

United States
Department of
Agriculture

Forest Service

Forest
Products
Laboratory

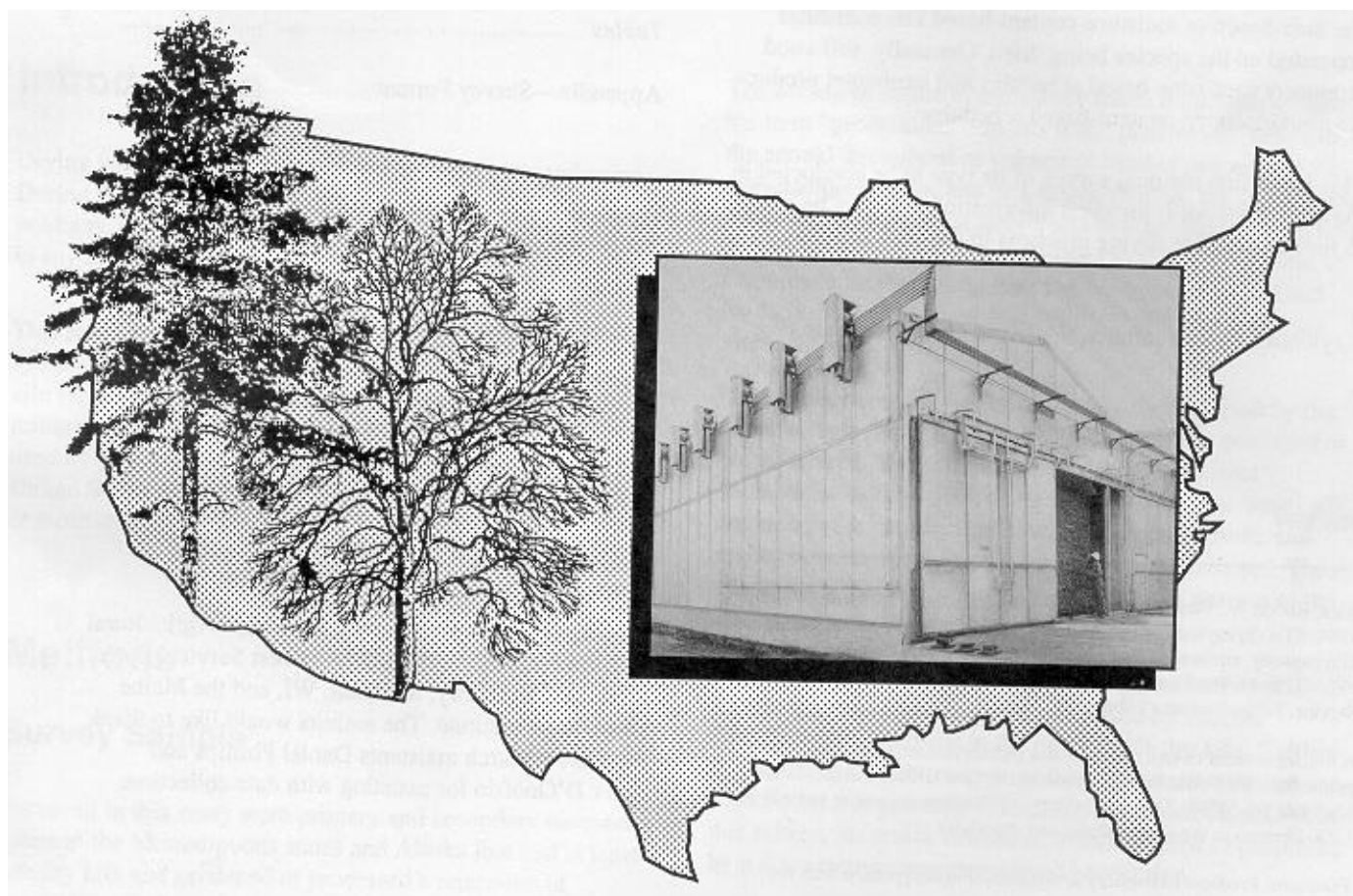
General
Technical
Report
FPL-GTR-81



Kiln Drying Lumber in the United States

A Survey of Volume, Species, Kiln Capacity, Equipment, and Procedures, 1992-1993

Robert W. Rice
Jeffrey L. Howe
R. Sidney Boone
John L. Tschernitz



Abstract

A survey was conducted of primary and secondary manufacturing firms that have at least one dry kiln and process approximately 2 million board feet or more of lumber annually. More than 1,500 surveys were completed, representing manufacturers in 43 states.

According to survey respondents, approximately 5 billion board feet of hardwood lumber and 24 billion board feet of softwood lumber were kiln dried annually. Drying data were collected for 48 commercial species or species groups and volume information was reported by state and region. The 13-state southern region dried more than twice as much wood as any other area.

There were more than 7,000 dry kilns in the United States with a holding capacity of 447 million board feet. This capacity varied by species and region. The majority of kilns were steam heated. The most common maximum operating temperature was between 160°F and 180°F. The decision to use time-based or moisture-content-based kiln schedules depended on the species being dried. Generally, softwood producers used time-based schedules and hardwood producers used moisture-content-based schedules.

This is the first national survey of its type to be conducted in the United States. It provides information that may be used to further examine drying practices in the United States.

Keywords: Drying lumber, dry kilns, drying methods

May 1994

Rice, Robert W.; Howe, Jeffrey L.; Boone, R. Sidney; Tschernitz, John L. 1994. Kiln drying lumber in the United States--a survey of volume, species, kiln capacity, equipment, and procedures, 1992-1993. Gen. Tech. Rep. FPL-GTR-81. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 24 p.

A limited number of free copies of this publication are available to the public from the Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398. Laboratory publications are sent to more than 1,000 libraries in the United States and elsewhere.

The Forest Products Laboratory is maintained in cooperation with the University of Wisconsin.

The United States Department of Agriculture (USDA) Forest Service is a diverse organization committed to equal opportunity in employment and program delivery. USDA prohibits discrimination on the basis of race, color, national origin, sex, religion, age, disability, political affiliation, and familial status. Persons believing they have been discriminated against should contact the Secretary, U.S. Department of Agriculture, Washington, DC 20250, or call (202) 720-7327 (voice), or (202) 720-1127 (TTY).

Contents

	<i>Page</i>
Introductio	1
Method	1
Survey Sampl	1
Survey Forma	2
Conduct of the Survey.....	2
Results and Discussion.....	2
Volume of Lumber Kiln Dried.....	2
Species of Lumber Kiln Dried by Volume	3
Kiln Drying Capacity, Number, and Types of Kilns	4
Average Kiln Size	4
Predryer and Fan-Shed Dryers	4
Drying Practices	4
Summary and Conclusions	5
<i>Tables</i>	5
Appendix--Survey Format	23

Acknowledgments

This survey was sponsored by the Maine Agricultural Experiment Station, the USDA Forest Service, Forest Products Laboratory, Madison, WI, and the Maine Toxicology Institute. The authors would like to thank graduate research assistants Daniel Phillips and Mark D'Onofrio for assisting with data collection.

United States
Department of
Agriculture

Forest Service

Forest
Products
Laboratory

General
Technical

FPL-GTR-81



Kiln Drying Lumber in the United States

A Survey of Volume, Species, Kiln Capacity, Equipment, and Procedures, 1992-1993

Robert W. Rice
Jeffrey L. Howe
R. Sidney Boone
John L. Tschernitz

Errata

The following two tables replace Tables 7 and 8 on pages 21 and 22
(Table 8 below, Table 7 on the reverse).

Table 8—Regional use of schedule bases^a

Geographic area	Total number of kilns	Kilns using various schedule bases (% of total)		
		Moisture- content- based	Time- based	Air dry before kiln
Regions				
North	2,825	61.4	25	36.2
Pacific coast	1,303	10.2	62.6	10.0
Rocky Mountains	391	19.4	71.0	10.7
South	2,575	48.0	36.7	12.1
Softwoods				
GA, SC, TX	338	24.1	59.6	5.7
ID, MT, WY	295	19.0	67.6	12.0
CA, OR	978	10.6	64.3	13.8
Hardwoods				
NY, OH, PA	1,015	68.8	20.2	36.1
KY, TN	640	58.5	26.6	58.2

^aIncludes manufacturers that process approximately 2 million board feet or more of lumber annually.

Table 7—Regional drying practices

Geographic area	Number of kilns operating at various maximum temperatures					Air dry before kiln drying per year (million board feet)	Number of kilns using various schedule bases		
	120°F to 159°F	160°F to 180°F	181°F to 211°F	212°F+	Other or unknown		Time-based	Moisture-content-based	Other or unknown
North	388	2,128	113	18	200	1,216.9	877	2,117	453
CT	4	4	25	0	0	4.0	29	4	25
IL	0	21	4	0	1	14.2	8	25	1
IN	8	124	0	0	32	100.1	71	146	0
IA	4	20	0	0	2	7.2	6	22	6
ME	67	106	7	12	4	91.4	130	113	84
MD	8	0	0	3	0	9.0	3	8	1
MA	7	38	0	0	0	29.3	21	38	1
MI	17	184	19	1	15	93.5	67	199	25
MN	24	80	6	0	6	87.8	32	85	24
MO	46	136	4	2	0	170.1	50	151	13
NH	54	46	0	0	5	22.5	72	84	4
NJ	0	9	0	0	0	8.9	9	9	0
NY	48	232	0	0	39	99.7	97	266	31
OH	17	196	4	0	12	97.9	77	198	37
PA	16	415	11	0	25	116.2	95	452	79
WV	8	169	3	0	0	25.9	42	94	10
WI	38	271	27	0	29	83.6	48	157	97
WI	38	271	27	0	29	155.6	20	66	15
Pacific coast	61	817	360	35	53	723.2	1,110	180	482
CA	13	355	133	0	26	446.6	442	64	166
OR	27	277	130	17	0	224.8	387	73	157
WA	21	185	97	18	27	51.8	281	43	159
Rocky Mountains	24	198	90	71	9	380.5	226	61	32
AZ	0	16	27	12	0	7.1	55	0	0
CO	4	2	0	2	0	2.6	8	4	0
ID	13	99	31	25	0	265.0	22	10	6
KS	1	18	0	0	0	9.5	7	17	1
MT	5	43	24	28	9	41.3	103	30	15
NM	0	7	0	0	0	7.2	7	0	0
SD	0	3	2	2	0	0.0	7	0	2
UT	0	1	0	0	0	0	0	0	1
WY	1	9	6	2	0	47.8	17	0	7
South	171	1,525	281	504	121	1,825.6	1,263	1,652	526
AL	7	74	22	80	21	91.5	114	96	26
AR	0	98	16	62	0	199.5	93	106	35
FL	4	4	2	30	2	80.7	28	10	10
GA	10	44	14	68	0	133.4	100	29	42
KY	31	144	33	0	38	147.6	81	188	41
LA	6	43	3	41	0	69.4	80	35	18
MS	23	152	33	90	27	182.4	146	164	106
NC	19	365	62	34	19	212.7	243	393	64
OK	0	0	7	1	0	16.8	8	1	1
SC	6	42	16	58	4	63.2	109	44	6
TN	35	313	42	3	1	331.0	137	292	82
TX	8	20	10	32	6	41.9	46	30	22
VA	22	226	21	5	3	255.6	78	264	73

^aIncludes manufacturers that process approximately 2 million board feet or more of lumber annually.

Kiln Drying Lumber in the United States

A Survey of Volume, Species, Kiln Capacity, Equipment, and Procedures, 1992-1993

Robert W. Rice, Assistant Professor, Wood Science and Technology
University of Maine, Orono, Maine

Jeffrey L. Howe, Research Assistant
Dept. of Forest Products, University of Minnesota
St. Paul, Minnesota

R. Sidney Boone, Forest Products Technologist
John L. Tschernitz, Chemical Engineer
Forest Products Laboratory
Madison, Wisconsin

Introduction

Drying wood is critical to its overall performance and value. During the conversion of logs to lumber and related products, more time and expense is incurred in drying than in any other processing step.

This study determined the volume of lumber kiln dried, species or species groups that are kiln dried, kiln capacity, kiln type, and drying practices including moisture monitoring methods and maximum drying temperatures that are used by primary and secondary lumber operators in the United States that process approximately 2 million board feet or more annually.

Methods

Survey Sample

Surveyed in this study were primary and secondary manufacturers in the 48 contiguous states and Alaska that had at least one dry kiln and produced or processed a minimum of approximately 2 million board feet of lumber annually. This excluded hardwood and softwood manufacturers without dry kilns and operations that had dry kilns but did not process 2 million board feet of lumber per year. We estimate this excluded between 20 and 30 percent of the primary and secondary manufacturers in the United States based on U.S. Government statistics and state manufacturers' directories.

The exclusive nature of the survey made it difficult to define the term "production." In this text, "production" refers to the annual throughput or volume of lumber processed by a manufacturer, regardless of whether primary log breakdown occurred at the manufacturer's site or elsewhere. Production figures here should not be compared to U.S. Department of Commerce lumber production figures from softwood and hardwood sawmills, which are derived differently and are more inclusive.

Our primary concern was the volume of wood dried by the manufacturer rather than where the lumber was produced or manufactured. This led, naturally, to some apparent anomalies-species such as southern yellow pine were counted in the "production" statistics for Minnesota, and mahogany was considered "produced" in Mississippi. These situations probably occurred in fewer than 1 percent of the manufacturers surveyed.

More important were situations where green lumber was produced at one manufacturer, purchased by another manufacturer, and dried in the purchaser's dry kiln. Neither this survey nor other surveys of forest products output account for this practice. Within the limits and objectives of this survey, the entire volume of wood handled or processed by a manufacturer was considered production.

Another difficulty concerned the term "lumber." Rarely did we encounter manufacturers that kiln dried products other than lumber (e.g., poles or large timber). When it did occur, the volumes of these products were mathematically converted from cubic feet or other units to board feet, and the result was tallied as lumber. Again, this situation probably occurred in fewer than 1 percent of the mills surveyed.

Lists of companies/firms for the survey were obtained by contacting state forestry personnel, university extension personnel, and others who provided directories or information about the industry. Lists from the 1993 Directory of the Wood Products Industry¹ and regional and state kiln-drying associations supplemented state directories.

Verification to determine if a manufacturer met the survey requirements was made by telephone. About 30 percent of the plants initially contacted did not meet survey criteria. About 8 percent of the manufacturers included in the final tally produced somewhat less than 2 million board feet of lumber during the 12 months preceding the survey, many due to an economic recession. Finally, lists of survey respondents were reviewed by individuals from each state to assure that all producers met the survey criteria.

Survey Format

The survey, a questionnaire with nine partially open-ended² questions (Appendix), was intended to obtain information about facilities, production, and drying activities of the respondents. Every effort was made to phrase questions clearly and allow clarification of answers. Two questions involved mill type and respondent's position. Three questions determined production by species, and four questions were specific to the firm's drying capacity and equipment.

Manufacturers were categorized in several ways. Mills having only sawmills and drying operations were considered primary producers or manufacturers. Manufacturers without sawmills but who had planer mills and/or other secondary operations in addition to dry kilns were considered secondary or nonprimary operations. A third category was established for integrated manufacturers who had both primary and secondary operations in addition to their dry kiln.

Conduct of the Survey

The survey was conducted by telephone. To minimize caller bias, a standard introductory message was used and surveyors were trained in kiln-drying activities. To assure consistency, responses from each state were reviewed on an individual basis as each state survey was completed.

The survey questionnaire was reviewed by USDA Forest Service, Forest Products Laboratory personnel, and pretested on four companies in Louisiana, Montana, and New Hampshire.

¹Malpas, Pamela G., Ed. 1993. Directory of the Wood Products Industry. Miller-Freeman Inc., San Francisco, CA.

²Partially open-ended in this case involves answers that generally fit in certain categories, but allows for options not previously considered to provide a richer response.

The survey was conducted from June 1992 through May 1993. During this period, substantial changes in industry structure and ownership were occurring in Washington and Oregon. This situation concerned the surveyors, and as a result, many of the mills in the Pacific Northwest were surveyed twice.

In polling the sample, the response rate was 95 percent. When manufacturers chose not to respond, the surveyors attempted to piece together the information by using alternative sources such as kiln drying membership directories or other membership lists. In some cases, no one could be reached to provide information. After three tries, the attempts were halted. These exceptions amounted to fewer than 1 percent of the sample.

Results and Discussion

A total of 1,509 questionnaires were completed. In some cases a single contact provided information about other facilities that were owned or controlled by the manufacturer. Thus, the actual number of facilities represented is somewhat greater than the number of questionnaires completed.

Most of the surveyed mills (53 percent) had integrated manufacturing operations, defined as having both primary and secondary operations in addition to dry kiln operations (Table 1). Of the total, 13 percent of respondents operated only a sawmill and drying operation, and nearly 35 percent were manufacturers with only nonprimary operations. The states having the most sawmill/dry-kiln-only operations were North Carolina (17), Pennsylvania (17), Indiana (13), New York (13), Mississippi (12), and Kentucky (11). States with the most nonprimary only operations were Tennessee (51), Wisconsin (42), Virginia (40), North Carolina (34), and Mississippi (30).

Most of the survey results are summarized in Tables 2, 4, and 7. Tables 3, 5, and 6 summarize information by species and geographic area. The USDA Forest Service Resources Planning Act (RPA) assessment regions (Fig. 1) are used. The volume of information makes it difficult to determine trends within the data. As a result, some of the major trends and characteristics are synthesized in a more concise form in other tables. These are highlighted in the following sections.

Volume of Lumber Kiln Dried

Approximately 29 billion (in this report 1 billion = 10⁹) board feet of lumber was kiln dried annually according to survey respondents (Table 2). Some 15 billion board feet was kiln dried in the South, representing about 91 percent of the overall production or throughput in that region (Table 3). Alabama, Arkansas, Georgia, Mississippi, and North Carolina dried nearly 64 percent of all the kiln-dried lumber in the 13-state region.



Figure 1—USDA Forest Service RPA Assessment Regions (excluding Alaska and Hawaii).

The manufacturers of the Pacific Coast region reported more than 7 billion board feet of lumber kiln dried, or about 73 percent of the throughput in that region. Oregon, Washington, and California each dried more than 2 billion board feet. Of the states surveyed, the manufacturers of Oregon produced and dried more wood than any other. No operating dry kilns were found in Alaska that met the survey criteria.

The manufacturers of the Rocky Mountain region and the Northern region each dried about 3.5 billion board feet, with Idaho and Montana leading in the Rocky Mountains and Maine, Pennsylvania, and Wisconsin leading the North (Table 3). About 92 percent and 79 percent of the lumber was kiln dried in the Rocky Mountain and Northern regions, respectively.

Species of Lumber Kiln Dried by Volume

Information on the volume of lumber kiln dried for 55 species or species groups was collected from 43 states. The species or species groups were taken from the list of “Commercial Species of the United States”³ Seven species were later eliminated because they were not produced by survey respondents. The remaining 48 species or species groups are listed along with the kiln dried volume of each species in Table 4. Data for the five leading softwood and the six leading hardwood species/species groups are shown in Table 5.

Softwoods

Just over 24 billion board feet of softwood lumber or 86 percent of reported production was kiln dried. Southern yellow pine kiln-dried lumber accounted for 12.5 billion

board feet or 94 percent of reported production. The states producing the largest volumes of kiln-dried southern yellow pine included Mississippi, Alabama, Georgia, South Carolina, and Arkansas.

Respondents reported drying more ponderosa pine lumber (2.8 billion board feet) than Douglas-fir (2.2 billion board feet). This was somewhat surprising. When seen as a percentage of production, however, about 93 percent of ponderosa pine and only 62 percent of Douglas-fir throughput was kiln dried. Considerable quantities of Douglas-fir dimension lumber are sold without kiln drying.

The western firs were grouped together. Manufacturers reported that about 1.9 billion board feet or 80 percent of production was kiln dried. Western hemlock was tallied separately, with about 0.8 billion board feet being kiln dried. In many cases, the surveyors considered the breakdown between hemlock and fir reported by manufacturers to be speculative.

Hardwoods

Almost 5 billion board feet of hardwood lumber, about 78 percent of the volume processed by manufacturers meeting the survey criteria, was kiln dried. Products such as furniture, cabinets, flooring, paneling, and moulding require final moisture contents of 6 to 8 percent. Almost all the lumber for these products is kiln dried. An additional 4 billion board feet of hardwood lumber was used by the pallet and container industry in 1991 and 1992.⁴ Virtually none of this lumber was kiln dried.

Overall, the oaks constituted the main hardwood species group. Slightly more than 1.7 billion board feet of red oak was kiln dried, according to survey respondents. The states drying the most red oak were Tennessee, Pennsylvania, Mississippi, Wisconsin, and Arkansas.

More than 700 million board feet of white oak was kiln dried. The leading states included Tennessee, Kentucky, Alabama, Arkansas, and Missouri. Tennessee dried nearly twice as much as any other state. When combined with the red oaks, the total volume of oak accounted for nearly 50 percent of all kiln-dried hardwood lumber.

Following the oaks, the species with the most lumber kiln dried was yellow-poplar with approximately 407 million board feet. The five leading states in drying this species were Virginia, North Carolina, Kentucky, Ohio, and West Virginia.

³Forest Products Laboratory. 1987. Wood handbook: Wood as an engineering material. Agric. Handb. 72. (Rev.) Washington, DC: U.S. Department of Agriculture. 466 p.

⁴Christoforo, John C.; Bush, Robert J.; Luppold, William G. 1994. A profile of the U.S. pallet and container industry. Forest Products Journal. 44(2): 9-14.

Approximately 386 million board feet of maple (hard/soft) was kiln dried, according to survey respondents. New York (71 million) and Michigan (65 million) were leaders followed by Wisconsin, North Carolina, and Oregon.

About 220 million board feet of red alder was kiln dried. Washington kiln dried just over 119 million board feet followed by Oregon with 100 million board feet.

Cherry ranked next with 120 million board feet kiln dried. Pennsylvania, with 46 million board feet dried, had more than twice as much as New York with 20 million board feet. Virginia, Ohio, and West Virginia completed the top five states drying cherry.

Kiln Drying Capacity, Number, and Types of Kilns

The dry-kiln holding capacity reported by survey respondents totaled approximately 447 million board feet (Table 2). The total number of dry kilns was 7,144, of which 6,285 were steam kilns (88 percent), 472 were dehumidification kilns (6.6 percent), and 337 were direct-fired kilns (5 percent). The category “other” consisted of vacuum, radio frequency, and other systems, which made up only two-thirds of 1 percent of the total. Dehumidifier, direct-fired, and hybrid systems that would be classified as “other” are often used in smaller facilities that were not included in this survey.

The Northern region had approximately 130 million board feet of kiln capacity with about 2,800 dry kilns. Of these, 2,503 were steam heated, 273 were dehumidification kilns, and 49 were direct fired. States having 10 million board feet or more kiln capacity included Pennsylvania, Wisconsin, New York, Maine, Michigan, Ohio, and West Virginia. As in the South, substantial quantities of both hardwoods and softwoods were kiln dried in this region.

The Pacific Coast region of California, Oregon, and Washington reported a kiln capacity of 102 million board feet and approximately 1,300 kilns. Of these, 1,253 were steam heated, 45 were dehumidification, and 5 were direct fired. Most kiln drying was done with softwoods. The only major hardwood species kiln dried was red alder.

The kiln capacity in the Rocky Mountain region was 33.4 million board feet in 392 kilns. Steam-heated kilns made up 365 of the total with direct fired and dehumidification each having 13 kilns. Softwoods constituted the bulk of the lumber dried in this region. Idaho, with 15 million board feet kiln capacity, and Montana, with 9 million board feet kiln capacity, were the leading states.

The Southern region had the largest capacity at 181 million board feet and about 2,600 dry kilns. Most direct-fired kilns (270) were located here as were most kilns in the “other” category (27). States having 15 million or more board feet of

kiln capacity included North Carolina, Mississippi, Tennessee, Virginia, and Alabama. Both softwood and hardwoods were kiln dried in substantial quantities in this region.

Average Kiln Size

The average kiln size varied substantially. The size breakdown, classified by region, is shown in Table 6. Using the standard assessment regions for kiln size can be somewhat misleading because many states produced substantial quantities of both hardwood and softwood lumber. A more precise approach is to determine the average kiln size using states where the production of either softwoods or hardwoods predominates. Those data are also shown in Table 6. In each of the chosen states, the production of softwoods or hardwoods is at least 10 times the other. Based on the reported information, it is apparent that a typical softwood kiln is substantially larger than a typical hardwood kiln.

Predryer and Fan-Shed Dryers

Predryer use was confined to areas where hardwood production predominates (Table 2). Of the 214 units reported, 51 percent were found in Ohio, Pennsylvania, Tennessee, Kentucky, and Wisconsin. The average predryer capacity was 544,000 board feet.

Survey respondents reported 39 fan-shed dryers located mainly in the Eastern United States. Their average capacity was about 24,000 board feet.

Drying Practices

summary of drying practices is shown in Table 7. The majority of kilns (69 percent) operated at maximum temperatures in the range of 160°F to 180°F. Elevated-temperature drying (181°F to 211°F) was the second most popular method with 12 percent of the total. High temperature (>212°F) and kilns operating below 160°F each comprised about 9 percent of the total. The “other/unknown” category represented persons who were not aware of the drying temperature details or who chose not to respond.

The majority of respondents (46 percent) used moisture-content-based drying schedules. About 38 percent of the surveyed mills used time-based schedules, and about 16 percent used a combination of temperature/time or a hybrid system, such as temperature drop across the load.

The choice of kiln schedule type (time, moisture content, or other) was also a function of the region and the species or species group being dried (Table 8). Moisture-content-based schedules predominate in the hardwood-producing regions, and time-based methods are favored by at least a 2-to-1 margin in softwood-producing regions.

Overall, about 12 percent of the lumber processed by survey respondents underwent some air drying prior to kiln drying. As illustrated in Table 8, the practice of air drying was both region and species dependent. Softwoods underwent substantially less air drying than did hardwoods. Both end use and kiln size may have affected these statistics. Softwoods tend to be used as construction lumber and are dried to grade specifications that are less restrictive than requirements that apply to hardwoods being dried for interior use.

Summary and Conclusions

A survey was conducted of primary and secondary manufacturing firms that had a least one dry kiln and processed approximately 2 million board feet or more of lumber annually. More than 1,500 surveys were completed, representing processing firms in 43 states.

Just over 29 billion board feet of lumber was kiln dried according to survey respondents. More than half the total was dried in the Southern region (15 billion); about 7 billion board feet was kiln dried in the Pacific Coast region states, and the Northern and Rocky Mountain regions dried about 3.5 billion board feet each.

Drying data and volumes were collected for 48 species. Twenty-four billion board feet of softwood lumber and about 5 billion board feet of hardwood lumber were dried. Just over half the softwood kiln dried was southern yellow pine (12.5 billion board feet), followed by ponderosa pine (2.8 billion board feet), and Douglas-fir (2.2 billion board feet). About 5 billion board feet of hardwood lumber was kiln dried, with oak comprising about 50 percent of the total. Other hardwoods with substantial quantities dried were yellow-poplar (407 million board feet), maple (386 million board feet), red alder (220 million board feet), and cherry (120 million board feet).

More than 7,000 dry kilns in the United States had a holding capacity of 447 million board feet. Eighty-eight percent of these were steam heated. The Southern region had the largest dry kiln capacity (181 million board feet) and about 2,600 kilns. More than 2,800 kilns were found in the Northern region with a holding capacity of 131 million board feet. The Pacific Coast region kiln capacity was 102 million board feet in 1,300 kilns, followed by the Rocky Mountain region with 33.4 million board feet in 392 kilns.

The most commonly used maximum operating temperature was between 160°F and 180°F. Use of time-based or moisture-content-based kiln schedules depended on the species being dried. Generally, softwood producers used time-based schedules and hardwood producers used moisture-content-based schedules.

Table 1—Number of manufacturers by operation category^a

State	Surveys completed	Sawmill only	Nonprimary only	Integrated
AL	78	6	17	55
AR	44	8	6	30
AZ	7	0	0	7
CA	46	3	7	36
CO	4	0	1	3
CT	3	1	1	1
FL	25	2	4	19
GA	60	5	25	30
IA	8	0	0	8
ID	30	8	5	17
IL	8	4	2	2
IN	28	13	8	7
KS	4	0	0	4
KY	53	11	25	17
LA	34	6	10	18
MA	11	0	6	5
MD	4	0	0	4
ME	45	3	2	40
MI	43	1	21	21
MN	41	3	21	17
MO	38	3	19	16
MS	89	12	30	47
MT	24	3	1	20
NC	108	17	34	57
NH	26	0	7	19
NJ	2	0	2	0
NM	3	0	0	3
NY	51	13	16	22
OH	39	5	20	14
OK	2	0	0	2
OR	68	3	17	48
PA	73	17	27	29
SC	46	6	11	29
SD	3	0	0	3
TN	77	9	51	17
TX	31	3	7	21
UT	1	0	0	1
VA	57	7	40	10
VT	21	2	8	11
WA	56	1	14	41
WI	81	6	42	33
WV	29	8	13	8
WY	8	3	0	5
Total	1,509	192	520	797

^aIncludes manufacturers that have dry kilns and process approximately 2 million board feet or more of lumber annually.

Table 2—Regional survey results^a

Geographic area	Completed surveys	Production	Number of kilns by type				Total kiln capacity	Total kiln dried per year	Number of predryers	Total predryer capacity	Number of fan-sheds	Total fan-shed capacity
			Steam	Direct fired	Dehumidifier	Other						
North	551	4,249.8	2,503	49	273	22	130.5	3,361.3	129	60.4	21	4.9
CT	3	26.5	33	0	0	0	0.6	23.1	0	0	0	0
IL	8	29.5	25	0	1	0	1.1	22.4	0	0	0	0
IN	28	162.3	141	3	20	0	6.6	138.9	5	2.5	0	0
IA	8	22.0	20	4	2	0	1.2	14.8	2	0.6	0	0
ME	45	757.9	167	0	26	3	10.1	716.9	5	2.1	4	0.1
MD	4	41.0	10	1	0	0	0.6	39.4	0	0	0	0
MA	11	53.4	37	0	8	0	2.2	45.3	2	1.5	0	0
MI	43	450.7	211	5	20	0	9.8	270.3	7	6.7	0	0
MN	41	294.4	87	3	25	1	4.8	211.4	6	2.2	1	0.2
MO	38	242.5	170	10	8	0	9.3	222.4	11	4.1	1	0.1
NH	26	169.3	88	0	15	2	4.2	145.7	1	0.3	0	0
NJ	2	9.0	9	0	0	0	0.3	8.9	0	0	0	0
NY	51	317.5	294	2	17	6	14.9	263.4	17	9.2	11	3.6
OH	39	263.7	208	0	21	0	9.9	226.0	26	8.4	2	0.5
PA	73	521.9	419	14	31	3	24.7	380.9	21	14	2	0.4
VT	21	117.9	112	0	20	0	4.8	95.0	4	1.1	0	0
WV	29	287.9	144	1	35	0	9.5	188.7	2	0.9	0	0
WI	81	482.9	328	6	24	7	15.3	347.9	20	6.9	0	0
Pacific Coast	170	9,875.9	1253	5	45	0	101.8	7,195.6	1	0.1	0	0
CA	46	3,002.3	527	0	0	0	38.3	2,191.6	1	0.1	0	0
OR	68	3,869.0	424	1	26	0	35.9	2,629.0	0	0	0	0
WA	56	2,968.5	302	4	19	0	27.7	2,359.3	0	0	0	0

Rocky Mountains	84	3,843.3	365	13	13	1	33.4	3552.2	0	0	0	0
AZ	7	347.2	55	0	0	0	5.1	305.7	0	0	0	0
CO	4	85.0	6	0	2	0	0.7	66.0	0	0	0	0
ID	30	1,854.2	152	9	7	0	15	1727.7	0	0	0	0
KS	4	9.9	17	1	0	1	0.7	9.8	0	0	0	0
MT	24	1,112.0	104	1	4	0	8.9	1067.7	0	0	0	0
NM	3	76.0	7	0	0	0	0.6	57.6	0	0	0	0
SD	3	151.0	7	0	0	0	0.9	151.0	0	0	0	0
UT	1	8.0	0	1	0	0	0	1.2	0	0	0	0
WY	8	200.0	17	1	0	0	1.5	165.5	0	0	0	0
South	704	1,6470.0	2,164	270	141	27	180.8	15031.6	84	56	18	4.6
AL	78	2,266.4	159	29	16	0	15	2012.9	2	1.7	0	0
AR	44	1,476.8	151	21	4	0	14.3	1368.0	7	6.1	1	0.1
FL	25	769.2	22	15	4	1	3.8	708.4	0	0	1	0
GA	60	2147.2	86	44	6	0	11.8	1924.3	0	0	0	0
KY	53	433.0	174	10	40	22	13.4	298.0	20	12.5	0	0
LA	34	1,145.0	63	28	2	0	8.2	1024.0	3	1.3	2	0.1
MS	89	2,914.9	270	50	4	1	24.1	2734.5	14	10.3	9	2
NC	108	1,665.9	453	25	21	0	34.3	1507.5	8	3.2	2	1.6
OK	2	170.0	7	1	0	0	0.8	169.9	0	0	0	0
SC	46	1,383.6	104	21	0	1	10	1325.9	2	0.1	1	0.6
TN	77	578.6	359	11	23	1	22	523.6	21	15.5	0	0
TX	31	986.3	61	13	1	1	5.7	939.8	0	0	0	0
VA	5	533.2	255	2	20	0	17.5	494.9	7	5.6	2	0.2
Totals	1,509	34,439.0	6,285	337	472	50	446.5	29141.0	214	116.4	39	9.5

^aVolume of lumber processed or throughput of primary or secondary manufacturers that have dry kilns and handle approximately 2 million board feet or more annually. Volumes in million board feet on 4/4 lumber basis.

Table 3—Volume of lumber kiln dried and produced per year by region and by leading states within regions

Region/state	Kiln dried (million board feet)	Production ^a (million board feet)	Kiln dried (% of total production)
North	3,361	4,250	79.1
ME	717	758	94.6
PA	381	522	73.0
WI	348	483	72.0
MI	270	451	59.9
NY	263	317	3.0
Pacific coast	7,196	9,876	72.9
OR	2,629	3,869	68.0
WA	2,359	2,969	79.5
CA	2,192	3,002	73.0
Rocky Mountains	3,552	3,843	92.4
ID	1,728	1,854	93.2
MT	1,068	1,112	96.0
AZ	306	347	88.2
WY	166	200	83.0
SD	151	151	100.0
South	15,032	16,470	91.3
MS	2,735	2,915	93.8
AL	2,013	2,266	88.8
GA	1,924	2,147	89.6
NC	1,508	1,666	90.6
AR	1,368	1,477	92.6
Total	29,141	34,439	84.6

^aVolume of lumber processed or throughput of primary or secondary manufacturers that have dry kilns and handle approximately 2 million board feet or more annually.

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a

State	Hardwoods									
	Alder-red		Ash		Aspen		Basswood		Beech-American	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL			8.35	6.53					0.30	0.23
AR			2.89	2.11	0.64	0.64				
AZ										
CA	0.50	0.50								
CO										
CT										
FL							0.68	0.02		
GA			0.38	0.38						
IA										
ID										
IL										
IN			6.49	6.42			2.00	2.00		
KS			0.05	0.04						
KY			4.08	2.54					5.40	5.13
LA			5.45	5.21						
MA			0.15	0.15						
MD										
ME			4.74	3.77					1.37	1.36
MI					8.40	6.40	0.09	0.09		
MN			0.90	0.88	31.56	17.05	3.96	2.18		
MO			1.30	1.30						
MS	0.01	0.0	13.93	11.30						
MT										
NC			9.16	6.56	1.83	1.83				
NH			1.50	1.50					0.60	0.60
NJ										
NM										
NY			12.66	10.34			1.20	1.20	0.60	0.44
OH			12.65	6.05						
OK										
OR	107.48	100.12	0.05	0.04						
PA			8.10	5.18			0.31	0.29	0.34	0.26
SC			2.38	0.52	1.75	1.65				
SD										
TN			6.50	5.83	0.35	0.14			6.00	6.00
TX			0.49	0.27						
UT										
VA			23.13	22.88			0.25	0.01	4.73	4.73
VT			3.78	3.61			0.88	0.88	1.22	1.05
WA	160.86	119.05	0.76	0.46						
WI			4.36	2.12	7.01	6.39	25.98	18.73	3.00	2.96
WV			12.85	12.50	1.25	1.25	7.05	2.36	0.63	0.38
WY										
Total	268.85	219.67	147.05	118.45	52.78	35.35	42.39	27.75	24.18	23.12

^aVolume of lumber processed or throughput of primary or secondary manufacturers that have dry kilns and handle approximately 2 million board feet or more annually. Hardwoods listed alphabetically followed by softwoods listed alphabetically. Common names taken from U.S. Department of Agriculture "Wood Handbook." Total volumes may not add precisely due to rounding.

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Hardwoods									
	Birch		Cherry-black		Cottonwood		Elm		Hackberry	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL					0.13	0.0	0.13	0.0	0.13	0.0
AR					6.00	3.00	0.25	0.13		
AZ										
CA										
CO										
CT										
FL										
FL										
IA					0.63	0.63				
ID										
IL										
IN			0.23	0.16						
KS									0.12	0.10
KY			2.55	1.54						
LA									2.80	2.80
MA	0.45	0.45	0.29	0.29						
MD										
ME	35.51	34.82	0.30	0.30						
MI	4.75	4.55	0.35	0.35						
MN	4.12	1.96	5.05	0.72	7.50	6.00	1.88	1.88		
MO					3.60	3.60				
MS			1.50	0.60	31.32	19.49	0.30	0.30	0.45	0.45
MT										
NC	0.18	0.0	6.80	6.80			0.18	0.0	0.18	0.0
NH	1.63	1.63								
NJ										
NM										
NY	2.20	1.18	21.21	19.97						
OH			7.98	7.98						
OK										
OR										
PA	0.19	0.18	66.78	45.95						
SC			7.00	7.00			0.78	0.25	0.88	0.0
SD										
TN			5.50	5.50	10.39	10.39			0.10	0.10
TX										
UT										
VA			9.05	9.05						
VT	11.53	7.72	6.00	6.00						
WA	1.00	0.60								
WI	8.48	6.51	0.14	0.14						
WV			14.35	7.66						
WY										
Total	70.03	59.59	155.07	120.00	59.56	43.11	3.50	2.55	4.65	3.45

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Hardwoods									
	Hickory-pecan		Hickory-true		Locust-honey/black		Maple-hard/soft		Oak-red	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL			4.95	4.95					136.78	93.61
AR							0.89	0.77	146.48	115.49
AZ										
CA										
CO										
CT									16.30	14.05
FL							0.68	0.07	5.01	0.43
GA							1.04	0.29	99.01	60.92
IA							1.02	0.94	6.64	3.94
ID										
IL									6.35	4.94
IN			2.30	1.85			4.33	3.88	44.05	36.74
KS									0.98	0.96
KY			1.92	0.62			7.13	6.60	126.61	100.79
LA	0.55	0.33							44.75	36.47
MA									3.78	3.78
MD									3.00	3.00
ME							13.05	11.59	5.18	4.15
MI							84.28	65.40	69.34	64.87
MN							7.03	2.45	30.47	27.50
MO			0.60	0.60			9.91	9.96	114.35	100.62
MS	9.03	9.03	0.26	0.26			9.69	7.88	198.70	129.09
MT										
NC	2.60	2.60	0.50	0.50			32.71	29.83	126.39	103.48
NH							2.75	2.25	12.03	11.62
NJ									2.48	2.48
NM										
NY			0.35	0.32			75.29	70.69	73.95	68.30
OH			0.35	0.35			17.90	17.65	105.10	92.77
OK										
OR							30.15	30.11		
PA							21.42	17.06	200.47	153.29
SC	1.05						4.10	2.00	18.63	11.34
SD										
TN			8.25	6.85	0.40	0.40	23.25	22.12	234.82	216.44
TX									7.80	6.59
UT										
VA	1.00	1.00	1.90	1.90			18.63	18.28	112.89	99.83
VT							21.30	17.32	0.99	0.99
WA							9.08	7.32		
WI			0.38	0.34			50.77	36.64	157.04	118.58
WV							8.33	4.51	102.30	75.93
WY										
Total	14.23	12.96	21.76	18.53	0.40	0.40	454.69	385.58	2,212.64	1,762.95

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Hardwoods									
	Oak-white		Sweetgum		Sycamore		Tupelo		Walnut-black	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL	80.47	55.95	3.13	1.50	0.13		0.13	0.0		
AR	67.37	51.15	2.75	1.77						
AZ										
CA	0.50	0.50							0.57	0.57
CO										
CT	8.25	7.31								
FL	0.05	0.00								
GA	14.25	10.47	0.29	0.29						
IA	1.44	0.83							3.13	2.97
ID										
IL	7.95	6.81							7.70	7.70
IN	30.78	26.66							12.65	10.13
KS	0.08	0.06							8.65	8.64
KY	84.66	72.00	0.18	0.17	0.18	0.17			1.45	1.39
LA	8.25	5.90	2.80	2.80						
MA										
MD	2.00	2.00								
ME										
MI	3.90	2.94								
MN	2.40	2.11							0.52	0.52
MO	60.52	54.64	0.60	0.60					14.00	14.00
MS	37.69	27.88	14.23	13.43						
MT										
NC	58.73	41.94	14.68	7.31	3.00	3.00	1.38	0.68		
NH										
NJ										
NM										
NY	40.45	38.98							0.30	0.30
OH	40.03	36.36							2.44	2.44
OK										
OR	0.80	0.24							0.05	0.04
PA	56.78	44.48							0.03	0.03
SC	9.03	6.00	3.30	0.33	0.18	0.0	2.10	0.0		
SD										
TN	164.74	154.45	4.00	4.00			0.75	0.75	0.43	0.38
TX	1.90	1.84								
UT										
VA	41.72	37.57			0.20	0.10	6.50	6.50	0.78	0.78
VT	0.21	0.21								
WA										
WI	27.37	18.96							0.20	0.16
WV	29.62	23.19								
WY										
Total	881.90	731.42	45.96	32.19	3.68	3.27	10.85	7.93	52.89	50.04

**Table 4—Production volumes and volumes kiln dried (in million board feet)
for 48 species^a—con.**

State	Hardwoods					
	Yellow-poplar		Mahogany		Miscellaneous hardwoods	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL	14.93	11.40			30.46	12.34
AR	0.64	0.64			64.95	8.83
AZ						
CA					0.81	0.81
CO						
CT					1.95	1.76
FL	0.08	0.06			0.69	0.02
GA	15.35	13.88			54.80	26.97
IA					9.10	5.48
ID						
IL					7.50	2.91
IN	11.30	8.03			48.14	43.09
KS					0.03	0.03
KY	64.85	55.35			132.46	51.64
LA					18.30	16.05
MA	3.08	3.08			33.85	31.15
MD					5.00	5.00
ME	0.82	0.02			4.67	3.76
MI					57.90	47.33
MN	0.08	0.08			14.37	10.52
MO	0.30	0.06			16.03	15.79
MS	28.36	21.92	8.50	8.50	89.01	51.94
MT						
NC	80.93	73.13			107.50	77.69
NH					16.65	15.03
NJ	3.00	3.00			3.53	3.45
NM						
NY					75.80	44.83
OH	45.55	35.22			31.31	26.78
OK					16.80	16.80
OR					14.45	14.17
PA	31.22	28.73			126.26	82.11
SC	0.88				16.03	16.03
SD						
TN	38.27	29.33			70.14	56.28
TX					29.86	22.00
UT						
VA	93.70	85.87			50.81	47.60
VT					30.27	24.76
WA						
WI	4.05	4.05			91.81	56.82
WV	66.52	33.08			44.98	27.88
WY						
Total	503.89	406.92	8.50	8.50	1,316.19	867.63

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Softwoods									
	Baldcypress		Cedar-Atlantic white		Cedar-eastern red		Cedar-incense		Cedar-Orford-Port	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL	0.50	0.50								
AR										
AZ										
CA							177.65	117.47		
CO										
CT										
FL	13.85	8.60								
GA	1.60	0.84								
IA										
ID										
IL										
IN										
KS										
KY										
LA	0.30	0.24								
MA										
MD										
ME					0.23	0.09				
MI			1.79	1.05						
MN										
MO					1.00	1.00				
MS										
MT										
NC	4.25	3.65			7.00	7.00				
NH					3.00	3.00				
NJ										
NM										
NY					0.15	0.09				
OH										
OK										
OR							3.63	3.63	0.45	0.45
PA										
SC	13.83	12.73								
SD										
TN										
TX										
UT										
VA										
VT										
WA							1.20	1.20		
WI										
WV										
WY										
Total	34.33	26.56	1.79	1.05	13.98	13.78	182.48	122.30	0.45	0.45

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Softwoods									
	Cedar-western red		Douglas-fir		Firs-eastern		Firs-western		Hemlock-eastern	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL										
AR										
AZ			6.43	10.71			11.90	8.93		
CA	33.00	29.30	598.53	271.16			596.80	451.47		
CO			6.03	0.63			6.03	0.63		
CT										
FL										
GA										
IA										
ID	275.20	232.95	332.51	322.97			509.06	466.70		
IL										
IN										
KS										
KY										
LA										
MA										
MD										
ME					72.69	72.54			42.23	39.70
MI										
MN	0.57	0.54								
MO										
MS										
MT	21.70	18.82	372.90	362.65			40.60	39.55		
NC										
NH									3.96	0.0
NJ										
NM			20.00	10.08			4.80	4.32		
NY									0.16	0.16
OH										
OK										
OR	10.70	3.61	1,397.40	685.70			438.03	375.36		
PA										
SC										
SD										
TN										
TX										
UT										
VA										
VT										
WA	86.31	69.34	855.22	555.70			759.95	554.15		
WI									1.00	0.75
WV										
WY			9.60	5.55			2.30	1.15		
Total	427.48	354.56	3,598.61	2,225.14	72.69	72.54	2,369.46	1,902.24	47.35	40.61

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Softwoods									
	Hemlock-western		Larch-western		Pine-eastern white		Pine-jack		Pine-lodgepole	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL										
AR										
AZ										
CA	23.10	2.89								
CO									20.63	18.13
CT										
FL	0.01	0.00			0.01	0.00				
GA					2.79	2.79				
IA										
ID	47.50	39.50	38.50	35.00					152.65	143.72
IL										
IN										
KS										
KY										
LA										
MA					11.80	6.37				
MD										
MB					164.50	135.94				
MI					7.26	5.79				
MN					23.13	15.63	46.88	46.88		
MO										
MS										
MT									216.90	203.36
NC					41.95	39.93	4.00	4.00		
NH					126.24	109.39				
NJ										
NM	1.20	0.72								
NY					8.76	3.60				
OH					0.40	0.40				
OK										
OR	422.55	250.25	19.95	18.63					62.80	47.05
PA					2.00	2.00				
SC										
SD										
TN					3.17	3.17				
TX										
UT									5.60	0.84
VA					23.47	22.57				
VT					40.39	32.09				
WA	554.12	525.36	77.60	72.85					64.40	63.43
WI					26.14	17.67				
WV										
WY									75.90	56.65
Total	1,055.98	823.59	136.05	126.47	482.00	397.33	50.88	50.88	598.88	533.18

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Softwoods									
	Pine-ponderosa		Pine-red		Pine-southern yellow		Pine-sugar		Pine-western white	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL					1,983.30	1,823.26				
AR					1,183.90	1,171.50				
AZ	301.97	274.53								
CA	743.25	660.11					335.40	313.14		
CO	0.63	0.63								
CT										
FL					746.80	697.81				
GA					1,956.20	1,805.94				
IA										
ID	245.33	241.51			13.00	13.00			129.25	125.65
IL										
IN										
KS										
KY					1.50	0.08				
LA					1,061.80	954.16				
MA										
MD					31.00	29.37				
ME			3.53	2.66						
MI	0.80	0.16	86.38	40.79	108.18	14.91				
MN	21.25	8.98	52.46	47.03	25.75	6.08			1.08	0.98
MO					20.20	20.20				
MS					2,471.62	2,430.93				
MT	142.25	136.27							39.15	39.15
NC					1,162.03	1,097.55				
NH										
NJ										
NM	46.40	38.88								
NY			1.00	1.00	2.00	2.00				
OH										
OK					153.20	153.10				
OR	945.29	906.53					41.55	41.55	17.50	17.50
PA			1.80	1.35						
SC					1,301.67	1,268.02				
SD	151.00	151.00								
TN					1.50	1.50				
TX					946.25	909.15				
UT										
VA					144.45	136.26				
VT			0.09	0.09						
WA	326.40	311.73								
WI	10.00	10.00	26.45	22.69	15.50	15.50				
WV										
WY	89.15	82.81								
Total	3,023.71	2,823.12	171.70	115.61	13,329.84	12,550.30	376.95	354.69	186.98	183.28

Table 4—Production volumes and volumes kiln dried (in million board feet) for 48 species^a—con.

State	Softwoods									
	Redwood		Spruce-eastern		Spruce-Engelmann		Spruce-Sitka		Misc. softwoods	
	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried	Production	Kiln dried
AL										
AR										
AZ					19.40	15.59				
CA	360.05	232.44			2.00	0.0			129.70	111.20
CO					51.70	45.88				
CT										
FL									1.36	1.35
GA									1.50	1.50
IA										
ID					45.00	43.60			66.20	63.10
IL										
IN										
KS										
KY										
LA										
MA										
MD										
ME			409.10	406.23						
MI					2.80	2.80			14.45	12.84
MN			3.90	3.90	4.00	2.80			5.55	4.75
MO										
MS									0.30	0.30
MT					95.70	90.94			182.80	177.00
NC										
NH			0.80	0.64					0.10	0.09
NJ										
NM					3.60	3.60				
NY									1.38	0.0
OH										
OK										
OR	1.95	1.75			83.55	65.95	6.00	2.70	282.84	80.01
PA									6.15	
SC										
SD										
TN									0.08	0.0
TX										
UT					1.60	0.24			0.80	0.12
VA										
VT			1.20	0.24						
WA							3.95	3.35	67.60	60.75
WI									23.20	8.92
WV										
WY					21.10	17.65			1.95	1.69
Total	362.00	234.19	415.00	411.01	330.45	289.04	9.95	6.05	785.95	523.62

Table 5—Total kiln dried volumes and production volumes per year of leading softwoods and hardwoods by region and by leading states within each region

Species	State	Kiln dried (million board feet)	Production ^a (million board feet)	Kiln dried (% of total production)	Species	State	Kiln dried (million board feet)	Production ^a (million board feet)	Kiln dried (% of total production)
Total hardwood		4,941	6,356	78.0	Total softwood		24,182.0	28,065.0	86.2
Red oak		1,763	2,213	79.7	Southern yellow pine		12,550	13,330	94.1
	TN	216	235	92.0		MS	2,431	2,472	98.3
	PA	153	200	76.5		AL	1,823	1,983	91.2
	MS	129	199	64.8		GA	1,806	1,956	92.3
	WI	19	157	75.8		SC	1,268	1,302	97.4
	AR	115	146	78.8		AR	1,172	1,184	98.9
White oak		731	882	82.9	Ponderosa pine		2,823	3,024	93.4
	TN	154	165	93.3		OR	907	945	96.0
	KY	72	85	84.7		CA	660	743	88.8
	AL	56	80	70.0		WA	312	326	95.7
	MO	55	61	90.2		AZ	275	302	91.1
	AR	51	67	76.1		ID	242	245	98.8
Yellow poplar		407	504	80.7	Douglas-fir		2,225	3,599	61.8
	VA	86	94	91.5		OR	686	1,397	49.1
	NC	73	81	90.1		WA	556	855	65.0
	KY	55	65	84.6		MT	363	373	97.3
	OH	35	46	76.1		ID	323	333	97.0
	WV	33	67	49.2		CA	271	599	45.2
Maple		386	455	84.8	Western firs		1,902	2,369	80.3
	NY	71	75	94.7		WA	554	760	72.9
	MI	65	84	77.4		ID	467	509	91.7
	WI	37	51	72.5		CA	451	597	75.5
	NC	30	33	90.1		OR	375	438	85.6
	OR	30	30	100.0	Western hemlock		824	1,056	80.3
Red alder		220	269	81.8		WA	525	554	94.8
	WA	119	1611	73.9		OR	250	423	59.1
	OR	100	107	93.4		ID	40	48	83.3
Cherry		120	155	77.4					
	PA	46	67	68.7					
	NY	20	21	95.2					
	VA	9	9	100.0					
	OH	8	8	100.0					
	WV	8	14	57.1					

^aVolume of lumber processed or throughput of primary or secondary manufacturers that have dry kilns and handle approximately 2 million board feet or more annually.

Table 6—Regional kiln capacity and capacity in states where production of either softwood or hardwood predominates^a

Geographic area	Average kiln capacity ^b (thousand board feet)	Total kilns ^c
Regions		
North	46.1	2,825
Pacific coast	78.1	1,303
Rocky Mountains	85.3	391
South	70.2	2,575
Softwoods		
ID, MT, WY	85.9	295
GA, SC, TX	81.3	338
CA, OR	75.8	978
Hardwoods		
KY, TN	55.3	640
NY, OH, PA	48.7	1,015

^aIncludes manufacturers that process approximately 2 million board feet or more of lumber annually.

^bVolumes on 4/4 basis

^cDoes not include unusual kiln types such as vacuum kilns or radio frequency kilns.

Table 7—Regional drying practices

Geographic area	Number of kilns operating at various maximum temperatures					Airdry before kiln drying per year (million board feet)	Number of kilns using various schedule bases		
	120°F to 159°F	160°F to 180°F	181°F to 211°F	212°F+	Other or unknown		Time-based	Moisture-content-based	Other or unknown
North		2,128	113	18	200	1,216.9	840	2,100	428
CT		4	25	0	0	4.0	1	1	0
IL		21	4	0	1	14.2	8	25	1
IN		124	0	0	32	100.1	71	146	0
IA		20	0	0	2	7.2	6	22	6
ME		106	7	12	4	91.4	130	113	84
MD		0	0	3	0	9.0	3	1	1
MA		38	0	0	0	29.3	21	38	1
MI		184	19	1	15	93.5	67	199	25
MN		80	6	0	6	87.8	32	85	24
MO		136	4	2	0	170.1	50	151	13
NH		46	0	0	5	22.5	72	84	4
NJ		9	0	0	0	8.9	0	2	0
NY		232	0	0	39	99.7	97	266	31
OH		196	4	0	12	97.9	77	198	37
PA		415	11	0	25	116.2	95	452	79
VT		77	3	0	30	25.9	42	94	10
WV		169	3	0	0	83.6	48	157	97
WI		271	27	0	29	155.6	20	66	15
Pacific coast		817	360	35	53	723.2	1,110	180	482
CA		355	133	0	26	446.6	442	64	166
OR		277	130	17	0	224.8	387	73	157
WA		185	97	18	27	51.8	281	43	159
Rocky Mountains		198	90	71	9	380.5	161	44	31
AZ		16	27	12	0	7.1	7	0	0
CO		2	0	2	0	2.6	4	2	0
ID		99	31	25	0	265.0	22	10	6
KS		18	0	0	0	9.5	3	2	0
MT		43	24	28	9	41.3	103	30	15
NM		7	0	0	0	7.2	3	0	0
SD		3	2	2	0	0.0	2	0	2
UT		1	0	0	0	0	0	0	1
WY		9	6	2	0	47.8	17	0	7
South		1,525	281	504	121	1,825.6	1,205	1,736	500
AL		74	22	80	21	91.5	114	96	26
AR		98	16	62	0	199.5	93	106	35
FL		4	2	30	2	80.7	28	110	10
GA		44	14	68	0	133.4	48	13	16
KY		144	33	0	38	147.6	81	188	41
IA		43	3	41	0	69.4	80	35	18
MS		152	33	90	27	182.4	146	164	106
NC		365	62	34	19	212.7	243	393	64
OK		0	7	1	0	16.8	2	1	1
SC		42	16	58	4	63.2	109	44	6
TN		313	42	3	1	331.0	137	292	82
TX		20	10	32	6	41.9	46	30	22
VA		226	21	5	3	255.6	78	264	73

^aIncludes manufacturers that process approximately 2 million board feet or more of lumber annually.

Table 8—Regional use of schedule bases^a

Geographic area	Total number of kilns	Kilns using various schedule bases (% of total)		
		Moisture-content-based	Time-based	Air dry before kiln
Regions				
North	2,825	62.4	25	36.2
Pacific coast	1,303	10.2	62.6	10.0
Rocky Mountains	391	18.6	68.2	10.7
South	2,575	50.5	35	12.1
Softwoods				
GA, SC, TX	338	26.0	60.8	5.7
ID, MT, WY	295	19.0	67.6	12.0
CA, OR	978	10.6	64.3	13.8
Hardwoods				
NY, OH, PA	1,015	68.8	20.2	36.1
KY, TN	640	58.5	26.6	58.2

^aIncludes manufacturers that process approximately 2 million board feet or more of lumber annually.

Appendix-Survey Format

Company _____ Date _____

City _____ State _____

Contact _____ Ph# _____

1. What is your business? Sawmill —
 Planer mill —
 Secondary manufacturer _____
 (e.g. turnings, cabinets, furniture parts, mouldings, etc.)

2. What is your estimated annual production (million bd ft)?

<5 _____ *	40-50 _____	*If <5
5-10 _____	50-60 _____	<1 _____
10-15 _____	60-70 _____	1-2 _____
15-20 _____	70-80 _____	2-3 _____
20-25 _____	80-90 _____	3-4 _____
25-30 _____	90-100 _____	4-5 _____
30-40 _____	Other _____	

3. What species do you produce?
 (Use column 1 on page 2. Please estimate percentages.)
4. What percent of your wood is kiln dried? (Use column 2 on page 2.)
5. How many kilns do you have and what is your total capacity?

	#	Capacity
Steam	_____	_____
Direct fired	_____	_____
Dehumidifier	_____	_____
Predryer	_____	_____
Fan shed	_____	_____
	Total	_____

6. What is the maximum temperature that you use for kiln drying?
 (Use column 3 on page 2.)
7. Is any of your wood dried before it goes in the kiln?
 If yes, which and how much (column 4)?
8. Do you dry using? Time schedules _____
 Sample boards _____
 Other _____
9. What is your position with the company? _____

Thank you for your time!

COMPANY _____

SPECIES	(COLUMN:1)	(COLUMN:2)	(COLUMN:3)	(COLUMN:4)
	PRODUCTION VOL ___%___	KILN DRIED VOL ___%___	MAX TEMP VOL ___%___	AIR DRIED VOL ___%___
HARDWOODS				
ALDER, RED	_____	_____	_____	_____
ASH	_____	_____	_____	_____
ASPEN	_____	_____	_____	_____
BASSWOOD	_____	_____	_____	_____
BEECH	_____	_____	_____	_____
BIRCH	_____	_____	_____	_____
BUCKEYE	_____	_____	_____	_____
CHERRY	_____	_____	_____	_____
COTTONWOOD	_____	_____	_____	_____
ELM	_____	_____	_____	_____
HACKBERRY	_____	_____	_____	_____
HICKORY, PECAN	_____	_____	_____	_____
HICKORY, TRUE	_____	_____	_____	_____
LOCUST, BLACK	_____	_____	_____	_____
MAPLE	_____	_____	_____	_____
OAK, RED	_____	_____	_____	_____
OAK, WHITE	_____	_____	_____	_____
SWEETGUM	_____	_____	_____	_____
SYCAMORE	_____	_____	_____	_____
TANOAK	_____	_____	_____	_____
TUPELO	_____	_____	_____	_____
WALNUT, BLACK	_____	_____	_____	_____
WILLOW, BLACK	_____	_____	_____	_____
YELLOW POPLAR	_____	_____	_____	_____
SOFTWOODS	PROD	KD	MAX TEMP	AIR DRIED
BALDCYPRESS	_____	_____	_____	_____
DOUG FIR	_____	_____	_____	_____
FIRS, TRUE(EAST)	_____	_____	_____	_____
FIRS, TRUE(WEST)	_____	_____	_____	_____
HEMLOCK, EAST	_____	_____	_____	_____
HEMLOCK, WEST	_____	_____	_____	_____
INCENSE-CEDAR	_____	_____	_____	_____
LARCH, WEST	_____	_____	_____	_____
PINE, EAST WHITE	_____	_____	_____	_____
PINE, JACK	_____	_____	_____	_____
PINE, LODGEPOLE	_____	_____	_____	_____
PINE, PITCH	_____	_____	_____	_____
PINE, POND	_____	_____	_____	_____
PINE, PONDEROSA	_____	_____	_____	_____
PINE, RED	_____	_____	_____	_____
PINE, SOUTHERN	_____	_____	_____	_____
PINE, SPRUCE	_____	_____	_____	_____
PINE, SUGAR	_____	_____	_____	_____
PINE, WEST WHITE	_____	_____	_____	_____
PORT-ORFORD-CED	_____	_____	_____	_____
REDCEDAR, EAST	_____	_____	_____	_____
REDCEDAR, WEST	_____	_____	_____	_____
REDWOOD	_____	_____	_____	_____
SPRUCE, EAST	_____	_____	_____	_____
SPRUCE, ENGLEMA	_____	_____	_____	_____
SPRUCE, SITKA	_____	_____	_____	_____
TAMARACK(larch)	_____	_____	_____	_____
WHITE CEDAR,N&AT	_____	_____	_____	_____