PROGRESS REPORT 11 DECEMBER 1957

Service Life of Treated and Untreated Fence Posts

1957 Progress Report on the T. J. Starker Post Farm

By

Robert D. Graham

Donald J. Miller

STATE OF OREGON
Forest Products Research Center
Corvallis

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Robert D. Graham
In charge, Wood Preservation

Donald J. Miller
Research Assistant

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

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TABLES

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SUMMARY

Thirty posts from 11 untreated series, 62 posts from 18 non-pressure-treated series, and 9 posts from 3 pressure-treated series failed. Causes of post failures since 1949 were:

Cause	Number of failures 1949-1956	1957
Fungi (decay)	314	92
Termites (damp-wood)	17	1
Fungi and termites	100	5
Fungi and other insects	28	3

One new series of untreated mountain hemlock posts (series 109) was installed.

Actual or estimated average service life of untreated post series is shown on page 8, and an attempt has been made to evaluate the various preservative treatments applied (page 9). Estimated increases in service life of posts of nondurable species due to preservative treatment are shown in Table 11.

Pressure-treated posts

Pressure-treated posts of nondurable species have continued to give long service. Boliden Salt-treated series 96 and 98, that have been installed for only 5 years, are in good condition. All other post series have been in service for at least 18 years.

Posts treated with zinc-meta-arsenite (series 33) and with chromated zinc chloride (series 43) are continuing to fail; their estimated average service life is 24 and 21 years respectively. The average service life of each of the remaining series is estimated to exceed 30 years.

The first post failure occurred in Tanalith-treated series 42.

Nonpressure-treated posts

Posts treated by double diffusion with copper sulfate and sodium chromate (series 99, 102, 105) are failing rapidly; this treatment has failed to increase the service life of various posts treated. Other chemical combinations applied by double diffusion (series 101, 104, 108) are proving more effective, although one post in red alder series 108 failed.

Failures continued in brush-treated series 80, 81, and 92. The last Osmoplastic bandage-treated cottonwood post (series 78) failed. Although these two treatments have added a few years to the service life of some series, they are not recommended for posts. The Osmosalt treatment appears promising for Douglas fir (series 75).

Posts treated by placing sodium pentachlorophenate (series 90) or sodium trichlorophenate (series 89) in holes drilled in the groundline area are failing rapidly. Posts soaked in a copper naphthenate-petroleum solution containing 1 percent copper (series 63, 65, 67) also continued to fail. No failures have occurred in posts soaked in Gasco creosote after 7 years, and only a few failures have occurred in posts soaked in a 5 percent pentachlorophenol-petroleum solution.

Untreated posts

Remaining posts in incense cedar series 29, Douglas fir series 97, and tanoak series 76 failed. The average service life of each series was: incense cedar, 14 years; Douglas fir and tanoak, 4 years.

Metal posts were rusty after 9 years' service.

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, 2,662 posts have been placed in the farm. Three introduced and 25 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 Arboretum 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 percent, a humus of one-half inch or less in thickness, and a nitrogen content of 0.1415 percent. 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 127 rainy days a year. Some summer intervals have approached drought conditions. An annual mean relative humidity of 64 percent 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 causes 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.

Many failed posts have been attacked by woodboring beetles, although damage seldom approaches that caused by fungi or termites.

Test specimens

Test posts usually are 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. Deterioration of the top is rated by visual inspection, while both stability 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 actual 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 percent 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 doubtlessly is retarded 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.

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

Characteristics, service records, and removal records of untreated posts are shown in Tables 2, 3, and 8. The various species tested are classified into two groups based largely on durability and amount of heartwood present in the posts. Series numbers are enclosed in parentheses for convenience in referring to tabular data. Actual or estimated average service life of series is expressed in years.

1. Durable species (*posts largely of heartwood*)

	Years
Cedar, Alaska (46)	17
Cedar, incense (29)	14
Cedar, Port Orford (21)	20
Cedar, western red (10, 11)	23, 22
Juniper, western (30)	25
Locust, black (40)	24
Oak, Oregon white (19)	22
Osage-orange (32)	over 30
Redwood (58)	25
Yew, Pacific (13)	30

2. ***Nondurable species*** *(posts largely of sapwood, or heartwood not durable)*

	Years
Alder, red (16, 106)	5, 4
Ash, Oregon (28)	6
Cascara buckthorn (20, 47)	5, 8
Cottonwood, black (14, 82)	5, 4
Cypress, Arizona (84)	5
Douglas fir (1, 55, 57, 72, 97, 100)	7, 6, 4, 7, 4, 4
Fir, grand (15)	9
Hemlock, mountain (109)	6
Hemlock, West Coast (38)	6
Larch, western (37)	7
Madrone, Pacific (26)	6
Maple, Oregon (17)	7
Pine, lodgepole (48, 29, 103)	5, 4, 4
Pine, ponderosa (36)	6
Pine, sugar (35)	7
Pine, Idaho white (34)	6
Spruce, Sitka (31)	6
Tanoak (76)	4

Average service life of untreated posts varies greatly due to differences in durability and amount of heartwood in each post. Posts from group 1 that are largely sapwood and posts from group 2 can be expected to have an average service life of only 4-6 years west of the Cascade mountains. Such posts should be properly treated with a preservative prior to installation in the ground.

Treated fence posts: nonpressure processes

Characteristics, service records, and removal records for fence posts treated by nonpressure processes are given in Tables 4, 5, and 9. Estimated increases resulting from preservative treatments are shown in Table 11. An attempt has been made to evaluate these treatments and, when possible, recommendations have been made concerning their use.

BORE HOLE (chemicals placed in holes drilled in green, unpeeled posts): Combinations of salt and mercuric chloride with or without arsenous oxide have increased the service life of pine and Douglas fir posts. Effectiveness has increased with number of holes used. Tops of the posts are not protected adequately by this method. The chemicals used are *very poisonous* and should be handled with *extreme care.*

BRUSHING TREATMENT: Brushing posts with preservatives did little or nothing to increase the service life of posts in 4 series and was somewhat more effective in a fifth series. The posts were thoroughly air-dried and two coats were applied on a very hot day. Brushing is *not recommended* for posts regardless of the preservative applied, for preservative penetration is low, and the amount of preservative retained by the posts is very small even under optimum conditions.

CHARRING: Charring is *not* a preservative treatment. If anything, it shortens the life of posts by reducing the size of the post in the critical ground-line area.

DOUBLE DIFFUSION: Treatments with copper sulfate and sodium chromate have not been effective; those with sodium fluoride and copper sulfate were not effective with alder but are increasing the life of Douglas fir posts. Zinc sulfate, arsenic acid, and sodium chromate treatment of lodgepole pine posts is proving effective, but service records are not long enough to warrant its recommendation at this time.

HOT AND COLD BATH: Hot-cold baths with various creosotes are effective treatments. However, full-length treatment of posts by this method is recommended to provide protection for tops of the posts.

OSMOSE BANDAGE AND SALTS: The ground-line bandage treatment was not effective for cottonwood and was only of slight value to Douglas fir. It is *not recommended* for posts of nondurable heartwood species.

Osmosalts is proving effective for Douglas fir posts. This treatment for freshly cut and peeled posts is promising and merits further study.

SOAKING: Soaking treatments with a copper naphthenate-petroleum solution containing 1 percent copper, or with a 5 percent zinc chloride solution, have not proved effective. A 5 percent sodium pentachlorophenate solution has increased the service life of cottonwood posts, although not sufficiently to warrant its use.

Soaking well air-seasoned posts with Gasco creosote and with a 5 percent pentachlorophenol solution is proving effective. Full-length post treatments are desirable.

TIRE TUBE WITH CHEMONITE: This end-diffusion treatment for green posts has increased the life of Douglas fir posts, although about 50 percent of the tops contain moderate to severe decay. The method is slow; each post must be treated individually.

TREATER DUST OR PASTE: Application of dust or paste containing a high percentage of arsenic trioxide to freshly cut, peeled, and unpeeled Douglas fir posts as they were installed and then adding the chemical to the back-fill greatly increased their service life. These pastes and dusts no longer are available.

Treated fence posts: pressure processes

Characteristics, service records, and removal records of posts treated by pressure processes are shown in Tables 6, 7, and 10. Estimated increases in the service life of posts due to preservative treatment are given in Table 11. All but two post series have been in service for 18 years. Boliden Salt-treated series 96 and 98 have been in service for only 5 years, but good condition of the posts indicates a long service life can be expected. Chromated zinc chloride and zinc-meta-arsenite (estimated increase in service life of 15 and 18 years respectively) have been less effective than preservatives listed below, which are estimated to have increased the service life of the post series indicated in parentheses by at least 25 years.

1. Chemonite (Douglas fir, 45; West Coast hemlock, 44)
2. Coal-tar creosote (Douglas fir, 23 and 53)
3. Coal-tar creosote—petroleum mixture (Douglas fir, 7 and 51)
4. Gasco creosote (Douglas fir, 52)
5. Tanalith (Douglas fir, 42; West Coast hemlock, 41)

Pressure treatments have been consistently effective in greatly increasing the service life of posts of nondurable species.

Methods of Applying Preservatives to Test Posts

BRUSH TREATMENT: Preservatives are applied to the wood surface with a brush. Brush treatment of fence posts is not recommended.

BORE HOLE: 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!**

CHARRING: Charring the surface of wood is not a preservative treatment.

DOUBLE DIFFUSION: Green, 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. Full-length treatment is desirable.

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, thoroughly seasoned and treated full length.

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 3 weeks or longer 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: See BORE-HOLE METHOD.

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 a water-soluble 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. This material has little or no preservative value.

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 percent zinc chloride and 18 percent sodium bichromate in a water solution.

COPPER NAPHTHENATE: The oil-soluble copper salt of naphthenic acid. Solutions containing 2 percent 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.

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

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.

ZINC CHLORIDE: A chemical applied to wood in a 2 to 5 percent 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
1956	51.0	104	15	......	40.59	0.02	11.89	93
Average	53.1	99	17	64.5	36.64	......	......	127

* 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	Sap-wood	Ground-line perimeter			Remarks
					Mini-mum	Maxi-mum	Aver-age	
				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, mountain	109	25	square, dry	....	15.0	15.0	15.0	
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: 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	16	25	....	0	5	....	....	....	....	....
Alder, red	106	25	1	3	4	5	0	3	3	0
Ash, Oregon	28	25	....	0	6	....	....	....	....	....
Cascara buckthorn	20	12	....	0	5	....	....	....	....	....
Cascara buckthorn	47	26	....	1	7	20	0	1	0	1
Cedar, Alaska	46	24	....	6	17	20	0	6	6	0
Cedar incense	29	25	2	0	14	....	....	....	....	....
Cedar, Port Orford	21	25	....	0	20	....	....	....	....	....
Cedar, western red	10	25	2	2	23	29	0	2	2	0
Cedar, western red	11	25	1	1	22	29	0	1	1	0
Cottonwood, black	14	25	....	0	5	....	....	....	....	....
Cottonwood, black	82	25	....	0	4	....	....	....	....	....
Cypress, Arizona	84	25	....	1	4	6	....	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	....	4	6	9	0	4	3	1
Douglas fir	97	25	8	0	4	....	....	....	....	....
Douglas fir	100	25	5	5	4	5	....	5	5	0
Fir, grand	15	25	....	0	9	....	....	....	....	....
Hemlock, mountain	109	25	....	25	....	1	25	0	25	0
Hemlock, West Coast	38	25	....	0	6	....	....	....	....	....
Juniper, western	30	25	....	6	22	28	....	6	1	5
Larch, western	37	25	....	0	7	....	....	....	....	....
Locust, black	40	22	....	10	18	23	9	1	9	1
Madrone, Pacific	26	25	....	0	6	....	....	....	....	....
Maple, Oregon	17	25	....	0	7	....	....	....	....	....
Metal, angle iron	60	25	....	25	....	9	25	0	25*	0
Metal, T-post	61	25	....	25	....	9	25	0	25*	0
Metal, H-beam	69	9	....	9	....	9	9	0	9*	0
Metal, channel	70	10	....	10	....	9	10	0	10*	0
Metal, T-post	71	10	....	10	....	9	10	0	10*	0
Oak, Oregon white	19	23	2	3	16	28	1	2	2	1
Osage-orange	32	26	....	26	....	25	26	0	26	0
Pine, lodgepole	48	26	....	0	5	....	....	....	....	....
Pine, lodgepole	49	25	....	0	4	....	....	....	....	....
Pine, lodgepole	103	25	3	3	4	5	0	3	3	0
Pine, ponderosa	36	25	....	0	6	....	....	....	....	....
Pine, sugar	35	25	....	0	7	....	....	....	....	....
Pine, Idaho white	34	25	....	0	6	....	....	....	....	....
Redwood	58	25	1	21	14	18	18	3	21	0
Spruce, Sitka	31	26	....	0	6	....	....	....	....	....
Tanoak	76	25	3	0	4	....	....	....	....	....
Yew, Pacific	13	23	2	9	20	29	5	4	9	0

* Surfaces of all posts rusted.

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: 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	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	2	14	4	5	14	0	14	0
Alder, red	108	25	1	24	4	5	18	6	24	0
Cedar, Port Orford	9	10	....	0	21	....	....	....	....	....
Cottonwood, black*	27	24	....	0	22	....	....	....	....	....
Cottonwood, black	68	25	....	25	....	9	25	0	25	0
Cottonwood, black	74	22	2	17	7	9	9	8	17	0
Cottonwood, black	77	25	....	11	5	9	6	5	11	0
Cottonwood, black	78	25	1	0	5	....	....	....	....	....
Cottonwood, black	87	25	....	25	....	7	25	0	25	0
Douglas fir	39	25	....	0	5	....	....	....	....	....
Douglas fir	79	25	....	24	6	8	24	0	24	0
Douglas fir	80	25	1	19	6	8	16	3	19	0
Douglas fir	81	23	2	16	6	8	6	10	16	0
Douglas fir	92	23	3	5	6	8	1	4	5	0
Douglas fir	22	25	....	0	6	....	....	....	....	....
Douglas fir	101	25	....	25	....	5	25	0	24	1
Douglas fir	102	25	14	11	4	5	7	4	11	0
Douglas fir†	2	23	....	0	28	....	....	....	....	....
Douglas fir	91	25	....	21	6	8	0	21	17	4
Douglas fir†	3	22	....	0	28	....	....	....	....	....
Douglas fir†	4	22	....	0	28	....	....	....	....	....
Douglas fir	89	25	3	12	6	9	0	12	9	3
Douglas fir	90	25	2	6	5	9	0	6	....	6
Douglas fir†	5	25	....	0	26	....	....	....	....	....
Douglas fir	6	25	....	0	21	....	....	....	....	....
Douglas fir	24	25	4	14	25	28	8	6	9	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	3	14	24	28	5	9	4	10
Douglas fir	59	12	....	12	....	15	12	0	7	5
Douglas fir	73	25	....	15	7	9	5	10	15	0
Douglas fir	75	25	....	25	....	9	25	0	25	0
Douglas fir	12	25	....	0	7	....	....	....	....	....
Douglas fir	62	25	....	23	7	9	23	0	23	0
Douglas fir	63	25	1	16	7	9	16	0	16	0
Douglas fir	64	25	....	25	....	9	25	0	25	0
Douglas fir	65	25	1	12	7	9	7	5	12	0
Douglas fir	66	25	....	23	7	9	17	6	23	0
Douglas fir	67	25	3	11	6	9	6	5	11	0
Douglas fir	88	23	....	23	....	7	23	0	23	0
Douglas fir	93	25	....	25	....	7	25	0	25	0
Douglas fir	94	25	....	25	....	7	25	0	25	0
Douglas fir	95	25	....	25	....	7	25	0	25	0
Douglas fir	8	22	....	0	12	....	....	....	....	....
Douglas fir	18	24	....	0	18	....	....	....	....	....
Douglas fir	54	25	....	25	....	18	25	0	15	10
Maple, Oregon	83	25	....	25	....	9	25	0	25	0
Pine, lodgepole	99	25	15	7	5	5	7	0	7	0
Pine, lodgepole	104	25	....	25	....	5	25	0	25	0
Pine, lodgepole	50	25	3	7	15	18	0	7	0	7
Pine, lodgepole	85	25	....	25	....	7	25	0	25	0
Pine, lodgepole	86	25	....	25	....	7	25	0	25	0
Pine, ponderosa	56	25	1	20	12	17	11	9	20	0

Table 6. Characteristics of Treated Fence Posts

Pressure processes

Species	Series number	Number of posts in test	Post description	Sapwood	Ground-line perimeter: Minimum	Ground-line perimeter: Maximum	Ground-line perimeter: Average	Type of preservative treatment
				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: 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	52	25	....	25	....	18	25	0	25	0
Douglas fir	45	25	....	23	18	19	22	1	23	0
Douglas fir	43	25	6	9	16	21	8	1	9	0
Douglas fir	7	25	....	25	....	29	25	0	25	0
Douglas fir	51	25	....	25	....	18	25	0	25	0
Douglas fir	53	25	....	25	....	18	25	0	25	0
Douglas fir	23	48	....	48	....	28	48	0	48	0
Douglas fir	42	25	1	24	21	21	24	0	24	0
Douglas fir	33	25	2	10	21	25	6	4	10	0
Douglas fir	96	25	....	25	....	5	25	0	25	0
Douglas fir	98	24	....	24	....	5	24	0	24	0
Hemlock, West Coast	41	25	....	25	....	21	25	0	25	0
Hemlock, West Coast	44	25	....	25	....	20	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	57
Alder, red	16	3- 5-29	25	25	7	10	8	....	....	....	....	....	....	....	....	....	....	....
Alder, red	106	11- 5-52	25	22	....	....	....	....	....	....	....	....	....	....	....	4	17	1
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	25	....	1	5	1	2	2	2	3	1	3	2	1	....	2
Cedar, Port Orford	21	5- 4-29	25	25	....	....	....	....	1	....	....	2	5	10	5	2	....	....
Cedar, western red	10	3- 6-29	25	23	....	....	....	....	1	....	1	....	....	5	8	4	2	2
Cedar, western red	11	4- 1-29	25	24	....	1	....	....	....	....	1	2	1	4	7	7	....	1
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	25	....	....	....	....	....	....	....	....	....	....	....	1	16	8
Douglas fir	100	11-19-52	25	20	....	....	....	....	....	....	....	....	....	....	....	....	15	5
Fir, grand	15	3- 5-29	25	25	5	4	3	4	3	4	2	....	....	....	....	....	....	....
Hemlock, mountain	109	11- 9-56	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
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	20	....	....	....	7	2	3	....	....	1	1	1	2	1	2
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	22	....	....	....	....	....	....	....	....	....	....	....	6	13	3
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	4	....	....	....	....	....	....	....	....	....	1	1	....	1	1
Spruce, Sitka	31	4-15-33	26	26	....	....	4	12	5	5	....	....	....	....	....	....	....	....
Tanoak	76	10- 6-51	25	25	....	....	....	....	....	....	....	....	....	....	....	7	15	3
Yew, Pacific	13	3- 5-29	23	14	....	....	....	2	2	1	....	....	....	1	....	5	1	2

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	57
Alder, red	105	11- 5-52	25	11	....	....	....	....	....	....	....	....	....	....	....	....	9	2
Alder, red	108	11-15-52	25	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
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	5	....	....	....	....	....	....	....	....	....	....	....	1	2	2
Cottonwood, black	77	4- 9-49	25	14	....	....	....	....	....	....	....	....	....	....	4	9	1	....
Cottonwood, black	78	12-28-48	25	25	....	....	....	....	....	....	....	....	....	....	4	20	....	1
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	6	....	....	....	....	....	....	....	....	....	....	....	....	5	1
Douglas fir	81	10- 5-49	23	8	....	....	....	....	....	....	....	....	....	....	....	6	....	2
Douglas fir	92	11-11-49	23	18	....	....	....	....	....	....	....	....	....	....	....	11	4	3
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	14	....	....	....	....	....	....	....	....	....	....	....	....	....	14
Douglas fir	2*	1- 7-28	23	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....
Douglas fir	91	11-19-49	25	4	....	....	....	....	....	....	....	....	....	....	....	....	4	....
Douglas fir	3*	1- 7-28	22	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	4*	1- 7-28	22	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	89	3-24-49	25	13	....	....	....	....	....	....	....	....	....	....	3	4	3	3
Douglas fir	90	4-17-49	25	19	....	....	....	....	....	....	....	....	....	....	3	11	3	2
Douglas fir	5*	3- 6-28	25	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	11	....	....	....	....	....	....	....	....	1	2	....	2	2	4
Douglas fir	25	2- 6-30	25	11	....	....	....	....	....	....	....	....	2	2	....	2	2	3
Douglas fir	59	6- 3-42	12	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	73	12-22-48	25	10	....	....	....	....	....	....	....	....	....	....	....	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	9	....	....	....	....	....	....	....	....	....	....	....	....	8	1
Douglas fir	64	12-18-48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas fir	65	3-20-49	25	13	....	....	....	....	....	....	....	....	....	....	1	3	8	1
Douglas fir	66	3-22-49	25	2	....	....	....	....	....	....	....	....	....	....	....	....	2	....
Douglas fir	67	3-21-49	25	14	....	....	....	....	....	....	....	....	....	....	1	6	4	3
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	18	....	....	....	....	....	....	....	....	....	....	....	....	3	15
Pine, lodgepole	104	11-15-52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	50	11- 1-38	25	18	....	....	....	....	....	....	1	1	1	....	2	5	5	3
Pine, lodgepole	85	11-15-50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	86	11-15-50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, ponderosa	56	12- 6-39	25	5	....	....	....	....	....	....	....	....	1	2	1	....	....	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	57
Douglas fir	52	10–11–39	25	0	....	....	....	....	....	....	....	....	....
Douglas fir	45	5– 1–37	25	2	....	....	....	....	....	....	1	1	....
Douglas fir	43	2–13–37	25	16	1	2	....	1	1	3	....	2	6
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	1	....	....	....	....	....	....	....	....	1
Douglas fir	33	4–15–33	25	15	....	....	....	....	1	3	6	3	2
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. ESTIMATED INCREASE IN SERVICE LIFE OF DOUGLAS FIR POSTS ATTRIBUTED TO PRESERVATIVE TREATMENT

Treatment	Series	Service Life: Estimated* increase	Service Life: Without failure to 1957**
		Years	*Years*
Bore hole			
Salt + $HgCL_2$	2, 91	22†, 4	
Salt + $HgCL_2$ + As_2O_3	3, 4	22†, 22†	
Sodium pentachlorophenate	90	1	
Sodium trichlorophenate	89	2	
Brushing			
Asphalt	39	0	
Carbolineum	92	1	
Copper naphthenate	80	2	
Creosote	81	2	
Pentachlorophenol	79	6	
Charring	22	0	
Double diffusion			
NaF—$CuSO_4$	101	....	5
$CuSO_4$—Na_2CrO_4	102	0	
Hot-cold bath			
Carbolineum	8	6	
Creosote-petroleum	18	12	
Gasco creosote	54	....	18
Osmose			
Bandage	73	4	
Salts	75		8
Soaking			
Pentachlorophenol	62, 64, 66, 94	10, ..., 10, ...	...., 9, ..., 7
Copper naphthenate	63, 65, 67, 93	5, 2, 3	...., ..., ..., 7
Gasco creosote	88, 95		7, 7
Pentachlorophenol	62, 64, 66, 94	10, ..., 10, ...	...., 9, ..., 7
Zinc chloride	12	1	
Tire Tube			
Chemonite	59		15
Treater dust or paste As_2O_3	5, 6, 24, 25	20†, 15, 22, 24	
Pressure processes			
Boliden salts	96, 98		5, 5
Chemonite	45	25	
Chromated zinc chloride	43	15	
Creosote	23, 53		28, 18
Creosote-petroleum	7, 51		29, 18
Gasco creosote	52		18
Tanalith	42	34	
Zinc-meta-arsenite	33	18	

* Estimated increase is based on actual or estimated average service life of a post series minus average service life of untreated post series of the same species. Estimated average service life was determined by the method explained in *Percentage Renewal and Average Service Life of Railway Ties,* Report R886, Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wisconsin.

** No estimate could be made of service life of post series in which no posts have failed.

† Removed before all posts failed.

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
Brooks-Scanlon Lumber Co., Bend, 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