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PROGRESS REPORT 10 OCTOBER 1956

Service Life of Treated and Untreated Fence Posts

1956 Progress Report on the T. J. Starker Post Farm

(Project No. 29)

By

Robert D. Graham

Donald J. Miller

OREGON FOREST PRODUCTS LABORATORY
State Board of Forestry and School of Forestry,
Oregon State College, Cooperating
Corvallis

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By

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A Research Project of the Oregon Forest Products Laboratory
Corvallis, Oregon

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Service Life of Treated and Untreated Fence Posts

1956 Progress Report on the T. J. Starker Post Farm

SUMMARY

Thirty-eight posts from 9 untreated series, 30 posts from 13 nonpressure-treated series, and 3 posts from 3 pressure-treated series failed. Failures occurred at or below the ground line. Causes of post failure since 1949 were:

Cause	Number of failures 1949-1955	1956
Fungi (decay)	270	44
Termites (damp-wood)	13	4
Fungi and termites	81	19
Fungi and other insects	24	4

Effectiveness of various preservative treatments for protecting Douglas fir posts have been summarized in Table 11.

Pressure-treated posts

Posts treated with zinc-meta arsenite and chromated zinc chloride have continued to fail gradually. The second failure in 19 years occurred in posts treated with Chemonite. Of the 347 pressure-treated posts installed, 25 posts from 3 series have failed. Average service life of removed posts was 17 years.

Nonpressure-treated posts

Red alder (series 105) and lodgepole pine (series 99) posts treated by double-diffusion process with copper sulfate and sodium chromate continued to fail after 4 years service. Douglas fir posts butt-treated with Osmoplastic (series 73) and soaked in copper naphthenate-diesel oil solution (series 65) were failing rapidly. Brushing peeled and thoroughly seasoned Douglas fir posts with several preservatives added a few years to their average service life in series 79, 80, and 81.

Untreated posts

Red alder, Douglas fir, tanoak, and Arizona cypress posts were failing rapidly. Average service life of failed posts was between 3 and 4 years. Untreated Alaska cedar posts were failing steadily after 19 years.

The T. J. Starker Post Farm

In 1927 the School of Forestry at Oregon State College established and has since maintained a "post farm" to obtain data on natural durability of native woods and effectiveness of different preservative treatments for species used as fence-post material. The first posts were set on January 7, 1928, and since inception of the program, 2,637 posts have been placed in the farm. Three introduced and 24 native species, in untreated condition, and 8 Oregon woods that were given various preservative treatments, have been or are being tested.

The T. J. Starker Post Farm is located on School of Forestry land in the Peavy Aboretum about 7 miles north of Corvallis, Oregon, on the west side of Highway 99W. Soil in the test area, located on an excellently drained south slope, is Olympic silty-clay loam. The slightly acid top 8 inches of soil has a pH of 5.4, an organic matter content of 4.71 per cent, a humus of one-half inch or less in thickness, and a nitrogen content of 0.1415 per cent. A number of old Douglas fir stumps are present in the test site.

Climatic conditions

Average annual rainfall in the Corvallis area since 1927 has been about 36 inches with about 128 rainy days per year. Some summer intervals have approached drought conditions. An annual mean relative humidity of 64 per cent and temperature of 53 F have prevailed. The temperature occasionally falls below freezing and occasionally exceeds 85 F. Cool afternoon breezes from the Pacific Ocean usually arise daily during the summer months. Table 1 gives climatological data for the Corvallis area for the years since 1927.

Wood-destroying organisms

Since 1949, an attempt has been made to determine the various organisms responsible for deterioration of posts installed in the test site. Although decay-producing fungi and damp-wood termites are the primary cause of post failures, carpenter ants and wood-boring beetles frequently contribute to general deterioration of posts.

Damp-wood termites swarm during late summer and early fall. At the time of annual inspection in early October, discarded wings of reproductives have been found at bases of many posts. Entry holes have been made at or below ground line. In only a few instances have termites been the primary cause of failure.

Although carpenter ants have been found in many failed posts, there is evidence to indicate galleries were constructed initially by termites. After destroying the termites, ants usually enlarge the galleries to some extent.

A high proportion of failed posts have been attacked by wood-boring beetles, although damage seldom approaches that caused by fungi or termites.

Test specimens

Test posts are usually installed in groups of 25; each group constitutes a test series. Posts in each series are placed 2 feet apart in a row running in a northerly direction up the test plot slope. Test series are spaced 3 feet apart, and all posts are set into the ground to a depth of 2 feet.

Prior to 1947, installed test posts ranged from 4 to 7 feet in length and from 3 to 70 square inches in ground-line cross sectional area. Test posts are now standardized at a length of 5 feet, and cross sectional areas of individual posts are limited to 16 ± 8 square inches at a distance of 2 feet from the butt ends. The average cross sectional area, 2 feet from the butt ends of posts in each series, must fall within the limits of 16 ± 2 square inches.

Post inspections

Annual inspections are made during October. A moderate push is applied to the top of each post, and each post that breaks is examined to establish the point and cause of failure. Formerly, a 50-pound horizontal pull was applied 2 feet above the ground. A deterioration rating is made of the top by visual inspection, while both the feel of the post and a prod are used to estimate deterioration below the ground.

Post farm records

Recorded data for each series of posts include source and species, sizes and type of individual posts, percentage of sapwood, processing prior to installation or preservative treatment, preservative treatment given (if any), date of installation, dates of individual post failures, condition of each post at each annual inspection period, and other pertinent facts.

Interpretation of Data

Posts and other wood products used in contact with the ground and exposed to weather are subject to attack by insects and wood-destroying fungi. The most vulnerable section of a fence post extends from a short distance above to some distance below the ground surface. This post zone usually has a more sustained favorable supply of moisture and air necessary for existence of these destructive agents. In areas of abundant rainfall or prolonged periods of high humidity, tops of fence posts also are subject to deterioration, but normally it proceeds at a slower rate. The ground-line section of a post also is important because preservatives are most subject to leaching action there and, on windy sites, sand erosion often cuts deeply into wood of this zone. To evaluate intelligently the results of any test of fence post serviceability, these and many other factors must be considered simultaneously.

Limitations of test data

The detailed tabular data presented at the end of this report cannot be applied indiscriminately to every locality and to all fence post service requirements. Data are basically comparative and applicable to one area and one type of use; these data must be adjusted empirically to fit other situations.

Posts tested in the T. J. Starker Post Farm usually are not subject to stapling, nailing, ground-line erosion, and physical forces that frequently reduce the service life of posts actually in use; but, on the other hand, these test posts are placed in climatic conditions conducive to virtually continuous insect attack and decay. The arbitrary method used to determine post failure is admittedly not comparable to physical forces that may be exerted on fence posts in acual service.

Influence of climatic conditions

Climate determines to a great extent the proportion of time that suitable conditions for decay exist in a given region. Optimum temperatures for the growth of decay-producing fungi range from 60 to 80 F, but some fungi can develop at temperatures as low as 35 F or as high as 120 F. If all parts of a wood post have a moisture content of 20 per cent or less (oven-dry basis), there is virtually no possibility of fungus growth. During long periods of extremely dry weather, and in periods when the temperature approaches freezing, decay rate in posts is retarded. Rate of post deterioration is doubtlessly much slower in regions where long periods of unfavorable conditions prevail. In western Oregon, for example, where favorable moisture and temperature conditions exist for long periods, untreated tops of posts that have been given adequate butt treatment with a good preservative often decay long before the ground-line sections are weakened seriously.

Consideration of post characteristics

Post service records in this report mean little, if characteristics of the wood are not taken into consideration. Size, amount of sapwood, and extractive constituents in the wood greatly influence the serviceability of untreated posts. Large posts may give long service, not only because of great gross volume of wood, but also because of the high proportion of heartwood they usually contain. The sapwood of no native species is naturally insect- and decay- resistant. Extractive constituents in heartwood of a few species promote resistance to insect and fungus attack. With some exceptions, these extractives give heartwood a color darker than that of sapwood.

Equal importance of preservatives and methods of preservation

The service life of treated wood is affected by the nature of preservative used, portion of the product treated, amount of preservative retained by the wood, method of treatment, and uniformity of treatment. Most preservatives are effective fungicides and insecticides, but extension of the service life of wood requires continued presence of preservative in a concentration toxic to organisms responsible for deterioration. It is important that preservative be present in areas subject to attack, principally the ground-line zone and, in some instances, the top of the post.

Method of treatment and preservative used are equally important, for poor treatment produces poor results. For this reason, a preservative cannot be condemned until it can be shown that the treatment was unsatisfactory despite application of the preservative by a proper treating method. Although a preservative may fail under one set of climatic conditions, it may prove extremely successful under different conditions. A preservative that is quite soluble in water, for example, may leach from wood in a region of abundant rainfall, but in a dry climate it may be permanent. Successful treatment provides uniform penetration into the treated area and retention of a sufficient quantity of preservative within the wood structure adequately to protect the wood under conditions in which it is to be used. High total retention of preservatives is not necessarily an indication of successful treatment; in some species end penetration of the preservative may be rapid, whereas side penetration may be slow. This condition may result in complete protection of the end of the post, with virtually no protection of the ground-line zone.

Preliminary Evaluation of Tests

Determination of the service life of a series in which most or all posts have failed is relatively simple; for many naturally decay-resistant untreated series and for treated series in which few posts have failed, estimation of average service life cannot be made with accuracy. Estimated service life, when given for any series in this report, is based on number of posts failed and on service age and condition of remaining posts. For a few untreated species, natural decay resistance as determined in other service tests has been taken into consideration in making estimates of service life.

Untreated fence posts

The characteristics, service records, and removal records of untreated fence posts are shown in Tables 2, 3, and 8. Based on the actual and estimated service life for each untreated series of posts, the various species tested or being tested are classified into three broad groups. Numerals in parentheses indicate series numbers for convenience in referring to tabular data.

1. ***Average service life of at least 20 years.***
   (Posts largely of heartwood.)

   Cedar, Alaska (46)
   Cedar, Port Orford (21)
   Cedar, western red (10, 11)
   Juniper, western (30)
   Locust, black (40)
   Osage-orange (32)
   Redwood (58)
   Yew, Pacific (13)

2. ***Average service life of 10 to 15 years.***
   (Posts largely of heartwood.)

   Cedar, incense (29)
   Oak, Oregon white (19)

3. ***Average service life of less than 10 years.***
   (Posts largely sapwood; or heartwood not durable in contact with the ground.)

   Alder, red (16)
   Ash, Oregon (28)
   Cascara buckthorn (20, 47)
   Cottonwood, black (14, 82)
   Cypress, Arizona (84)
   Douglas fir (1, 55, 57, 72)
   Fir, grand (15)
   Hemlock, West Coast (38)
   Larch, western (37)
   Madrone, Pacific (26)
   Maple, Oregon (17)
   Pine, lodgepole (48, 49)
   Pine, ponderosa (36)
   Pine, sugar (35)

Pine, Idaho white (34)
Spruce, Sitka (31)
Tanoak (76)

Initial failures of untreated posts of species showing an average service life of less than 10 years usually occurred at the end of the first 2 or 3 years of service. If such posts must be used, one should expect to replace a few posts after this relatively short time interval, although average service life for the entire lot may be several times greater than this.

Treated fence posts: nonpressure processes

Characteristics, service records, and removal records for fence posts treated by nonpressure preservation processes are given in Tables 4, 5, and 9. An attempt has been made to evaluate each treatment and, where a treatment has failed to produce a longer average service life than that of untreated material of the same species, the suspected cause of such failure is indicated. Nonpressure preservative treatments have been segregated into two groups on the basis of performance. Names and series numbers of species receiving these treatments are indicated in parentheses.

1. ***Treatments not increasing the average service life of posts.***

BRUSH APPLICATION OF ASPHALT EMULSION (Douglas fir, 39). Brush application of the most efficient preservative can hardly be considered an effective treatment for fence posts. The preservative cannot penetrate the wood sufficiently, and posts retain little of the preservative.

CHARRING (Douglas fir, 22). Charring is not a preservative treatment. If it accomplishes anything, it tends to *shorten* the average service life of posts by producing seasoning checks that give spores of decay-producing fungi access to interior parts of the post and by reducing wood volume in the critical zone.

COLD SOAKING IN 5 PER CENT SOLUTION OF ZINC CHLORIDE (Douglas fir, 12). These posts were not appreciably benefited by this treatment for two possible reasons: (a) inadequate treatment of the ground-line section and (b) leaching of the water-soluble preservative.

HOT AND COLD BATH IN CARBOLINEUM "B" (Port Orford cedar, 9). This treatment seems to have had little effect in increasing the average service life of this species; the service record of untreated Port Orford cedar is very similar to that of the treated material.

OSMOPLASTIC (cottonwood, 78). There was virtually no increase in the service life of posts by this treatment.

2. ***Treatments increasing the average service life of posts.***

A. C. M. Co. treater dust and paste (Douglas fir, 5, 6, 24, 25).

Hot and cold bath using Carbolineum "B" (Douglas fir, 8).

Hot and cold bath using creosote (black cottonwood, 27).

Hot and cold bath using 50 per cent creosote and 50 per cent crankcase oil (Douglas fir, 18).

Hot and cold bath using Gasco creosote oil (Douglas fir, 54).

Salt treatment (Douglas fir, 2, 3, 4; and lodgepole pine, 50).

Soaking in Permatol "A" (ponderosa pine, 56).

Tire-tube method using Chemonite (Douglas fir, 59).

Reference to service records (Table 5) of posts in the latter of the two foregoing groups will reveal that many of these nonpressure treatments have been highly effective in protecting the groundline zone. Serious deterioration in the tops of such posts indicates some form of top treatment also should be given.

Treated fence posts: pressure processes

Characteristics, service records, and removal records of fence posts treated by pressure processes are shown in Tables 6, 7, and 10. Service records of some pressure-treated series are comparatively short, but there is every reason to expect long service life from posts pressure-treated with preservatives listed below. Names and series numbers of species treated with these preservatives are indicated in parentheses.

1. Chemonite (Douglas fir, 45; and West Coast hemlock, 44).
2. Coal-tar creosote (Douglas fir, 53).
3. Coal-tar creosote and petroleum mixture (Douglas fir, 51).
4. Creosote (Douglas fir, 23).
5. Creosote, 70 per cent and fuel oil, 30 per cent (Douglas fir, 7).
6. Gasco creosote oil (Douglas fir, 52).
7. Wolman (Tanalith) salts (Douglas fir, 42; and West Coast hemlock, 41).
8. Zinc-meta-arsenite (Douglas fir, 33).

Although service life of Douglas fir (Series 43), has been increased by chromated zinc chloride treatment, nine post failures have occurred in the series, indicating this preservative treatment has been less effective than those in the foregoing list.

Methods of Applying Preservatives to Test Posts

BRUSH TREATMENT: Preservatives and preservative solutions are applied to the wood surface with a brush. Brush treatment of fence posts cannot be recommended as an effective treatment.

CHARRING: Although sometimes called a preservative treatment, charring the surface of wood cannot be justly designated a preservative treatment.

DOUBLE DIFFUSION: Green, peeled, or partially peeled posts are placed in a water solution of one chemical for 2 or 3 days and then transferred to a second water solution of a different chemical for 2 or 3 days. The chemicals diffuse into the wood where they react to form a toxic compound relatively insoluble in water. Removal of three or more full-length strips of bark improves distribution of the chemical. Butt-treated posts should be stacked with tops down to facilitate movement of chemicals to the tops.

HOT AND COLD BATH: In this treatment, often called the open-tank method, posts first are soaked in a hot preservative solution for a number of hours; then posts either are allowed to cool in the preservative or are transferred into a cool solution. Posts to be treated by this method should be peeled and thoroughly seasoned. One end, both ends, or the entire length of the post may be treated by this method.

OSMOPLASTIC BANDAGE: A 9-inch strip of the bark of a green post is removed at the ground line, and the peeled area is coated with a preservative mixture. A water-resistant covering is wrapped tightly around the coated area. The preservative mixture also is applied to post ends.

OSMOSALTS: Osmosalts in a thick water solution are applied to ends and to peeled surfaces of green posts, which are then piled closely and covered for varying periods of time to allow the preservative mixture to diffuse into the wood.

PRESSURE TREATMENTS: Prior to treatment, posts are air-seasoned, artificially seasoned in the preservative by boiling under vacuum, or conditioned by steaming. Hot preservative is injected into the wood under pressure in a closed container, and a final vacuum usually is applied to remove excess preservative and dry the surface of the wood. The full length of the post receives treatment.

SALT TREATMENT: A $\frac{3}{4}$-inch hole slanting toward the butt is drilled to a depth of about 2 inches just above the ground line of an unpeeled, freshly cut pole. One tablespoonful of a dry mixture of equal proportions by weight of salt (sodium chloride) and corrosive sublimate (mercuric chloride) or one tablespoonful of dry mixture of equal proportions by weight of salt, corrosive sublimate, and arsenous oxide is placed in the hole. A snug-fitting wood plug is then driven into the hole. Holes should be spaced not more than five inches apart around the circumference of each post and staggered vertically to prevent weakening the post seriously. **Corrosive sublimate and arsenous oxide are very poisonous chemicals. Handle with extreme care!**

SOAKING TREATMENT: Posts are placed in preservative solution to the desired depth and permitted to soak for a number of hours or days. Posts should be peeled and thoroughly seasoned. For many species, that portion of the post 6 inches above and 12 inches below ground line should be incised to a depth of $\frac{1}{2}$ inch. This treatment has proved successful for some species and much less effective for others. It is primarily a sapwood treatment.

TIRE-TUBE METHOD: One end of a portion of an automobile tire inner tube is slipped over the butt end of an unpeeled, freshly cut post laid with butt end higher than top end on an inclined rack. The open end of the tire tube is elevated, and the tube is filled with preservative. The preservative, after a period of time, diffuses through the sapwood and finally drips out the low end of the post.

Preservative Materials Used for Test Posts

Virtually all preservatives are poisonous. Many may cause irritations when the chemical itself, its solutions, or its vapor contact the skin. Some are extremely poisonous and corrosive. Care should be exercised in handling all preservatives; exposed portions of the body should be washed frequently.

All preservatives should be stored in closed, clearly identified containers. Manufacturer's recommendations should be followed implicitly.

ASPHALT EMULSION: An emulsion or suspension of finely dispersed particles of asphalt in water. Asphalt is a black to a dark brown solid or semisolid material composed predominantly of bitumens.

BOLIDEN SALTS: This preservative contains arsenic acid, sodium arsenate, sodium bichromate, and zinc sulfate.

CARBOLINEUM: Carbolineum, or anthracene oils, are coal-tar distillates of higher specific gravity and higher boiling range than ordinary coal-tar creosote. The exact composition of Carbolineum "B" is not known.

CHEMONITE: Chemonite solution consists of copper, arsenic, and ammonium acetate dissolved in ammoniacal solution.

CHROMATED ZINC CHLORIDE: The preservative contains about 82 per cent zinc chloride and 18 per cent sodium bichromate in a water solution.

COPPER NAPHTHENATE: The oil-soluble copper salt of naphthenic acid. Solutions containing 2 per cent copper by weight have been recommended for optimum performance.

CREOSOTE, CREOSOTE OIL, OR COAL-TAR CREOSOTE: A distillate of coal tar produced by a high-temperature carbonization of bituminous coal. It consists principally of liquid and solid aromatic hydrocarbons, contains appreciable quantities of tar acids and tar bases, and has a continuous boiling-point range beginning about 200 C, and extending to a temperature at least 125 C higher.

CREOSOTE MIXTURES: Creosote may be mixed in varying proportions with petroleum, crankcase oil, or other diluents that act as carriers for the creosote.

GASCO CREOSOTE: A distillate of tar residue resulting from the cracking of asphaltic-base petroleum oils in which artificial fuel gas is the main product.

OSMOSALTS: A proprietary wood preservative containing sodium fluoride, sodium bichromate, dinitrophenol, and sometimes arsenic. The chemicals are water-soluble.

PENTACHLOROPHENOL: An oil-soluble chemical compound formed from phenol and chlorine. Solutions containing 5 per cent pentachlorophenol by weight are recommended for wood in contact with soil.

PERMATOL "A": A preservative containing pentachlorophenol as its toxic constituent. The name, Permatol, has been copyrighted by the Western Pine Association.

SALT AND CORROSIVE SUBLIMATE: A mixture of equal proportions by weight of the two water-soluble chemicals. Corrosive sublimate (mercuric chloride) is the toxic chemical, and the salt serves to hold moisture. **Corrosive sublimate is an extremely poisonous chemical.**

SALT, CORROSIVE SUBLIMATE, AND ARSENOUS OXIDE: A mixture of equal proportions by weight of the three chemicals. Arsenous oxide is an additional water-soluble toxic agent. Addition of this chemical apparently contributes little, if anything, to effectiveness of the corrosive sublimate. **Corrosive sublimate is an extremely poisonous chemical.**

SODIUM PENTACHLOROPHENATE: The water-soluble sodium salt of pentachlorophenol.

SODIUM TRICHLOROPHENATE: The water-soluble sodium salt of trichlorophenol.

TREATER DUST, GRANULAR TREATER DUST, AND TREATER PASTE: Preservatives formerly produced by the Anaconda Copper Mining Company as byproducts of its copper smelting operation. Arsenic trioxide is the principal toxic constituent of the preservatives that were sold in dust, granular, and paste forms. The paste form was applied directly to wood; the dust and granular forms were placed around posts as earth was backfilled in the post-setting operation. Manufacture of these preservatives has been discontinued.

WOLMAN SALTS (TANALITH): A proprietary wood preservative normally containing sodium fluoride, dinitrophenol, sodium chromate, and sodium arsenate. It is injected in water solution.

ZINC CHLORIDE: A chemical applied to wood in a 2 to 5 per cent water solution.

ZINC-META-ARSENITE: A preservative prepared by dissolving zinc oxide and arsenic trioxide in water acidified with acetic acid.

Table 1. Climatological Data, Corvallis, Oregon*

Year	Mean temperature	Maximum temperature	Minimum temperature	Mean relative humidity	Total rainfall	Minimum monthly rainfall	Maximum monthly rainfall	Rainy days (0.1 inch or more)
	F	*F*	*F*	*Per cent*	*Inches*	*Inches*	*Inches*	*Number*
1928	53.4	102	20	......	39.86	0.00	9.43	136
1929	52.7	97	16	70.5	24.45	Trace	11.44	98
1930	52.7	98	4	69.2	23.68	0.00	5.07	110
1931	54.4	104	24	68.5	39.13	0.00	9.12	131
1932	53.4	99	9	62.6	36.94	Trace	8.09	135
1933	52.3	96	11	64.3	42.59	0.00	14.15	145
1934	55.2	99	26	62.5	35.42	0.10	9.71	115
1935	52.6	106	15	63.0	26.35	0.10	4.76	105
1936	54.2	93	19	67.6	32.11	Trace	10.82	121
1937	53.6	98	10	66.8	58.06	0.08	11.17	157
1938	54.3	104	21	64.0	32.04	Trace	7.42	139
1939	54.9	104	25	65.6	26.33	0.22	8.53	113
1940	55.7	100	20	67.2	40.36	Trace	9.80	128
1941	55.0	104	26	64.7	32.95	0.00	7.99	131
1942	53.9	104	17	59.9	39.20	Trace	12.69	......
1943	53.1	95	11	58.2	31.53	0.02	5.60	100
1944	53.2	103	21	58.2	22.99	Trace	4.63	97
1945	53.4	98	20	64.4	37.79	0.08	10.08	133
1946	52.2	107	20	61.9	33.42	0.01	6.78	145
1947	53.7	95	18	64.0	33.91	0.16	9.05	141
1948	51.5	97	19	63.6	40.14	0.06	7.46	158
1949	52.5	95	12	61.2	34.84	Trace	11.84	135
1950	53.0	99	—1	68.1	48.58	0.21	12.17	171
1951	53.3	99	18	66.5	38.38	0.02	7.36	136
1952	52.3	100	15	......	27.68	0.00	7.13	118
1953	52.3	94	25	......	50.21	Trace	12.23	170
1954	50.9	86	17	......	45.73	0.53	11.86	90
1955	49.6	100	14	......	47.41	0.00	12.64	105
Average	53.2	99	17	64.5	36.50	......	9.25	128

* Data from Agricultural Experiment Station, Oregon State College, Corvallis.

Table 2. CHARACTERISTICS OF UNTREATED FENCE POSTS

Species	Series number	Number of posts in test	Post description	Sapwood	Ground-line perimeter			Remarks
					Minimum	Maximum	Average	
				Per cent	*Inches*	*Inches*	*Inches*	
Alder, red	16	25	Split	25	15.0	24.0	19.6	
Alder, red	106	25	Round, peeled	100	9.7	18.5	11.9	
Ash, Oregon	28	25	Split	30	14.4	24.0	19.2	
Cascara buckthorn	20	12	Round, peeled	70	6.0	13.3	8.9	
Cascara buckthorn	47	26	Round, unpeeled	35	12.6	30.2	17.3	
Cedar, Alaska	46	24	Split, mostly heartwood	....	13.0	22.5	17.7	From tree down 4 years
Cedar, incense	29	25	Split	0	15.6	26.4	20.4	
Cedar, Port Orford	21	25	Split	0	17.0	32.0	24.4	
Cedar, western red	10*	25	Split	0	18.0	23.0	19.9	Selected for dark color
Cedar, western red	11*	25	Split	0	17.0	21.0	19.1	Selected for light color
Cottonwood, black	14	25	Split	20	17.0	28.0	22.4	
Cottonwood, black	82	25	Round, unpeeled	95	9.7	17.6	14.1	
Cypress, Arizona	84	25	Round, unpeeled	100	10.4	14.7	12.6	
Douglas fir	1	25	Round, unpeeled	60	15.5	22.0	19.1	
Douglas fir	55	25	Square	0	16.0	16.0	16.0	
Douglas fir	57	25	Square	0	16.0	16.0	16.0	
Douglas fir	72	25	Round, unpeeled	48	10.4	16.3	13.5	
Douglas fir	97	25	Square	5	14.5	14.5	14.5	
Douglas fir	100	25	Round, 4 strips peeled	80	12.6	19.8	16.3	
Fir, grand	15	25	Split	65	17.5	28.0	22.4	
Hemlock, West Coast	38	25	Square	0	16.0	16.0	16.0	
Juniper, western	30	11	Round, peeled	40	19.0	26.5	22.1	
	30	14	Split	40	17.5	27.5	23.9	
Larch, western	37	25	Square	0	16.0	16.0	16.0	
Locust, black	40	8	Round	20	6.3	17.3	10.4	
	40	14	Split	20	11.3	27.0	15.8	
Madrone, Pacific	26	25	Round and split	40	16.5	27.5	21.2	
Maple, Oregon	17	25	Split	25	17.5	24.5	20.4	
Metal	60	25	Angle iron, 1.1 lb. per foot	....	......	......	......	Aluminum paint
Metal	61	25	"T" post, 1.2 lb. per foot	....	......	......	......	Red oxide paint
Metal	69	9	H-beam, 4 lb. per foot	....	......	......	......	Green enamel, baked
Metal	70	10	Flanged channel, 1.3 lb. per foot	....	......	......	......	Green enamel, baked
Metal	71	10	"T" post, 1.5 lb. per foot	....	......	......	......	Green enamel, baked
Oak, Oregon white	19	24	Split	20	15.0	23.5	18.5	
Osage-orange	32	11	Round, unpeeled	10	15.8	26.0	20.1	
		15	Split	10	12.6	20.6	17.5	
Pine, lodgepole	48	26	Round, peeled	55	12.6	18.8	15.7	From dead trees
Pine, lodgepole	49	25	Round, peeled	55	12.6	18.8	15.7	From live trees
Pine, lodgepole	103	25	Round, 4 strips peeled	80	9.1	16.7	11.9	
Pine, ponderosa	36	25	Square	0	16.0	16.0	16.0	
Pine, sugar	35	25	Square	0	16.0	16.0	16.0	
Pine, Idaho white	34	25	Square	0	16.0	16.0	16.0	
Redwood	58	25	Square	0	16.0	16.0	16.0	
Spruce, Sitka	31	26	Square	0	16.0	16.0	16.0	
Tanoak	76	25	Round, unpeeled	100	9.1	15.4	12.2	
Yew, Pacific	13	23	Round, peeled	10	9.7	23.2	15.7	

* From same group of posts.

Table 3. SERVICE RECORDS OF UNTREATED FENCE POSTS

Species	Series number	Number of posts in test	Number of posts failed at last inspection	Number of posts remaining	Average service life of failed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts			
							Ground-line zone		Top	
							Little or none	Moderate to severe	Little or none	Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Alder, red	16	25	....	0	5	....	....	....	....	....
Alder, red	106	25	7	4	3	4	0	4	4	0
Ash, Oregon	28	25	....	0	6	....	....	....	....	....
Cascara buckthorn	20	12	....	0	5	....	....	....	....	....
Cascara buckthorn	47	26	....	1	7	19	0	1	0	1
Cedar, Alaska	46	24	4	6	17	19	0	6	6	0
Cedar incense	29	25	....	2	13	27	0	2	2	0
Cedar, Port Orford	21	25	....	0	20	....	....	....	....	....
Cedar, western red	10	25	1	4	22	28	0	4	4	0
Cedar, western red.	11	25	....	2	21	28	0	2	2	0
Cottonwood, black	14	25	....	0	5	....	....	....	....	....
Cottonwood, black	82	25	....	0	4	....	....	....	....	....
Cypress, Arizona	84	25	6	1	4	5	1	....	1	0
Douglas fir	1	25	....	0	7	....	....	....	....	....
Douglas fir	55	25	....	0	6	....	....	....	....	....
Douglas fir	57	25	....	0	4	....	....	....	....	....
Douglas fir	72	25	5	4	6	8	0	4	3	1
Douglas fir	97	25	7	8	3	4	5	3	8	0
Douglas fir	100	25	4	10	3	4	2	8	10	0
Fir, grand	15	25	....	0	9	....	....	....	....	....
Hemlock, West Coast	38	25	....	0	6	....	....	....	....	....
Juniper, western	30	25	....	6	22	27	1	5	1	5
Larch, western	37	25	....	0	7	....	....	....	....	....
Locust, black	40	22	....	10	18	22	9	1	10	0
Madrone, Pacific	26	25	....	0	6	....	....	....	....	....
Maple, Oregon	17	25	....	0	7	....	....	....	....	....
Metal, angle iron	60	25	....	25	....	8	25	0	25	0
Metal, T-post	61	25	....	25	....	8	25	0	25	0
Metal, H-beam	69	9	....	9	....	8	9	0	9	0
Metal, channel	70	10	....	10	....	8	10	0	10	0
Metal, T-post	71	10	....	10	....	8	10	0	10	0
Oak, Oregon white	19	23	....	5	15	27	4	1	3	2
Osage-orange	32	26	....	26	....	24	26	0	26	0
Pine, lodgepole	48	26	....	0	5	....	....	....	....	....
Pine, lodgepole	49	25	....	0	4	....	....	....	....	....
Pine, lodgepole	103	25	....	6	3	4	2	4	6	0
Pine, ponderosa	36	25	....	6	....	....	....	....	....	....
Pine, sugar	35	25	....	0	7	....	....	....	....	....
Pine, Idaho white	34	25	....	0	6	....	....	....	....	....
Redwood	58	25	....	22	13	17	20	2	22	0
Spruce, Sitka	31	26	....	0	6	....	....	....	....	....
Tanoak	76	25	3	3	4	5	0	3	3	0
Yew, Pacific	13	23	1	11	18	28	5	6	10	1

Table 4. CHARACTERISTICS OF TREATED FENCE POSTS

Nonpressure processes

Species	Series number	Post description	Sapwood	Ground-line perimeter: Minimum	Ground-line perimeter: Maximum	Ground-line perimeter: Average	Preservative treatment*	Average retention per cubic foot: Butt	Average retention per cubic foot: Top	Average total retention per post
			Per cent	*Inches*	*Inches*	*Inches*		*Pounds*	*Pounds*	*Pounds*
Alder, red	105	Round, peeled, green	100	9.7	18.5	11.9	Double diffusion, butts, 6 per cent copper sulfate—2 days; 8 per cent sodium chromate—2 days	......	......	......
Alder, red	108	Round, green, 4 strips peeled	100	9.4	17.3	13.2	Double diffusion, butts, 4 per cent sodium fluoride—2 days; 6 per cent copper sulfate—2 days	......	......	......
Cedar, Port Orford	9	Round, peeled	25	18.0	21.5	19.5	Hot-cold bath, carbolineum "B," butt	......	......	......
Cottonwood, black	27	Split, peeled	20	16.5	24.5	21.6	Hot-cold bath, creosote, B-6	......	......	......
Cottonwood, black	68	Round, peeled, incised	89	11.0	17.3	13.5	Soak, 5 per cent pentachlorophenol-diesel oil, B-6, T-1	7.31	4.06	2.86
Cottonwood, black	74	Round, peeled, incised	99	11.0	16.0	13.5	Soak, 5 per cent sodium pentachlorophenate, B-4, T-1	7.66	4.47	2.93
Cottonwood, black	77	Round, peeled, incised	95	11.0	17.3	13.5	Soak, copper naphthenate-diesel oil (1 per cent copper), B-6, T-1	2.71	1.47	1.04
Cottonwood, black	78	Round, ground-line peeled, green	83	11.3	16.6	13.8	Osmoplastic bandage	......	......	......
Cottonwood, black	87	Round, peeled, incised	90	11.0	17.3	14.1	Soak, Gasco creosote oil, B-3, T-2	10.9	10.1	5.80
Douglas fir	39	Round, peeled	60	15.5	22.0	19.1	Brush, asphalt emulsion, butt	......	......	......
Douglas fir	79	Round, peeled, dry	40	10.4	17.0	14.1	Brush, 2 coats, 5 per cent pentachlorophenol-diesel oil	......	......	......
Douglas fir	80	Round, peeled, dry	46	10.4	18.5	13.8	Brush, 2 coats, copper naphthenate-diesel oil	......	......	......
Douglas fir	81	Round, peeled, dry	44	11.3	17.9	14.8	Brush, 2 coats, coal-tar creosote	......	......	......
Douglas fir	92	Round, peeled, dry	46	9.4	18.2	14.1	Brush, 2 coats Avenarius carbolineum	......	......	......
Douglas fir	22	Round, peeled	60	12.5	19.3	14.7	Charred ¼ inch deep, butt	......	......	......
Douglas fir	101	Round, green, 4 strips peeled	65	12.9	19.2	17.0	Double diffusion, butts, 4 per cent sodium fluoride—2 days; 6 per cent copper sulfate—2 days	......	......	......
Douglas fir	102	Round, green, 4 strips peeled	65	13.8	18.8	16.3	Double diffusion, butts, 6 per cent copper sulfate—2 days; 8 per cent sodium chromate—2 days	......	......	......

* B (butt) and T (top) are followed by treating time in hours.

Table 4. Characteristics of Treated Fence Posts (*Continued*)

Nonpressure processes

Species	Series number	Post description	Sapwood	Ground-line perimeter: Minimum	Ground-line perimeter: Maximum	Ground-line perimeter: Average	Preservative treatment*	Average retention per cubic foot: Butt	Average retention per cubic foot: Top	Average total retention per post
			Per cent	*Inches*	*Inches*	*Inches*		*Pounds*	*Pounds*	*Pounds*
Douglas fir	2	Round, unpeeled, green	60	14.0	22.7	18.3	Salt and mercuric chloride, 1 hole, butt	......	......	......
Douglas fir	91	Round, unpeeled, green	32	10.4	16.6	14.1	Salt and mercuric chloride (2:1), 1 hole, butt	......	......	......
Douglas fir	3	Round, unpeeled, green	60	15.0	26.0	19.9	Salt, mercuric chloride, and arsenous oxide, 2 holes, butt	......	......	......
Douglas fir	4	Round, unpeeled, green	60	15.0	22.0	17.5	Salt, mercuric chloride, and arsenous oxide, 3 holes, butt	......	......	......
Douglas fir	89	Round, unpeeled, green	45	9.4	17.3	14.1	Sodium trichlorophenate, 3 holes, butt	......	......	......
Douglas fir	90	Round, unpeeled, green	39	11.3	17.3	14.1	Sodium pentachlorophenate, 3 holes, butt	......	......	......
Douglas fir	5	Round, unpeeled, green	60	13.0	20.5	15.6	A.C.M. Co. treater dust, butt	......	......	......
Douglas fir	6	Round, unpeeled, green	60	13.0	20.5	16.5	A.C.M. Co. granulated treater dust, butt	......	......	......
Douglas fir	24	Round, peeled, green	60	12.0	18.5	14.4	A.C.M. Co. treater paste, butt	......	......	2.00
Douglas fir	25	Round, peeled, green	60	12.5	18.0	15.5	A.C.M. Co. treater paste, butt	......	......	4.00
Douglas fir	59	Round, unpeeled, green	60	13.6	21.4	17.4	Tire-tube, full-length diffusion, Chemonite	......	......	6.00
Douglas fir	73	Round, ground-line peeled, green	58	11.0	16.6	14.1	Osmoplastic bandage	......	......	......
Douglas fir	75	Round, peeled, green	46	11.0	17.3	14.1	Osmosalts, covered 30 days	......	......	......
Douglas fir	12	Round, peeled	60	11.9	16.7	13.8	Soak, 5 per cent zinc chloride, B-192	......	......	......
Douglas fir	62	Round, peeled, incised	33	11.3	16.0	13.8	Soak, 5 per cent pentachlorophenol-diesel oil, B-2, T-2	1.02	0.40	0.37
Douglas fir	63	Round, peeled, incised	26	10.4	17.6	13.5	Soak, copper naphthenate-diesel oil (1 per cent copper), B-48, T-6	1.64	0.26	0.50
Douglas fir	64	Round, peeled, incised	46	10.4	17.3	14.1	Soak, 5 per cent pentachlorophenol-diesel oil, B-48, T-6	2.22	0.45	0.95
Douglas fir	65	Round, peeled, incised	40	11.0	16.3	14.1	Soak, copper naphthenate-diesel oil (1 per cent copper), B-2, T-2	0.75	0.30	0.29
Douglas fir	66	Round, peeled	40	11.0	17.3	14.1	Soak, 5 per cent pentachlorophenol-diesel oil, B-48, T-6	1.03	0.23	0.35

* B (butt) and T (top) are followed by treating time in hours.

Table 4. CHARACTERISTICS OF TREATED FENCE POSTS (*Continued*)

Nonpressure processes

Species	Series number	Post description	Sapwood	Ground-line perimeter			Preservative treatment*	Average retention per cubic foot		Average total retention per post
				Minimum	Maximum	Average		Butt	Top	
			Per cent	*Inches*	*Inches*	*Inches*		*Pounds*	*Pounds*	*Pounds*
Douglas fir	67	Round, peeled	33	10.7	17.3	13.8	Soak, copper naphthenate-diesel oil (1 per cent copper), B-48, T-6	0.73	0.24	0.25
Douglas fir	88	Round, butt peeled and incised	40	9.4	18.5	13.8	Soak, Gasco creosote oil, B-168, T-48	3.1	2.2	1.40
Douglas fir	93	Round, peeled, incised	32	9.4	17.0	14.1	Soak, copper naphthenate-diesel oil (1 per cent copper), B-144, T-48	3.0	1.2	1.20
Douglas fir	94	Round, peeled, incised	33	11.6	16.3	13.8	Soak, 5 per cent pentachlorophenol-diesel oil, B-144, T-48	3.5	1.5	1.30
Douglas fir	95	Round, peeled, incised	32	11.3	17.3	14.1	Soak, Gasco creosote oil, B-144, T-48	3.2	1.5	1.30
Douglas fir	8	Round, peeled	60	10.0	21.2	16.6	Hot-cold bath, butt, Carbolineum "B," B-6	......	......	......
Douglas fir	18	Round, peeled	60	12.0	18.0	15.8	Hot-cold bath, creosote and crankcase oil (50/50), B-20	......	......	0.88
Douglas fir	54	Square	0	16.0	16.0	16.0	Hot-cold bath, Gasco creosote, B-6	......	......	0.57
Maple, Oregon	83	Round, peeled, incised	75	11.0	17.3	14.1	Soak, 5 per cent pentachlorophenol-diesel oil, B-24, T-2	7.49	2.03	2.72
Pine, lodgepole	99	Round, green, 4 strips peeled	75	9.1	15.4	12.3	Double diffusion, butts, 6 per cent copper sulfate—2 days; 8 per cent sodium chromate—2 days	......	......	......
Pine, lodgepole	104	Round, green, 4 strips peeled	80	9.4	18.2	13.5	Double diffusion, butts, 5 per cent zinc sulfate plus 0.7 per cent arsenic acid —2 days; 8 per cent sodium chromate—2 days	......	......	......
Pine, lodgepole	50	Round, unpeeled	55	12.6	19.8	15.5	Salt, mercuric chloride, and arsenous oxide, 1 hole, butt	......	......	......
Pine, lodgepole	85	Round, peeled, incised	65	11.9	16.0	13.5	Soak, Gasco creosote oil, B-43, T-24	4.1	1.8	1.5
Pine, lodgepole	86	Round, peeled, incised	76	9.7	16.3	13.5	Soak, 5 per cent pentachlorophenol-diesel oil, B-43, T-24	4.1	2.5	1.6
Pine, ponderosa	56	Square	0–35	16.0	16.0	16.0	Soak, Permatol "A," 17 hours	......	......	0.61

*B (butt) and T (top) are followed by treating time in hours.

Table 5. Service Records of Treated Fence Posts

Nonpressure processes

Species	Series number	Number of posts in test	Number of posts failed at last inspection	Number of posts remaining	Average service life of failed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts: Ground-line zone: Little or none	Ground-line zone: Moderate to severe	Top: Little or none	Top: Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Alder, red	105	25	5	16	3	4	16	0	16	0
Alder, red	108	25	....	25	....	4	23	2	25	0
Cedar, Port Orford	9	10	....	0	21	....	....	....	....	....
Cottonwood, black*	27	24	....	0	22	....	....	....	....	....
Cottonwood, black	68	25	....	25	....	8	25	0	25	0
Cottonwood, black	74	22	....	19	6	8	17	2	19	....
Cottonwood, black	77	25	....	11	5	8	6	5	11	0
Cottonwood, black	78	25	....	1	5	8	1	0	1	0
Cottonwood, black	87	25	....	25	....	6	25	0	25	0
Douglas fir	39	25	....	0	5	....	....	....	....	....
Douglas fir	79	25	....	24	6	7	24	0	24	0
Douglas fir	80	25	1	20	6	7	17	3	20	0
Douglas fir	81	23	....	18	6	7	10	8	18	0
Douglas fir	92	24	2	9	5	7	1	8	9	0
Douglas fir	22	25	....	0	6	....	....	....	....	....
Douglas fir	101	25	....	25	....	4	25	0	24	1
Douglas fir	102	25	....	25	....	4	25	0	25	0
Douglas fir†	2	23	....	0	28	....	....	....	....	....
Douglas fir	91	25	1	21	6	7	0	21	20	1
Douglas fir†	3	22	....	0	28	....	....	....	....	....
Douglas fir†	4	22	....	0	28	....	....	....	....	....
Douglas fir	89	25	....	15	5	8	0	15	9	6
Douglas fir	90	25	1	8	5	8	0	8	1	7
Douglas fir†	5	25	....	0	26	....	....	....	....	....
Douglas fir	6	25	....	0	21	....	....	....	....	....
Douglas fir	24	25	....	18	23	27	11	7	13	5

* The average service life of butts of these posts would have been greater than 22 years, whereas the average service life of the tops probably was less than 10 years.

† Removed from test for chemical analysis; 1955.

Table 5. SERVICE RECORDS OF TREATED FENCE POSTS (*Continued*)

Nonpressure processes

Species	Series number	Number of posts in test	Number of posts failed at last inspection	Number of posts remaining	Average service life of failed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts: Ground-line zone: Little or none	Ground-line zone: Moderate to severe	Top: Little or none	Top: Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Douglas fir	25	25	1	17	22	27	7	10	6	11
Douglas fir	59	12	....	12	....	14	12	0	8	4
Douglas fir	73	25	6	15	7	8	11	4	15	0
Douglas fir	75	25	....	25	....	8	25	0	25	0
Douglas fir	12	25	....	0	7	....	....	....	....	....
Douglas fir	62	25	....	23	7	8	23	0	23	0
Douglas fir	63	25	3	17	7	8	17	0	17	0
Douglas fir	64	25	....	25	....	8	25	0	25	0
Douglas fir	65	25	5	13	6	8	8	5	13	0
Douglas fir	66	25	2	23	7	8	15	8	23	0
Douglas fir	67	25	1	14	5	8	6	8	14	0
Douglas fir	88	23	....	23	....	6	23	0	23	0
Douglas fir	93	25	....	25	....	6	25	0	25	0
Douglas fir	94	25	....	25	....	6	25	0	25	0
Douglas fir	95	25	....	25	....	6	25	0	25	0
Douglas fir	8	22	....	0	12	....	....	....	....	....
Douglas fir	18	24	....	0	18	....	....	....	....	....
Douglas fir	54	25	....	25	....	17	25	0	10	15
Maple, Oregon	83	25	....	25	....	8	25	0	25	0
Pine, lodgepole	99	25	1	22	3	4	22	0	22	0
Pine, lodgepole	104	25	....	25	....	4	25	0	25	0
Pine, lodgepole	50	25	1	10	14	17	0	10	1	9
Pine, lodgepole	85	25	....	25	....	6	25	0	25	0
Pine, lodgepole	86	25	....	25	....	6	25	0	25	0
Pine, ponderosa	56	25	....	21	11	16	14	7	21	0

Table 6. Characteristics of Treated Fence Posts

Pressure processes

Species	Series number	Number of posts in test	Post description	Sapwood	Ground-line perimeter			Type of preservative treatment
					Minimum	Maximum	Average	
				Per cent	*Inches*	*Inches*	*Inches*	
Douglas fir	52	25	Square, incised	0	16.0	16.0	16.0	Gasco creosote oil, posts incised, absorption 4.23 pounds per post (7.6 pounds per cubic foot)
Douglas fir	45	25	Square	0	16.0	16.0	16.0	Chemonite, average retention 0.58 pounds of dry salt per cubic foot
Douglas fir	43	25	Round, peeled	60	12.0	16.7	14.2	Chromated zinc chloride, absorption of 0.78 pounds dry salt per post (1 pound per cubic foot)
Douglas fir	7	25	Round, peeled	60	12.0	21.0	17.7	70 per cent creosote, 30 per cent fuel oil, absorption 1.5 to 16 pounds (average 7.2 pounds) per post, treated twice
Douglas fir	51	25	Square, incised	0	16.0	16.0	16.0	Coal-tar creosote and petroleum mixture, average absorption 3.8 pounds per post, (6.2 pounds per cubic foot)
Douglas fir	53	25	Square, incised	0	16.0	16.0	16.0	Coal-tar creosote, absorption 8.1 pounds per post (13.0 pounds per cubic foot)
Douglas fir	23	49	Round, peeled	60	11.6	16.7	14.5	Creosote, absorption unknown
Douglas fir	42	25	Square	0	16.0	16.0	16.0	Wolman salts (Tanalith), dry salt absorption 0.302 pounds per cubic foot, kiln dried after treatment
Douglas fir	33	25	Square	0	13.9	16.6	14.8	Zinc-meta-arsenite, absorption 0.1 pounds per post, treated twice
Douglas fir	96	25	Round, peeled	60	14.1	16.9	22.0	Boliden salts, average retention of 0.44 pound dry salt per cubic foot
Douglas fir	98	24	Square	5	14.5	14.5	14.5	Boliden salts, average retention of 0.40 pound dry salt per cubic foot
Hemlock, West Coast	41	25	Square	0	16.0	16.0	16.0	Wolman salts (Tanalith), dry salt absorption 0.302 pounds per cubic foot, posts kiln dried after treatment
Hemlock, West Coast	44	25	Square	0	16.0	16.0	16.0	Chemonite, average retention 0.75 pounds of dry salt per cubic foot

Table 7. SERVICE RECORDS OF TREATED FENCE POSTS

Pressure processes

Species	Series number	Number of posts in test	Number of posts failed at last inspection	Number of posts remaining	Average service life of failed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts			
							Ground-line zone		Top	
							Little or none	Moderate to severe	Little or none	Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Douglas fir	52	25	....	25	....	17	25	0	25	0
Douglas fir	45	25	1	23	18	18	23	0	23	0
Douglas fir	43	25	1	15	11	20	14	1	15	0
Douglas fir	7	25	....	25	....	28	25	0	25	0
Douglas fir	51	25	....	25	....	17	25	0	25	0
Douglas fir	53	25	....	25	....	17	25	0	25	0
Douglas fir	23	48	....	48	....	27	48	0	48	0
Douglas fir	42	25	....	25	....	20	25	0	25	0
Douglas fir	33	25	1	12	21	24	7	5	12	0
Douglas fir	96	25	....	25	....	4	25	0	25	0
Douglas fir	98	24	....	24	....	4	24	0	24	0
Hemlock, West Coast	41	25	....	25	....	20	25	0	25	0
Hemlock, West Coast	44	25	....	25	....	19	25	0	25	0

Table 8. Failures of Untreated Fence Posts

Species	Series number	Date set	Number of posts in test	Total number of posts failed	Number of posts failed, at two-year intervals												
					32	34	36	38	40	42	44	46	48	50	52	54	56
Alder, red	16	3– 5–29	25	25	7	10	8	....	....	....	....	....	....	....	....	....	....
Alder, red	106	11– 5–52	25	21	....	....	....	....	....	....	....	....	....	....	....	4	17
Ash, Oregon	28	3–19–30	25	25	1	9	6	8	....	1	....	....	....	....	....	....	....
Cascara buckthorn	20	3– 5–29	12	12	4	5	2	....	1	....	....	....	....	....	....	....	....
Cascara buckthorn	47	1–29-38	26	25	....	....	....	....	1	8	3	5	6	1	1	....	....
Cedar, Alaska	46	11– 6–37	24	18	....	....	....	....	....	....	....	....	....	2	2	10	4
Cedar, incense	29	3–19–30	25	23	....	1	5	1	2	2	2	3	1	3	2	1	....
Cedar, Port Orford	21	5– 4–29	25	25	....	....	....	....	1	....	....	2	5	10	5	2	....
Cedar, western red	10	3– 6–29	25	21	....	....	....	....	1	....	1	....	....	5	8	4	2
Cedar, western red	11	4– 1–29	25	23	....	1	....	....	....	....	1	2	1	4	7	7	....
Cottonwood, black	14	3– 5–29	25	25	8	14	2	1	....	....	....	....	....	....	....	....	....
Cottonwood, black	82	3–24–49	25	25	....	....	....	....	....	....	....	....	....	....	12	11	2
Cypress, Arizona	84	10– 6–51	25	24	....	....	....	....	....	....	....	....	....	....	....	11	13
Douglas fir	1	1– 7–28	25	25	4	12	6	3	....	....	....	....	....	....	....	....	....
Douglas fir	55	10–11–39	25	25	....	....	....	....	....	1	8	9	4	3	....	....	....
Douglas fir	57	12– 6–39	25	25	....	....	....	....	....	8	16	1	....	....	....	....	....
Douglas fir	72	12–17–48	25	21	....	....	....	....	....	....	....	....	....	....	2	10	9
Douglas fir	97	11–17–52	25	17	....	....	....	....	....	....	....	....	....	....	....	1	16
Douglas fir	100	11–19–52	25	15	....	....	....	....	....	....	....	....	....	....	....	....	15
Fir, grand	15	3– 5–29	25	25	5	4	3	4	3	4	2	....	....	....	....	....	....
Hemlock, West Coast	38	9–20–33	25	25	....	....	3	11	8	1	1	....	1	....	....	....	....
Juniper, western	30	1–12–30	25	19	....	....	....	....	....	1	1	....	2	3	3	7	2
Larch, western	37	9–20–33	25	25	....	....	....	14	3	4	1	....	....	1	2	....	....
Locust, black	40	4–13–35	22	12	....	....	....	....	....	....	....	....	....	1	3	5	3
Madrone, Pacific	26	2– 6–30	25	25	....	9	10	6	....	....	....	....	....	....	....	....	....
Maple, Oregon	17	3– 5–29	25	25	....	11	11	3	....	....	....	....	....	....	....	....	....
Metal, angle iron	60	11–13–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, T-post	61	11–13–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, H-beam	69	12–11–48	9	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, channel	70	12–11–48	10	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, T-post	71	12–11–48	10	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Oak, Oregon white	19	5– 7–29	23	18	....	....	....	7	2	3	....	....	1	1	1	2	1
Osage-orange	32	4–15–33	26	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	48	11– 1–38	26	26	....	....	....	....	....	11	11	2	1	....	1	....	....
Pine, lodgepole	49	11– 1–38	25	25	....	....	....	....	....	18	7	....	....	....	....	....	....
Pine, lodgepole	103	11–15–52	25	25	....	....	....	....	....	....	....	....	....	....	....	6	13
Pine, ponderosa	36	9–20–33	25	25	....	....	1	10	9	2	1	2	....	....	....	....	....
Pine, sugar	35	9–20–33	25	25	....	....	2	10	5	2	1	4	1	....	....	....	....
Pine, Idaho white	34	9–20–33	25	25	....	....	1	9	14	....	1	....	....	....	....	....	....
Redwood	58	12–20–39	25	3	....	....	....	....	....	....	....	....	....	1	1	....	1
Spruce, Sitka	31	4–15–33	26	26	....	....	4	12	5	5	....	....	....	....	....	....	....
Tanoak	76	10– 6–51	25	22	....	....	....	....	....	....	....	....	....	....	....	7	15
Yew, Pacific	13	3– 5–29	23	12	....	....	....	2	2	1	....	....	....	1	....	5	1

Table 9. FAILURES OF TREATED FENCE POSTS

Nonpressure processes

Species	Series number	Date set	Number of posts in test	Total number of posts failed	Number of posts failed, at two-year intervals												
					32	34	36	38	40	42	44	46	48	50	52	54	56
Alder, red	105	11–5–52	25	4	....	....	....	....	....	....	....	....	....	....	....	....	9
Alder, red	108	11–15–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Cedar, Port Orford	9	4–20–28	10	10	....	....	....	....	1	....	2	....	1	....	5	1	....
Cottonwood, black	27	2–6–30	24	24	....	....	....	....	....	....	....	....	....	4	20	....	....
Cottonwood, black	68	12–23–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Cottonwood, black	74	4–23–49	22	3	....	....	....	....	....	....	....	....	....	....	....	1	2
Cottonwood, black	77	4–9–49	25	14	....	....	....	....	....	....	....	....	....	....	4	9	1
Cottonwood, black	78	12–28–48	25	24	....	....	....	....	....	....	....	....	....	....	4	20	....
Cottonwood, black	87	11–4–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	39	9–20–33	25	25	....	....	2	10	13	....	....	....	....	....	....	....	....
Douglas fir	79	11–5–49	25	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Douglas fir	80	10–17–49	25	4	....	....	....	....	....	....	....	....	....	....	....	....	5
Douglas, fir	81	10–5–49	24	6	....	....	....	....	....	....	....	....	....	....	....	6	....
Douglas fir	92	11–11–49	25	13	....	....	....	....	....	....	....	....	....	....	....	11	4
Douglas fir	22	5–4–29	25	25	4	8	5	7	1	....	....	....	....	....	....	....	....
Douglas fir	101	11–19–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	102	11–18–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	2*	1–7–28	....	1	....	....	....	....	....	....	....	....	....	....	....	1	....
Douglas fir	91	11–19–49	25	3	....	....	....	....	....	....	....	....	....	....	....	....	4
Douglas fir	3*	1–7–28	....	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	4*	1–7–28	....	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	89	3–24–49	25	10	....	....	....	....	....	....	....	....	....	....	3	4	3
Douglas fir	90	4–17–49	25	16	....	....	....	....	....	....	....	....	....	....	3	11	3
Douglas fir	5*	3–6–28	....	7	....	....	....	....	....	....	....	....	....	....	3	4	....
Douglas, fir	6	3–20–28	25	25	....	1	....	....	....	1	4	1	4	4	4	6	....
Douglas fir	24	2–6–30	25	7	....	....	....	....	....	....	....	....	1	2	....	2	2
Douglas fir	25	2–6–30	25	7	....	....	....	....	....	....	....	....	2	2	....	2	2
Douglas fir	59	6–3–42	12	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	73	12–22–48	25	4	....	....	....	....	....	....	....	....	....	....	....	3	7
Douglas fir	75	4–16–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	12	3–14–29	25	25	2	9	6	6	1	....	....	1	....	....	....	....	....
Douglas fir	62	12–29–48	25	2	....	....	....	....	....	....	....	....	....	....	....	....	2
Douglas fir	63	2–19–49	25	5	....	....	....	....	....	....	....	....	....	....	....	....	8
Douglas fir	64	12–18–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	65	3–20–49	25	7	....	....	....	....	....	....	....	....	....	....	1	3	8
Douglas fir	66	3–22–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	2
Douglas fir	67	3–21–49	25	10	....	....	....	....	....	....	....	....	....	....	1	6	4
Douglas fir	88	10–21–50	23	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	93	10–21–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	94	10–7–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	95	10–7–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	8	3–6–29	22	22	....	....	....	7	7	2	1	5	....	....	....	....	....
Douglas fir	18	5–7–29	24	24	1	....	1	1	3	2	1	4	1	5	4	1	....
Douglas fir	54	10–11–39	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Maple, Oregon	83	3–26–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	99	11–15–52	25	2	....	....	....	....	....	....	....	....	....	....	....	....	3
Pine, lodgepole	104	11–15–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	50	11–1–38	25	14	....	....	....	....	....	....	1	1	1	....	2	5	5
Pine, lodgepole	85	11–15–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	86	11–15–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, ponderosa	56	12–6–39	25	4	....	....	....	....	....	....	....	....	1	2	1	....	....

*Posts removed for chemical analysis, 1955.

Table 10. Failures of Treated Fence Posts

Pressure processes

Species	Series number	Date set	Number of posts in test	Total number of posts failed	Number of posts failed, at two-year intervals							
					42	44	46	48	50	52	54	56
Douglas fir	52	10–11–39	25	0	....	....	....	....	....	....	....	....
Douglas fir	45	5– 1–37	25	1	....	....	....	....	....	....	1	1
Douglas fir	43	2–13–37	25	9	1	2	....	1	1	3	....	1
Douglas fir	7	3– 6–29	25	0	....	....	....	....	....	....	....	....
Douglas fir	51	10–11–39	25	0	....	....	....	....	....	....	....	....
Douglas fir	53	10–11–39	25	0	....	....	....	....	....	....	....	....
Douglas fir	23	5–31–29	48	0	....	....	....	....	....	....	....	....
Douglas fir	42	12– 5–36	25	0	....	....	....	....	....	....	....	....
Douglas fir	33	4–15–33	25	12	....	....	....	....	1	3	6	1
Douglas fir	96	11–17–52	25	0	....	....	....	....	....	....	....	....
Douglas fir	98	11–18–52	24	0	....	....	....	....	....	....	....	....
Hemlock, West Coast	41	12– 5–36	25	0	....	....	....	....	....	....	....	....
Hemlock, West Coast	44	5– 1–37	25	0	....	....	....	....	....	....	....	....

Table 11. SERVICE LIFE, ACTUAL OR ESTIMATED, OF TREATED AND UNTREATED DOUGLAS FIR POSTS

Treatment	Series	Service life		
		Actual	Estimated*	No failure to 1956†
		Years	*Years*	*Years*
None	1, 55, 57	1, 6, 4		
	72, 97, 100		7, 4, 4	
Charring	22	6		
Brush				
Asphalt, butt	39	5		
Carbolineum	92		7	
Copper naphthenate	80		9	
Creosote	81		9	
Pentachlorophenol	79		12	
Double diffusion				
NaF—$CuSo_4$	101			
$CuSo_4$—Na_2CrO_4	102			
Bore hole				
Salt + HgCl	2	28‡		
	91		10	
Salt + HgCl + As	3, 4	28, 28‡		
Sodium pentachlorophenate	90		7	
Sodium trichlorophenate	89		8	
Treater dust or paste	6	21		
	5, 24, 25		34, 32, 31	
Tire tube				
Chemonite	59			14
Osmose				
Bandage	73		9	
Salts	75			8
Soaking				
Copper napthenate	63, 65, 67		8, 7, 8	
	93			6
Gasco creosote	88, 95			6, 6
Pentachlorophenol	62, 66		13, 12	
	64, 94			8, 6
Zinc chloride	12	7		
Hot-cold bath				
Carbolineum	8	12		
Creosote and oil	18	18		
Gasco creosote	54			17
Pressure				
Boliden salts	96, 98			4, 4
Chemonite	45		30	
Creosote	43		21	
Chromated ZnCl	23, 53			27, 17
Creosote—fuel oil	7, 51			28, 17
Gasco creosote	52			17
Tanalith (Wolman salts)	42			20
Zinc meta-arsenite	33		24	

* Estimated life is based on actual service life of failed posts, extended to unfailed posts by the method developed for cross ties by J. D. MacLean, as explained in *Percentage Renewal and Average Service Life of Railway Ties*. Report R 886, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, Madison, Wisconsin.

† No estimate could be made of series in which no posts have failed.

‡ Removed in 1955 before failure.

T. J. Starker Post Farm Cooperators

Anaconda Copper Mining Co., Wood Preserving Department, Butte, Montana
Bolidens Gruvaktiebolag, Stockholm, Sweden
Bradley-Woodard Lumber Co., Bradwood, Oregon
Carbolineum Wood Preserving Co., Milwaukee, Wisconsin
Chemonite Wood Preserving Co., San Francisco, California
J. W. Copeland Yards, Corvallis, Oregon
Corvallis Lumber Co., Corvallis, Oregon
Harold Dahl, Troutdale, Oregon
Dant & Russell, Portland, Oregon
Dow Chemical Co., Midland, Michigan
Holmes-Eureka Lumber Co., Eureka, California
The Hunt Co., 3700 West Six Mile Road, Detroit, Michigan
C. D. Johnson Lumber Corp., Toledo, Oregon
Kirchmann Hardwood Co., San Francisco, California
McGoldrick Lumber Co., Spokane, Washington
Nuodex Products Co., Inc., Elizabeth, F, New Jersey
Osmose Wood Preserving Co. of America, Inc., Buffalo, New York
Pope & Talbot, Inc., St. Helens, Oregon
Portland Gas & Coke Co., Portland, Oregon
R. H. Rawson, Portland, Oregon
Southern Pacific Co., Eugene, Oregon
U. S. Department of Agriculture, Forest Service
  Deschutes National Forest, Bend, Oregon
  Forest Products Laboratory, Madison, Wisconsin
  Pacific Northwest Forest and Range Experiment Station, Portland, Oregon
  Umpqua National Forest, Roseburg, Oregon
  Willamette National Forest, Eugene, Oregon
Warren Southwest, Inc., Wilmington, California
Washington Wood Preserving Co., Spokane, Washington
West Coast Wood Preserving Co., Seattle, Washington
West Oregon Lumber Co., Portland, Oregon
Western Pine Association, Portland, Oregon
Weyerhaeuser Timber Co., Klamath Falls, Oregon
Willamette Valley Lumber Co., Dallas, Oregon