QUALITY CONTROL IN REMANUFACTURING

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Raw material costs are rising in almost every industry. Forest products are no exception. Stumpage prices for Ponderosa Pine in Washington and Oregon have increased from about $40/MBF in 1972 to over $400/MBF. Douglas-fir from some timber sales has jumped from $70/MBF to over $500/MBF. One effect of this raw material cost at Simpson has been the development of a Lumber Size Control program. The obvious benefit of this effort is increased volume recovery.

Other benefits are evident beyond the sawmill. Rough green lumber from the mill can quickly be evaluated for size by observing fresh full units on the green chain or in yard storage. Uniform width and even top layers generally indicate accurate size. Uniform sizes will result in benefits to remanufacturing. Stick layers will be parallel providing unrestricted passages for consistent air flow. This will result in more uniform drying. The results become obvious in reduced oven-dry degrade and/or reduced wet lumber reprocessing. Kiln schedules can be refined and relied upon because of the reduction of variability. In addition, stick damage will decrease and, in the case of size reductions, charge volumes may be increased. As an example of volume increase potential, a thickness reduction from 1.750" to 1.670" saves only .080" per piece. Multiplying this savings times the present 69 layers per kiln car provides 5-1/2" of available height in each kiln. This would allow at least two additional layers to be added to the charge or approximately 3% increase in volume. Another aspect of a size reduction in the sawmills is the potential of rendering ceiling baffles ineffective if marginal distances presently exist. Lack of size control and the effect, can be subjectively analyzed by observing specific units of stuck lumber being loaded and later removed after drying. Wavy layers, blocked air passages, and voids entering a kiln will later be found to produce wet pockets, broken stickers, cup and twist. Economic analysis of reducing these defects should be done for individual operations based upon size, species, costs, price, and grades produced. Benefits are achievable.

Other areas to investigate and analyze are rough green inventory, sorter-stick layers, physical and mechanical condition of kilns, cooling shed, and handling equipment. Careless storage resulting in spilled loads damages lumber and often embeds rocks and other debris which will damage planers. If large volumes of high value material must be inventoried before processing it may be beneficial to cover or sprinkle these. Chains, skate rolls, slides and other transfer or bearing points can cause mars or scratches that affect finished appearance. Loose, worn, or inoperative stick layers may be causing improper alignment or stickering. Leaks in cooling shed roofs, uneven grades for fork lifts, and equipment operators uninformed of the importance or value of the material they process all contribute to lost volume or increased costs.

Our Shelton facility operates three sawmills with an annual production volume of 260 MMBF. Two planer mills process this volume. The South Planer handles the majority of green dimension and small timbers while the North Planer processes the 128 MMBF annual dry kiln production. Ten double track kilns of 200 MBF capacity dry boards, dimension, laminating stock, and shop. Two new Hildebrand kilns, each with 75 MBF capacity, dry cut-stock for finger jointing. Each kiln charge is recorded on a form, Figure 1.

This provides a reference for many areas related to quality. Kiln number, charge number, dates, position by length in the kiln, size, species, and intermediate and final moisture content. Based upon current recovery and grade analysis it can be used to project estimated volumes for sales.

Shrinkage is an important factor to consider when establishing target sizes for the sawmill. The amount of shrinkage is directly related to final moisture content, Figure 2.

Failure to control lower final moisture contents can result in excessive shrinkage resulting in considerable grade loss.

The type of material and end use must be considered as well as the geographic region where the product will be put into service, Figure 3.

A 5% difference exists between the recommended moisture content of interior use wood products from the Southwest to the Southeast.

The North Planer Mill at Simpson has two planer lines. Both are preceded by a contact type moisture detection and wet drop-out system. The 2" Planer line also includes a Continuous Lumber Tester for production of machine stress rated lumber. M.S.R. lumber grade recovery is directly related to moisture content, Figure 4.

Modulus of elasticity (or stiffness) is the primary reference for strength in this system. A typical distribution of "E" values shows a narrow range and a high peak or frequency about the desired "E" value after machine grading, Figure 5.

Recovery can be directly influenced by slight changes in average moisture content. An increase in "E" at the rate of 2% for each 1% decrease in moisture content is possible, Figure 6.

Desired moisture content must be weighed against degrade losses at low moisture contents for specific operations.

How do you measure moisture content? With electrical resistance meters, by counting wet lumber kick out, by waiting for the lumber bureau inspector, or a customer claim? What type of quality control or process control do you have? What feedback to the dry kiln supervisor do you provide? These questions have to be answered based upon individual needs. In addition to monitoring the kilns at Shelton the wet lumber drop-out is reported. Wet drop-out averages 3-5%. Grade recovery is evaluated and specific problem areas investigated. During each planer run moisture checks are made with a hand held electrical resistance meter at the rate of fifty checks per hour throughout the run. These checks are recorded and provide graphic evidence of the final moisture content, Figure 7.

Size, species, kiln and charge, as well as production dates are included. By recording moisture readings for lumber by length such things as steam leaks, faulty fans, ineffective baffles can be detected by reference to the kiln loading diagram, Figure 8.

By measuring and recording at least fifty pieces per hour approximately 3% of the production is sampled. This is sufficient to give a good picture of what final moisture content will be, it provides an immediate and continuous check on the moisture detection system operation ahead of the planer, and is a source of information, if problems occur, for the planer supervisor to consider in making decisions. At the end of each run a copy of this form is given to the dry kiln supervisor. It becomes a reference in detecting problems and adjusting schedules or drying time if necessary. Of equal importance is the fact that it provides positive feedback when good control and desired moisture contents are achieved, Figure 9.

An example of good drying will have a normal bell shape distribution with a narrow range. It will not exceed the maximum allowable moisture content except by a few percent nor will it be grouped around the minimum. Laminating stock requires tight control. Ninety-eight percent of the lumber can be held within a 6% range, Figure 10.

In addition to moisture content, laminating stock thickness is measured and recorded. Sample boards are pulled from production throughout the run. Each sample piece is measured on both edges at two foot intervals. The required tolerance is ± .008", Figure 11.

Management receives a weekly summary of moisture content inspections. Information as to kiln, size, species, and percentages above and below desired limits is provided. Quick review of this report allows management to evaluate lumber drying activity, Figure 12.

Summary

The State of the Art is changing. Equipment is already available to accurately measure, record, and report automatically lumber sizes in the sawmill, moisture and temperature in dry kilns, and finished lumber sizes, moisture, and strength. It is possible to produce good lumber and a quality finished product while remaining cost competitive without elaborate equipment. Until you sample, record, and share information, gathered by hand or machine, you cannot control or properly direct efforts to improve grade and volume recovery of your costly raw material.

Literature Cited

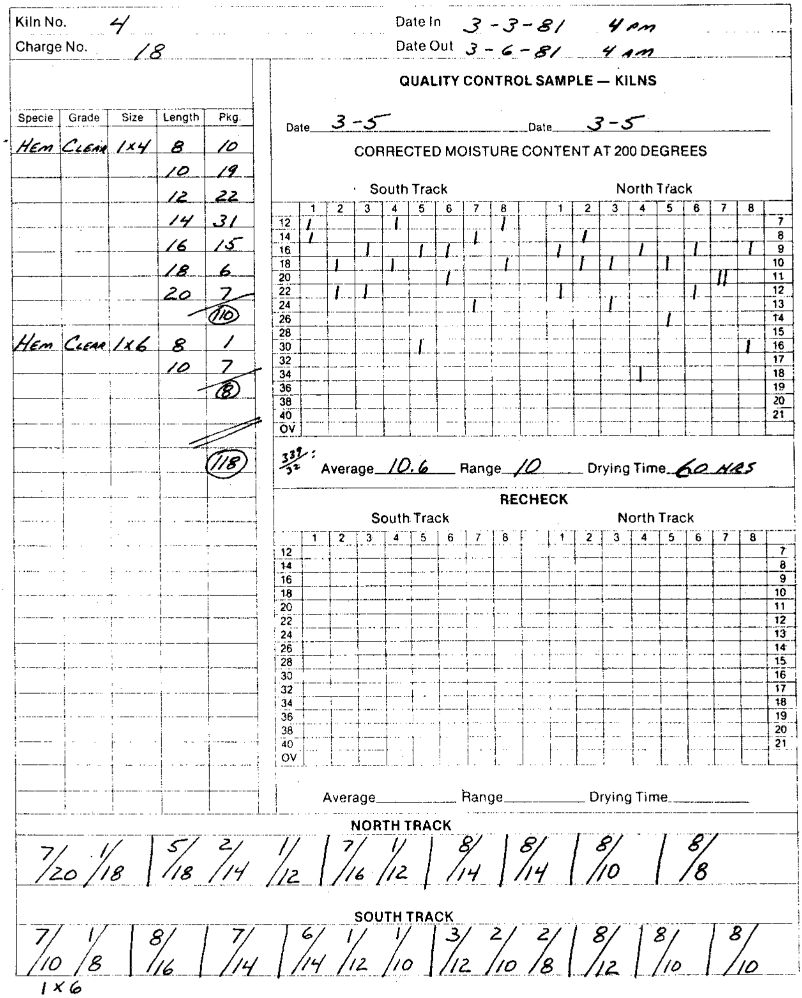
1. Forest Products Laboratory. 1974. Wood Handbook. U.S. Dept. of Agri. Handbook '72, Washington, D.C.

2. Panshin, A. J., and C. DeZeeuw. 1964. Textbook of Wood Technology, Vol. 1. McGraw-Hill, New York.

3. Western Wood Products Association. 1971. Technical guide, Dimensional Stability. Portland, Oregon.

4. Western Wood Products Association. 1979. Western Woods Use Book. Portland, Oregon.

KILN CHARGE RECORD



Kiln No. 4 — Charge No. 18

Date In 3-3-81 4 PM — Date Out 3-6-81 4 AM

Specie	Grade	Size	Length	Pkg.
Hem	Clear	1x4	8	10
			10	19
			12	22
			14	31
			16	15
			18	6
			20	7
				(110)
Hem	Clear	1x6	8	1
			10	7
				(8)
				(118)

QUALITY CONTROL SAMPLE — KILNS

Date 3-5 — Date 3-5

CORRECTED MOISTURE CONTENT AT 200 DEGREES

South Track — North Track

339/32: Average 10.6 Range 10 Drying Time 60 HRS

RECHECK

South Track — North Track

Average ______ Range ______ Drying Time ______

NORTH TRACK

7/20, 1/18 | 5/18, 2/14, 1/12 | 7/16, 1/12 | 8/14 | 8/14 | 8/10 | 8/8

SOUTH TRACK

7/10, 1/8 | 8/16 | 7/14 | 6/14, 1/12, 1/10 | 3/12, 2/10, 2/8 | 8/12 | 8/10 | 8/10

1x6

Figure 1. Kiln charge record.

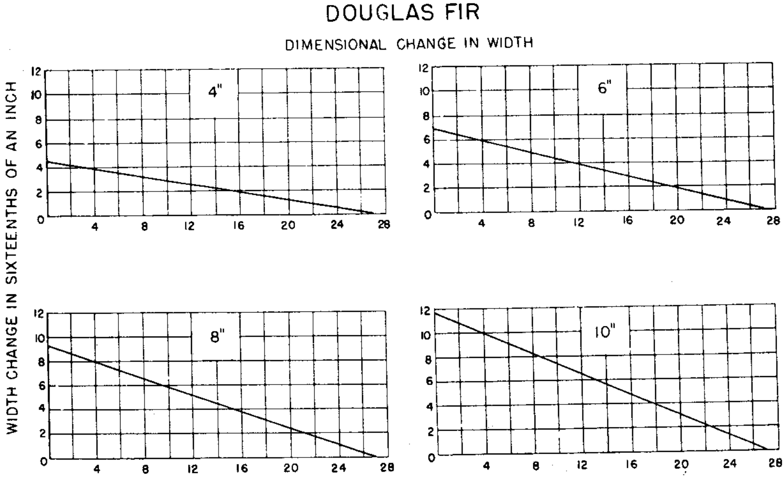


Figure 2. Relationship of shrinkage and final moisture content.

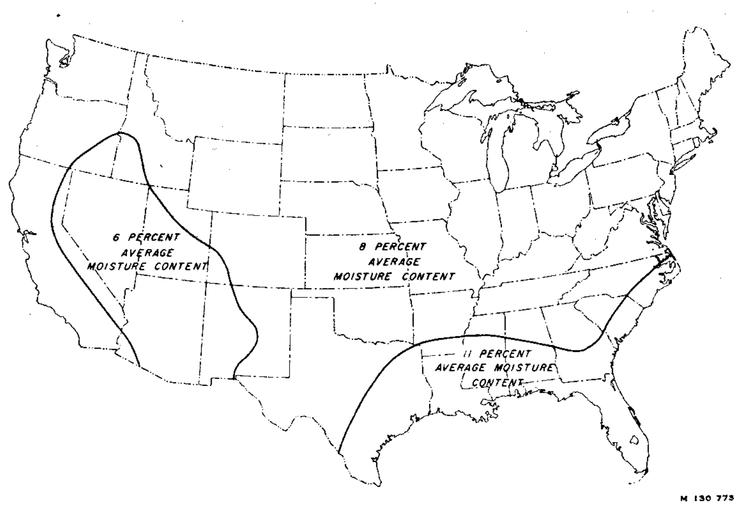


Figure 3. Recommended average moisture content for interior use of wood products in various areas of the United States.

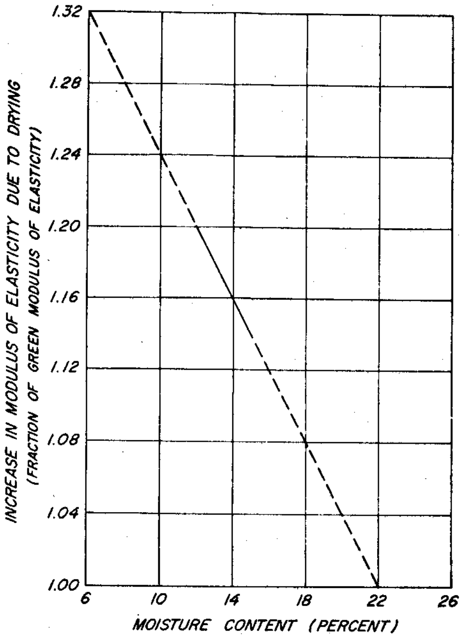


Figure 4. Modulus of elasticity as a function of moisture content of lumber.

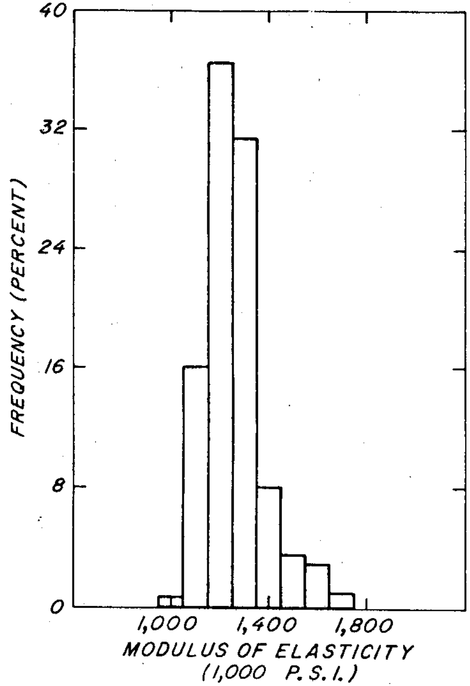
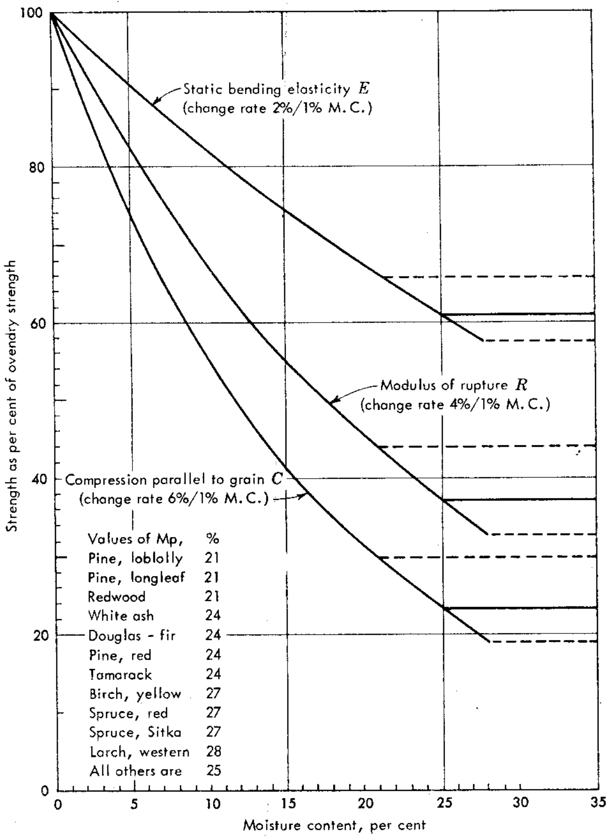


Figure 5. Typical distribution of modulus of elasticity values in machine stress grading.



Change of moisture content in wood and its effect on the strength properties. (*Drawn from data in the "Wood Handbook."*[5])

Figure 6. Change of moisture content in wood and its effect on the strength properties.

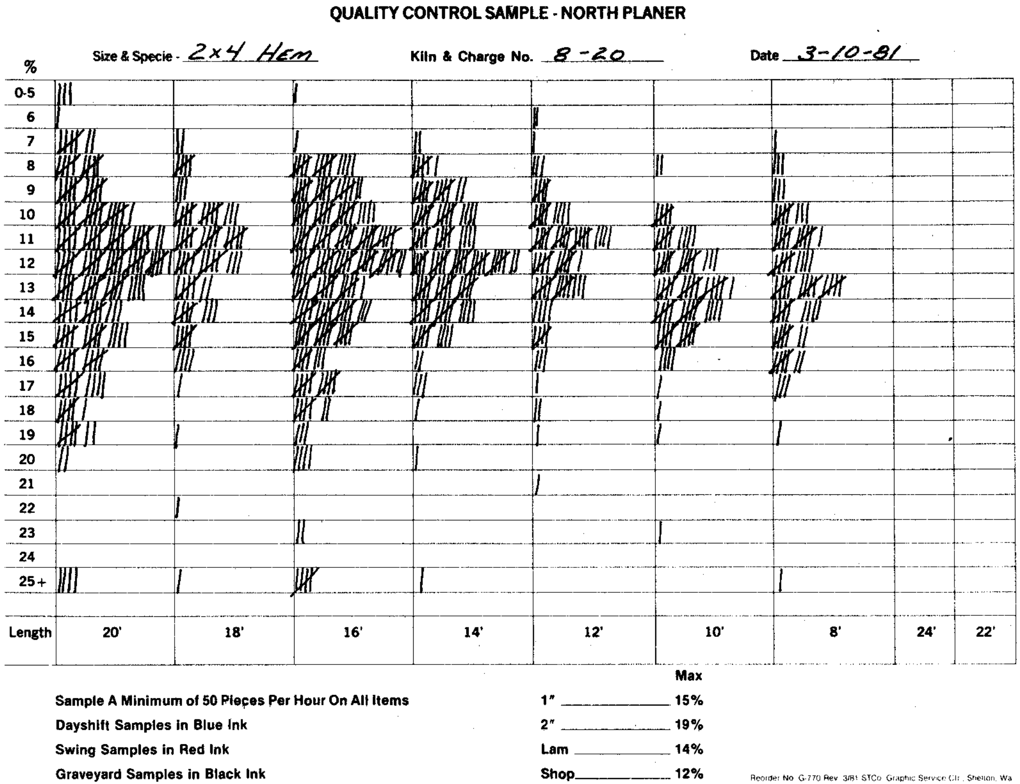


Figure 7. Graphic illustration of final moisture content.

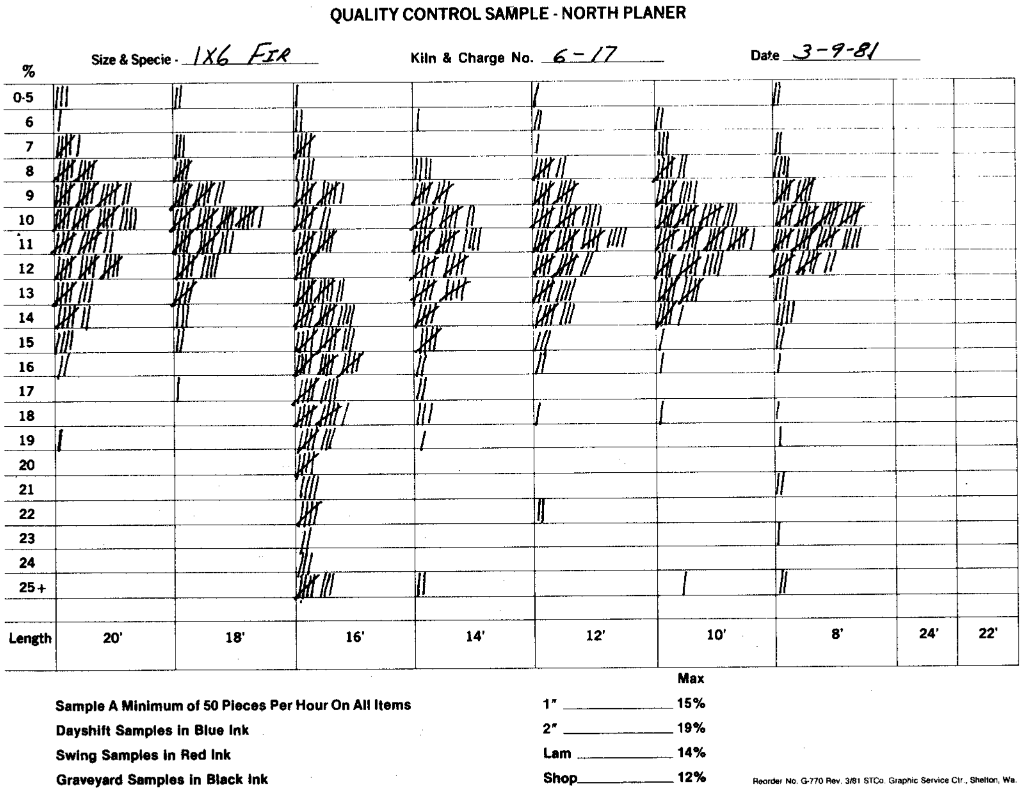


Figure 8. Moisture meter readings can detect problems in the kiln by reference to kiln loading diagram.

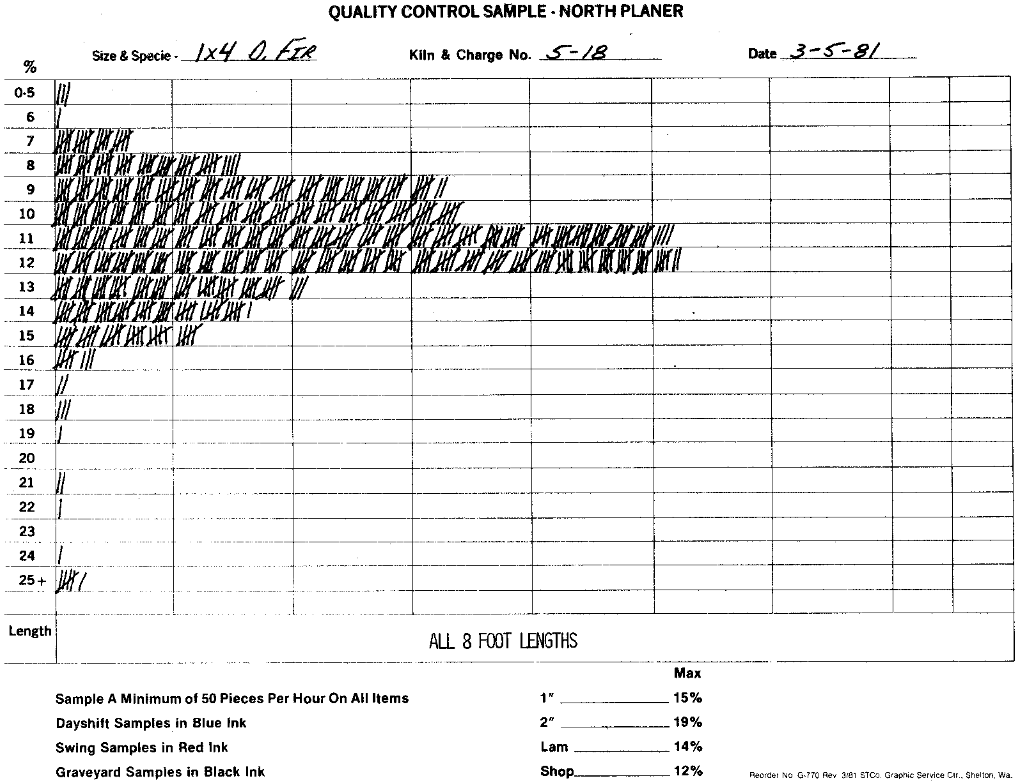


Figure 9. Feed back when achieving good control and desired moisture contents.

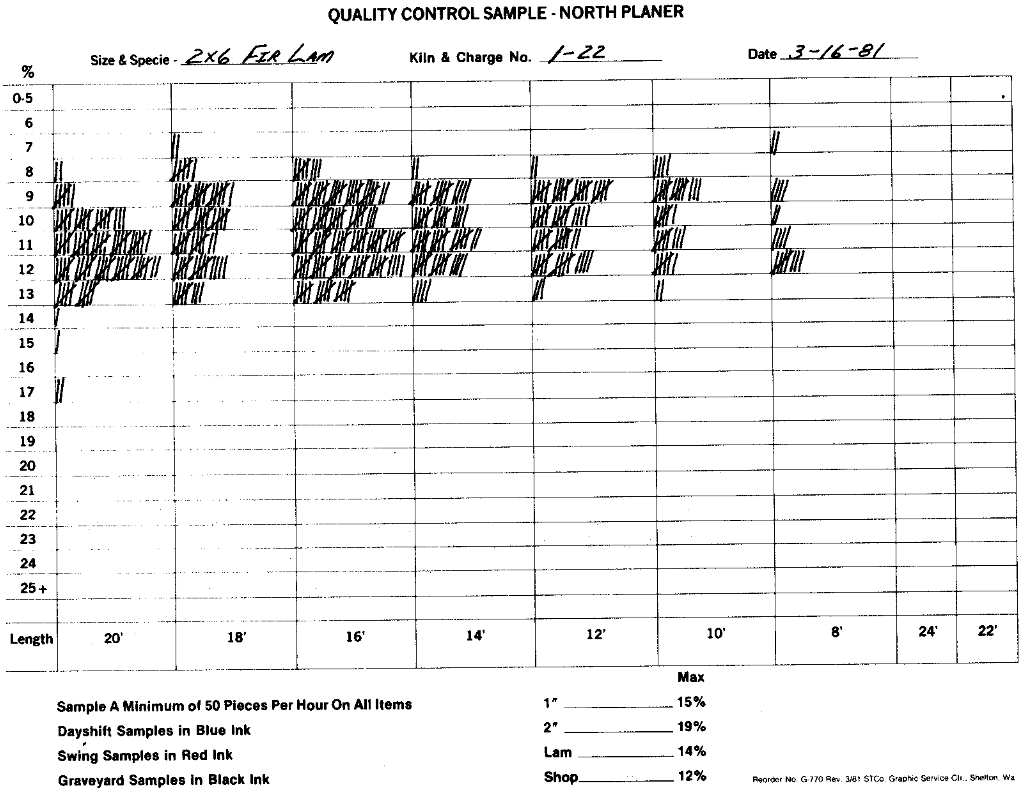


Figure 10. Normal moisture content distribution with a narrow range.

PLANER THICKNESS **QUALITY CONTROL REPORT**

DATE 3-16

KILN # 1-22

PLANNER LINE # 2" LUMBER SIZE 2x6 SPECIE FIR SAMPLED BY McCord Sudcamp

TOLERANCE ALLOWED IS -.008 to + .008

Reading at intervals as shown starting from grader end. Mark board and take readings directly opposite of each other.

Length	1' From End		3' From End		5' From End		7' From End		9' From End		11' From End		13' From End		15' From End		17' From End		19' From End	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
20'	.000	+.006	.000	.000	-.001	+.003	-.002	.000	.000	+.001	.000	+.002	.000	+.002	-.002	-.003	+.003	+.002	.000	+.004
	+.002	+.002	+.003	+.005	-.004	-.002	-.003	+.002	+.001	+.004	+.002	+.006	+.004	+.007	-.003	-.006	.000	+.001	+.003	+.006
	+.005	+.008	+.003	+.003	+.004	+.001	+.007	+.006	+.004	+.008	+.001	+.003	+.002	-.003	-.001	-.001	-.005	-.007	-.001	-.003
	+.001	-.003	-.002	-.005	+.002	-.003	+.005	-.001	+.008	+.002	+.006	-.004	+.002	.000	+.001	-.001	-.002	-.002	-.001	-.002
18'	+.003	+.001	.000	.000	+.001	.000	+.003	+.004	+.001	.000	-.001	-.001	-.002	-.001	+.007	+.004	+.002	+.005		
	+.001	.000	+.003	+.001	.000	+.002	+.001	+.004	+.002	+.002	.000	.000	-.001	+.004	+.001	+.001	.000	-.002		
16'	-.002	-.001	+.001	.000	-.001	-.005	-.006	-.008	-.004	-.002	-.001	+.003	+.001	+.002	+.008	-.001				
	+.008	+.005	+.003	+.007	+.001	+.004	+.005	+.001	+.001	.000	+.002	+.003	-.004	+.003	.000	-.003				
	+.003	+.004	.000	+.001	-.005	+.006	+.002	+.007	+.003	+.004	+.001	-.006	+.002	+.005	+.001	+.002				
14'	-.002	+.003	-.005	-.006	+.001	.000	.000	-.002	-.003	.000	+.004	-.001	+.003	+.002						
	-.007	-.005	+.004	-.006	+.003	-.002	-.001	+.004	+.003	+.006	+.006	+.006	+.004	+.001						
	+.003	+.007	+.001	+.001	+.003	+.001	+.002	-.001	.000	.000	-.001	-.002	+.002	-.005						
12'	-.006	-.001	.000	+.002	+.006	+.004	+.002	+.005	+.001	.000	-.001	-.003								
	-.002	+.003	+.004	+.007	+.001	.000	-.005	-.002	+.003	+.001	+.004	+.008								
	+.001	.000	+.003	+.007	+.001	+.004	+.004	-.002	-.001	.000	.000	+.001								

Figure 11. Record of measured thickness of laminating stock.

QUALITY CONTROL WEEKLY REPORT
DRY PLANER MOISTURE CONTENT INSPECTION

WEEK OF March 31, 1980

1" CLEAR

Kiln Charge	4-15, 6-14	3-17 7-18	3-17, 3-15, 1-19	
Size & Species	1x4 FIR	1x6 HEM	1x8 HEM	
# of Samples	871	512	588	
% Below 6%	20	2	0	
% Above 15%	1	15	9	

DIMENSION & 1" COMMON

Kiln Charge	5-19	2-16	8-19, 10-17	
Size & Species	2x3 FIR	2x4 HEM	2x8 HEM RIP	
# of Samples	292	469	758	
% of Below 8%	3	9	25	
% Above 21%	2	7	3	

Kiln Charge				
Size & Species				
# of Samples				
% Below 8%				
% Above 21%				

LAM STOCK

Kiln Charge	1-21	9-19	9-19, 6-15	
Size & Species	2x4 FIR LAM	2x4 FIR LAM	2x6 FIR LAM	
# of Samples	350	415	137	
% Below 10%	42	74	19	
% Above 14%	2	0	7	

SHOP

Kiln Charge	4-15, 8-18			
Size & Species	1 5/8 x 5 HEM			
# of Samples	423			
% Below 6%	12			
% Above 12%	8			

REMARKS: CHARGE 9-19 2x4 LAM WAS VERY LOW MC%

Figure 12. Quality control weekly report.