ASSOCIATION OF AMERICAN RAILROADS | RESEARCH AND TEST DEPARTMENT

REPORT BRIEF

DURABILITY OF WOOD CROSSTIES (PHASE 1)

R-702 93)

The durability and longevity of wood crosstie products are well known in the railroad industry. Wood products dominate the crosstie market, today. Yet, there is a lack of basic information on the wood tie strength-age relationship in railroad service.

Due to the relatively long life of the wood tie, service testing of new products is impractical for current purchasing decisions. An accelerated, but realistic testing method is required.

This report discusses the development of an accelerated aging technique for treated timber crossties. This process can be used for quality control in manufacturing or developing treated timber products.

A cyclic accelerated aging technique that is adaptable as a routine quality control method in the manufacturing or developing of wood crosstie products was developed. SIxcyclesof this accelerated aging technique may be equivalent to more than 20 years of natural aging depending on the property used to relate accelerated and natural aging. Ninety-five perCent Confidence intervals of plus and minus three years border this relationship.

Testing of crossties removed from track has been used to calibrate the aging process. These results have also been used to develop strength-age relationships for crossties in one service environment. Several tests were conducted in order to characterize the properties essential to tie performance. Among these are bending stiffness, plate area hardness and stiffness, lateral spike resistance, and vertical spike withdrawal resistance. Of these, bending stiffness and plate area stiffness showed the best correlations to tie age.

The applicability of the accelerated aging process was demonstrated in a comparison test of air-dried, boulton-dried, and vapor-dried ties. Boulton-dried ties appear to be stiffer than air-dried or vapor-dried ties. However, the normalized strength loss rates of the three groups are very similar.

Copies of the MR Report: "Durability of Wood Crossties (Phase 1)", are available from the Document Distribution Center, Chicago Technical Center, 3140 South Federal Street, Chicago, Illinois 60616. The AAF? report number is F7-702: the price is $10.00 for member railroads and $30.00 for nonmembers. The cost includes taxes and surface mail postage if mailed within North America. There will be a surcharge for any overseas mail. Checks should be made payable to the Association of American Railroads. This report was issued in October,1987. A report list is available upon request.

Exhibit 1.10. Artificial Accelerated Aging Cycle

Six-Cycle Aging Schedule	
Condition	Exposure Period
Vacuum (25 inches) in water	30 minutes
Pressure (170 psi) in water	30 minutes
Freezing (0 F)	3 hours
Steaming(250 F, 15 psi)	30 minute warm-up + 10 hours
Oven Drying (220 F)	9.5 hours
Conditioning (70 F and 50-60% R.H.)	24 hours

2.0 TIE STRENGTH TEST RESULTS

The results of mechanical strength tests of ties removed from track are given below. These tests characterize the performance capabilities of ties in track at typical mainline sites. Comparison with new tie strengths provided strength deterioration-age-tonnage relationships for various locations.

Exhibit 2.17. Mechanical Test Results for Artificially Aged Ties

TEST: COMPRESSION (PSI)								
TIE GROUP	NUMBER OF TIES	NUMBER OF AGING CYCLES						
		0	1	2	3	4	5	6
AIR	28	38842	30362	22469	19467	17005	15826	14616
		100	78	58	50	44	41	38
BOULTON	38	34898	28424	23276	18276	16540	14623	13484
		100	81	67	52	47	42	39
VAPOR	18	30770	23172	19295	16293	14188	12680	11660
		100	75	63	53	46	41	38
ALL:AVERAGE VALUE		35328	27945	22154	18248	16191	14607	13471
PERCENT OF NEW		100	79	63	52	46	41	38

TEST: HARDNESS (LOS)								
TIE GROUP	NUMBER OF TIES	NUMBER OF AGING CYCLES						
		0	1	2	3	4	5	6
AIR	28	4712	3375	2365	2101	1595	1469	1385
		100	72	50	45	34	31	29
BOULTON	38	3978	2958	2380	1944	1772	1439	1295
		100	74	60	49	45	36	33
VAPOR	18	3989	2762	2220	1859	1349	1301	1181
		100	69	56	47	34	33	30
ALL:AVERAGE VALUE		4225	3055	2341	1978	1622	1420	1300
PERCENT OF NEW		100	72	55	47	38	34	31

TEST: SPIKE TEST (LBS)		DRIVE-IN		WITHDRAWAL		LATERAL	
TIE GROUP	NUMBER OF TIES	NUMBER OF AGING CYCLES					
		0	6	0	6	0	6
AIR	28	10660	3940	8538	1910	3460	1860
		100	37	100	22	100	49
BOULTON	38	8729	3588	7900	1332	3063	1143
		100	41	100	17	100	37
VAPOR	18	8735	3460	7405	1015	2660	860
		100	40	100	14	100	32
ALL:AVERAGE VALUE		9299	3654	7942	1409	3061	1218
PERCENT OF NEW		100	39	100	18	100	40

Exhibit 4.1. Strength Specifications of New Crossties

Species	Compressive MOE		Face Hardness		Modulus of Rupture	
	Sample Size	Mean (Std. Dev.)	Sample Size	Mean (Std. Dev.)	Sample Size	Mean (Std. Dev)
Oaks	71	34,725 (8,082)	70	4,284 (1,136)	52	7,809 (1,191)
	Max	52,220	Max	8,220	Max	10,340
	Min	17,583	Min	2,755	Min	5,300
Hem-Fir	- 20	26,626 (6,189)	20	2,051 (550)	20	5,051 (1,269)
	Max	39,621	Max	3,387	Max	7,709
	Min	15,142	Min	1,137	Min	3,293
Pines	46	25,418 (8,822)	46	2,072 (568)	40	5,123 (1,365)
	Max	44,078	Max	3,807	Max	7,197
	Min	6,229	Min	1,227	Min	2,418

Species	Spike Drive-in Load		Spike Lateral Resistance		Spike Withdrawal	
	Sample Size	Mean (Std. Dev.)	Sample Size	Mean (Std. Dev.)	Sample Size	Mean (Std. Day)
Oaks	49	8,977 (1,402)	49	3,097 (481)	49	8,200 (1,035)
	Max	12,400	Max	4,355	Max	10,940
	Min	6,640	Min	2,090	Min	6,230
Hem-Fir	19	5,741 (1,233)	19	2,479 (612)	19	3,273 (949)
	Max	9,154	Max	3,444	Max	5,356
	Min	4,326	Min	1,071	Min	1,865
Pines	46	4,193 (1,056)	46	2,145 (565)	46	2,714 (1,132)
	Max	7,095	Max	3,292	Max	6,380
	Min	2,520	Min	1,270	Min	796

Note: MOE and MOR are in psi while all others are expressed in pounds.

Max = Maximum
MTh = Minimum