and swelling will be present above cankers
Dead branches: Yellow to red-brown foliage will be common when branches above cankers are killed
Bark discoloration: in spring, blisters appear as small (1-3 mm) yellow to light-brown patched. Once dried, the dark lesions are visible all year round.

White Pine Blister Rust

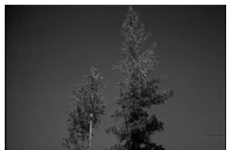
Defects: Rusts and Cankers – Some Local Suspects

White Pine Blister Rust
Caused by *Cronartium ribicola*
Targets most 5 needle pines, including white, limber, whitebark, etc

What to Look For:
Blisters: within the lesions, white blisters appear that contain powdery, orange-yellow spores.

Blisters will develop each year until the stem above a canker is killed.

Defect:
• Only cull killed tops and branches



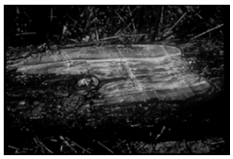
White Pine Blister Rust

Defects: Rusts and Cankers – Some Local Suspects

Atropellis Cankers
Caused by *Atropellis spp.*
Only affects pines

What to Look For:
Cankers: Perennial – the wood beneath each canker is streaked blue-black or grey-green
Fungi: black discs appear on bark of cankered areas

Defect:
• Common to use a 15% deduction for logs with canker



Atropellis Canker

Defects: Wounds

Mechanical Wounds: Defects usually limited to the wound area unless there are other signs of decay

Sweep or Crook: Stem is usually divided up into as many useable sections as possible.

Defects: Animal Damage

No defect:
Damage resulting from bears, elk and sapsuckers generally do not result in any cull

Woodpecker Damage:
Presence of woodpecker holes generally indicate that insect borers and heartwood loss is present

Defects: Bark Beetles and Stem Insects

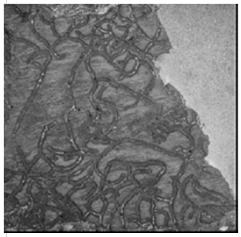
Mountain Pine Beetle
Dendroctonus ponderosae
Affects lodgepole pine, ponderosa pine, western white pine, whitebark pine, and limber pine

What to Look For:
White pitch tubes: seen in the lower stem with red boring dust present
Red attack: Foliage rapidly turns red

Defect:
• Sapwood to a depth of 10" will be heavily stained.
• No defect except eventual tree mortality

Defects: Bark Beetles and Stem Insects

Western Pine Beetle
Dendroctonus brevicomis
Affects lodgepole pine, ponderosa pine, and western white pine



What to Look For:
White pitch tubes: seen in the lower stem with red boring dust present
Galleries: Maze-like and crisscrossing

Defect:
• Sapwood to a depth of 10" will be heavily stained.

Defects: Bark Beetles and Stem Insects

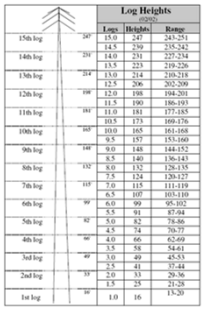
Pine and Spruce Engravers
Ips spp.
Affects pines and spruces

What to Look For:
Change in color: tree turn grey-green and then yellow, followed by light brown
Galleries: Egg galleries radiate from a central chamber

Defect:
• Tree mortality
• Sapwood is often stained blue leading to loss in value

Log Valuation: Grading

Understanding the value of logs derived from a tree informs landowners and log buyers of the fair price for the timber



	Log Heights (ft)		
	Logs	Heights	Range
15th log	15.0	247	243-251
	14.5	239	235-242
14th log	14.0	231	227-234
	13.5	223	219-226
13th log	13.0	214	210-218
	12.5	206	202-209
12th log	12.0	198	194-201
	11.5	190	186-193
11th log	11.0	181	177-185
	10.5	173	169-176
10th log	10.0	165	161-168
	9.5	157	153-160
9th log	9.0	148	144-152
	8.5	140	136-143
8th log	8.0	132	128-135
	7.5	124	120-127
7th log	7.0	115	111-119
	6.5	107	103-110
6th log	6.0	99	95-102
	5.5	91	87-94
5th log	5.0	82	78-86
	4.5	74	70-77
4th log	4.0	66	62-69
	3.5	58	54-61
3rd log	3.0	49	45-53
	2.5	41	37-44
2nd log	2.0	33	29-36
	1.5	25	21-28
1st log	1.0	16	13-20

Main factors that determine the value of a log: Species, Scale, and Grade.

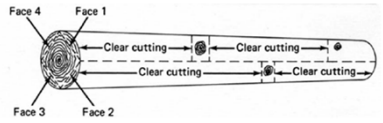
Grade is a measure of the quality of the log and the products that can be derived. Grade is usually inferred by how much defect free wood is present in the 1st log.

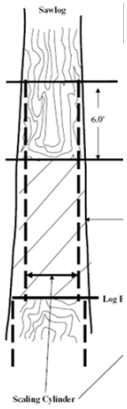
The butt log will usually contain the highest percentage of clear wood (non defect).

Grade can be assigned on standing timber during cruising (each log per tree done independently) or once the trees are felled.

Log Valuation: Grading Definitions

Scaling Cylinder: cylinder within log with diameter equal to DIB at small-end
Surface Clear (clear-cuts): portion of log's surface area free of grading defects
Worm Holes: Pin (<1/16" dia), Small (<1/4" dia), Large (>1/4" dia)
Knots: Pin (<1/2" dia), Small (1/2 -3/4" dia), Medium (3/4 – 1 ½" in dia) Large (>1 ½ " dia)

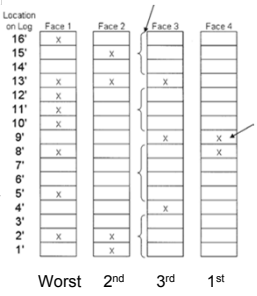




Log Valuation: Grading

Component of a Grade:
Tree / Log Size: Specific products require minimum log diameters and length
Scaling Diameter: 80% DBH (where form class / top 1st log DIB is not known)
Grading Faces: Butt log is divided into 4 sections – attempt to have majority of defect in one face (the worst face). 2nd worst face is usually "tree grade"

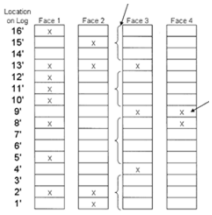
Generally, faces are graded by the lengths that products can be obtained.



Worst 2nd 3rd 1st

Log Valuation: Softwood Log Grading

Veneer class (High and some low quality logs that can be utilized)
Sawlog class (logs adapted for the production of yard and structural timber)



Count number of clear faces: (rotate log such that the majority of the defects are in one face)

Grade 1: logs with 3-4 clear faces
Grade 2: logs with 1-2 clear faces
Grade 3: logs with no clear faces

Next, reduce the log by "1 grade" for each instance of:

Sweep: ≥ 3" and ≥ 1/3rd log scaling diameter
Heartrot: if evidence of advanced rot present

Log Valuation: Hardwood Log Grading

Veneer class (Highest quality)
Factory class (Lumber quality) - The USDA FS usually divide them into 3 grades: F1, F2, and F3 (table below).
Low quality logs have two classes: construction class (where appearance is not a concern) and local-use class for use in pallets and in products where standards are not required.
Straightness (i.e. presence of sweeps) and taper also affect grade

Grading Factors		Log Grades				
		Tree Grade 1			Tree Grade 2	Tree Grade 3
Length of grading zone, *feet*		Butt 16			Butt 16	Butt 16
DBH minimum, *inches*		16+			13+	10+
Scaling diameter, *inches*		13	16	20+	12+	8+
Clear cuttings	Minimum length, *feet*	7	5	3	3	2
	Maximum number	2	2	2	3	No-limit
Minimum cumulative length of clear cuttings (12-foot section), *feet*		10	10	10	8	6
Minimum cumulative length of clear cuttings (14-foot section), *feet*		11.7	11.7	11.7	9.3	7
Minimum cumulative length of clear cuttings (16-foot section), *feet*		13.3	13.3	13.3	10.7	8
Maximum sweep and crook allowance		15%			30%	50%

Adapted from USDA Forest Service standard grades for factory lumber logs from Rast et al. (1973).

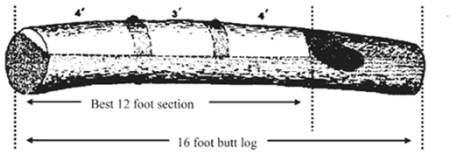
Log Valuation: F1 Grade

Figure 8. Example of an F1 grade, 16-foot butt-log. *Adapted from Rast and others, USDA Forest Service, 1973.*

Grading Factors		Log Grades				
		Tree Grade 1			Tree Grade 2	Tree Grade 3
Length of grading zone, *feet*		Butt 16			Butt 16	Butt 16
DBH minimum, *inches*		16+			13+	10+
Scaling diameter, *inches*		13	16	20+	12+	8+
Clear cuttings	Minimum length, *feet*	7	5	3	3	2
	Maximum number	2	2	2	3	No-limit
Minimum cumulative length of clear cuttings (12-foot section), *feet*		10	10	10	8	6
Minimum cumulative length of clear cuttings (14-foot section), *feet*		11.7	11.7	11.7	9.3	7
Minimum cumulative length of clear cuttings (16-foot section), *feet*		13.3	13.3	13.3	10.7	8
Maximum sweep and crook allowance		15%			30%	50%

Adapted from USDA Forest Service standard grades for factory lumber logs from Rast et al. (1973).

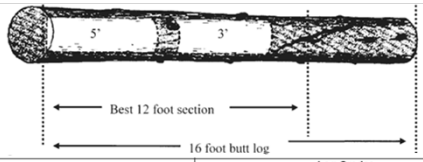
Log Valuation: F2 Grade



Grading Factors		Log Grades				
		Tree Grade 1			Tree Grade 2	Tree Grade 3
Length of grading zone, *feet*		Butt 16			Butt 16	Butt 16
DBH minimum, *inches*		16+			13+	10+
Scaling diameter, *inches*		13	16	20+	12+	8+
Clear cuttings	Minimum length, *feet*	7	5	3	3	2
	Maximum number	2	2	2	3	No-limit
Minimum cumulative length of clear cuttings (12-foot section), *feet*		10	10	10	8	6
Minimum cumulative length of clear cuttings (14-foot section), *feet*		11.7	11.7	11.7	9.3	7
Minimum cumulative length of clear cuttings (16-foot section), *feet*		13.3	13.3	13.3	10.7	8
Maximum sweep and crook allowance		15%			30%	50%

Adapted from USDA Forest Service standard grades for factory lumber logs from Rast et al. (1973).

Log Valuation: F3 Grade

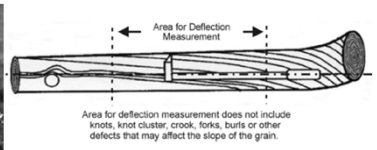


Grading Factors		Log Grades				
		Tree Grade 1			Tree Grade 2	Tree Grade 3
Length of grading zone, *feet*		Butt 16			Butt 16	Butt 16
DBH minimum, *inches*		16+			13+	10+
Scaling diameter, *inches*		13	16	20+	12+	8+
Clear cuttings	Minimum length, *feet*	7	5	3	3	2
	Maximum number	2	2	2	3	No-limit
Minimum cumulative length of clear cuttings (12-foot section), *feet*		10	10	10	8	6
Minimum cumulative length of clear cuttings (14-foot section), *feet*		11.7	11.7	11.7	9.3	7
Minimum cumulative length of clear cuttings (16-foot section), *feet*		13.3	13.3	13.3	10.7	8
Maximum sweep and crook allowance		15%			30%	50%

Adapted from USDA Forest Service standard grades for factory lumber logs from Rast et al. (1973).

Log Valuation: Features that Reduce Quality

Twist (Spiral Grain): Some trees spiral around their central axis causing the grain to spiral. This reduces wood strength and in excessive cases causes the wood to not be merchantable.



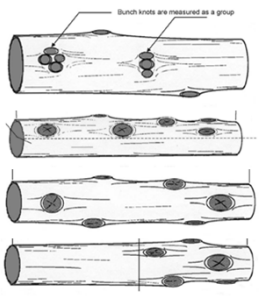
Area for deflection measurement does not include knots, knot cluster, crook, forks, burls or other defects that may affect the slope of the grain.

Insect and Worm Holes: In some regions, there are limits on the number of insect holes that can be present within certain grades.

Sound Stain: Stain that has not become a deductible rot is a grade defect

Log Valuation: Features that Reduce Quality

Size, number, and location of knots: Generally knots larger than 1" will reduce lumber quality as the grain will deflect around the knot.



Knots are generally described as sound or rotten; and tight or loose.

Sound and tight knots produce higher quality lumber than rotten and loose knots.

Rotten knots occur where fungus spores enter a broken or dead branch or where decay is internal.

Tight knots occur when the branches were still green at the time of harvest.

Log Valuation: Example Grades

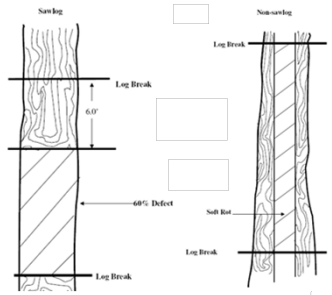
No.1 Peeler Douglas Fir minimums:
Gross Diameter: > 30 inches
Gross length: > 17 feet
Surface: 90% clear
Knots: maximum 2 per log
Annual ring count: 8 per inch
Slope of grain: < 3 inches per foot

No.2 Peeler Douglas Fir minimums:
Gross Diameter: > 30 inches
Gross length: > 17 feet
Surface: 75% clear
Knots: maximum 2 per log
Annual ring count: 8 per inch
Slope of grain: < 3 inches per foot

No.3 Peeler Douglas Fir minimums:
Gross Diameter: > 24 inches
Gross length: > 17 feet
Surface: Limited to knot indicators < 1 ½" in diameter
Knots: maximum 1 per foot of log length
Annual ring count: 6 per inch
Slope of grain: < 3 inches per foot

Defecting Standing Timber: The Cubic Approach

In the cubic approach each sawlog can have up to 60% defect. Non-sawlogs products are cruised for gross volume with no deductions made



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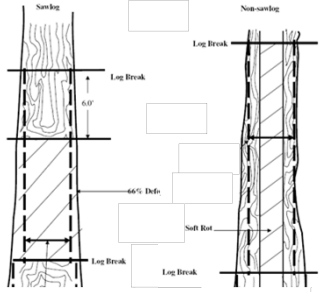
Defecting Standing Timber: The Scribner Approach

In the Scribner approach each sawlog can have up to 66% defect. Non-sawlogs products are cruised for gross volume with no deductions made



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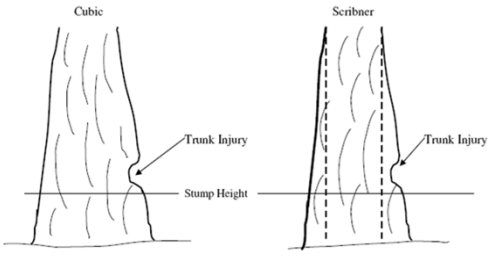
Defecting Standing Timber: Trunk Injuries

When dealing with fire scars, basal, and trunk injuries deductions are only made if there is volume loss. Scribner defects are only counted if the defect penetrates the scaling cylinder.



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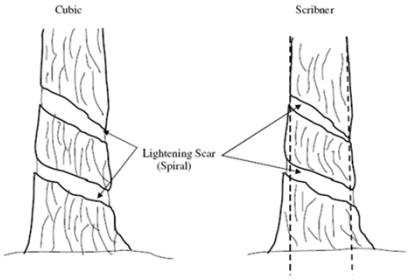
Defecting Standing Timber: Trunk Injuries

Lightning scars will cause defects using both the cubic and Scribner methods.



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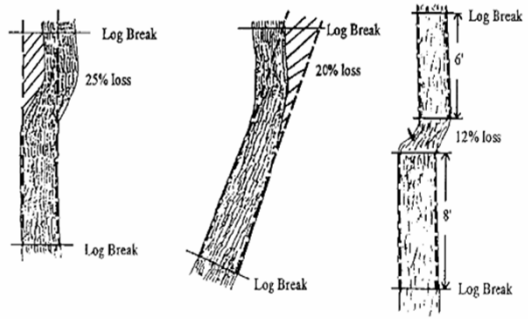
Defecting Standing Timber: Crooks and Sweeps



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