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November 23, 1995

TO: Larry Swan, Winema National
Forest, Klamath Falls, OR

FROM: Mike Milota, OSU, Corvallis, OR

RE: Report on presteaming of juniper

We have completed the work to compare the effect of presteaming on the warp observed in juniper when it is ripped. The bundles of wood received were sorted into two similar groups. One group was then stacked and presteamed at 200°F and approximately a 2 to 3°F wet-bulb depression for 22 hours prior to drying. Each group was then dried according to the following schedule:

Time, hr	Dry-bulb	Wet-bulb	
0-24	130	125	
24-48	140	125	
48-72	150	125	
72-96	155	135	
96-104	160	135	
104-106	off	off	cool down
106-130	160	155	conditioning

The wood was allowed to cool with weights on top prior to unstacking (The load had been top-weighted with 48 lbs/ft² of concrete.) A third group of 25 boards would not fit into the kiln and were air dried in the lab. These formed a third test group.

From each group, 100 boards (22 for the air dried group) were selected to be resawed. The selection criterion was simply whether the boards looked like they could be ripped without breaking into pieces due to knots. The crook in each piece was measured on the best edge. A concave crook on this edge was recorded as positive and a convex crook was recorded as negative.

A 2.5"-wide strip was ripped off the best edge of each of the selected boards. The warp was remeasured on this 2.5" strip using the same system for positive and negative crook. Thus, the same edge was measured before and after ripping.

The results of these measurements are attached to this memo and summarized below. Presteaming appeared to have no significant effect on the warp that occurred during ripping. The presteaming done in this study was probably more severe than that which could be done in a commercial kiln. Therefore, no further presteaming experiments are recommended. One encouraging point to this data is that air dried stock was no more prone to warp than kiln dried stock.

All values in inches	Warp Before Cut		Warp After Cut		Change in Warp		Absolute Value of Change	
	Ave	SD	Avg	SD	Avg	SD	Avg	SD
Presteamed	0.01	0.67	-0.42	1.08	-0.42	1.01	0.75	0.80
Not Presteamed	-0.19	0.59	-0.18	0.79	0.02	0.64	0.45	0.45
Air Dried	-0.08	0.56	-0.09	0.84	-0.01	0.63	0.44	0.45

The kiln dried lumber was picked up by Bill Breedlove in early November and taken to Rainier Wood Products. We labeled the presteamed material as "A" and the material that was not presteamed as "B". The air dried material was not sent.

Sincerely,

Michael R. Milota
Associate Professor

07-12-00

PreSteamed (A)

Sample	Warp before cut, cm		Warp after cut, cm			Dif	Abs Dif	Broke
	-- Warp -	Avg. Warp	-- Warp -	Avg. Warp				
1	0.5		0.5					1
2	0.5		0.5					1
3	-0.5	-1	-0.65	-1.2	-2.5	-1.85	-1.2	1.2
4	1.3		1.3	2		2	0.7	0.7
5	-1.1	-1	-1	-1.2	-1.9	-1.55	-0.55	0.55
6	-0.2	-1	-0.4	-0.4	-0.8	-0.6	-0.2	0.2
7	-0.3	-1	-0.4	-1.1	-1.7	-1.4	-1	1
8	0		0	-2.5	-2.1	-2.3	-2.3	2.3
9	0.5		0.5	-1.1	-1	-1.05	-1.55	1.55
10	-0.8	-0	-0.55	-2.7	-1.6	-2.15	-1.6	1.6
11	0		0	-0.9	-1.8	-1.35	-1.35	1.35
12	-1	-1	-1.1	-1.7	-3.2	-2.45	-1.35	1.35
13	0		0	-0.8	-0.9	-0.85	-0.85	0.85
14	0		0	-1.2	-1.9	-1.55	-1.55	1.55
15	0.5		0.5	-2	-1.3	-1.65	-2.15	2.15
16	0.6		0.6	-0.6	-2	-1.3	-1.9	1.9
17	-0.3	-1	-0.6	-1.8	-1.5	-1.65	-1.05	1.05
18	0.5		0.5	-0.9	-2.6	-1.75	-2.25	2.25
19	0		0	0		0	0	0
20	0.4		0.4	-1.2	-1.5	-1.35	-1.75	1.75
21	-0.5	-0	-0.45	-1.9	-1.2	-1.55	-1.1	1.1
22	0		0	-0.7	-0.9	-0.8	-0.8	0.8
23	0		0	-1	-1.8	-1.4	-1.4	1.4
24	0		0	-1.1	-1.1	-1.1	-1.1	1.1
25	0		0	-0.4	-0.6	-0.5	-0.5	0.5
26	0		0	-0.5	-1.2	-0.85	-0.85	0.85
27	0.3		0.3	0.8		0.8	0.5	0.5
28	0.3		0.3	1		1	0.7	0.7
29	0		0	-1.5	-0.9	-1.2	-1.2	1.2
30	-0.7	-0	-0.5	-0.4	-1.1	-0.75	-0.25	0.25
31	0		0	-0.3	-0.6	-0.45	-0.45	0.45
32	0		0	0		0	0	0
33	0.3		0.3	0.3		0.3	0	0
34	0		0	0		0	0	0
35	0		0	0.5		0.5	0.5	0.5
36	0.5		0.5	0		0	-0.5	0.5
37	0.4		0.4	0		0	-0.4	0.4
38	0		0	-0.6	-0.7	-0.65	-0.65	0.65
39	-0.3	-0	-0.25	0		0	0.25	0.25
40	0.5		0.5	-0.2	-1.3	-0.75	-1.25	1.25
41	-0.9	-1	-0.7	-1.2	-0.5	-0.85	-0.15	0.15
42	0		0	-0.7	-0.3	-0.5	-0.5	0.5
43	0		0	0.6		0.6	0.6	0.6
44	0.5		0.5	0.7		0.7	0.2	0.2
45	-0.5	-1	-0.7	-1.5	-1.3	-1.4	-0.7	0.7
46	0.7		0.7	-0.7	-0.6	-0.65	-1.35	1.35
47	0		0	-0.9	-0.9	-0.9	-0.9	0.9
48	0		0	0.3		0.3	0.3	0.3
49	0.3		0.3	0.3		0.3	0	0
50	0.6		0.6	-9	-0.7	-4.85	-5.45	5.45
51	0		0	0		0	0	0
52	0		0	0.2		0.2	0.2	0.2

53	-0.3	-0	-0.3	-1.5	-1.4	-1.45	-1.15	1.15	
54	0		0	0		0	0	0	
55	1.7		1.7	0.7		0.7	-1	1	
56	-0.7	-1	-0.65	-0.3	-0.7	-0.5	0.15	0.15	
57	0		0	-0.4	-0.5	-0.45	-0.45	0.45	
58	0.9		0.9	0.4		0.4	-0.5	0.5	
59	0.3		0.3	-1.2	-2.5	-1.85	-2.15	2.15	
60	0.5		0.5	-1.1	-0.9	-1	-1.5	1.5	
61	1.1		1.1	-0.2	-0.5	-0.35	-1.45	1.45	
62	0.9		0.9	1.9		1.9	1	1	
63	-1.4	-2	-1.65	-1.2	-2.1	-1.65	0	0	
64	-0.3	-1	-0.5	-0.4	-0.8	-0.6	-0.1	0.1	
65	-0.3	-1	-0.5	-0.3	-0.7	-0.5	0	0	
66	0		0	0		0	0	0	
67	0		0	-0.4	-0.2	-0.3	-0.3	0.3	
68	-0.2	-1	-0.4	-0.4	-0.7	-0.55	-0.15	0.15	
69	0		0	0		0	0	0	
70	0		0	0.4		0.4	0.4	0.4	
71	0.6		0.6						1
72	-0.7	-0	-0.45	-0.3	-0.8	-0.55	-0.1	0.1	
73	0.9		0.9	-0.3	-0.3	-0.3	-1.2	1.2	
74	-1.1	-1	-1	1.2		1.2	2.2	2.2	
75	0.6		0.6	0.8		0.8	0.2	0.2	
76	0.8		0.8	1.2		1.2	0.4	0.4	
77	-0.7	-1	-0.6	1.1		1.1	1.7	1.7	
78	-1.5	-2	-1.75	-1.5	-1.4	-1.45	0.3	0.3	
79	0.8		0.8	-1.7	-0.9	-1.3	-2.1	2.1	
80	-1.5	-2	-1.7						1
81	0		0	0.4		0.4	0.4	0.4	
82	1		1	1.1		1.1	0.1	0.1	
83	0.6		0.6	1.3		1.3	0.7	0.7	
84	-0.2	-1	-0.35	0		0	0.35	0.35	
85	1.5		1.5	1.4		1.4	-0.1	0.1	
86	-0.6	-0	-0.5	-0.2	-0.3	-0.25	0.25	0.25	
87	-0.3	-1	-0.7	0.7		0.7	1.4	1.4	
88	0.6		0.6						1
89	0.7		0.7	0.8		0.8	0.1	0.1	
90	-0.5	-2	-1	-0.2	-0.9	-0.55	0.45	0.45	
91	-0.4	-1	-0.45	-0.4	-1.5	-0.95	-0.5	0.5	
92	0		0	0.5		0.5	0.5	0.5	
93	-1.6	-2	-1.65	-1.8	-2	-1.9	-0.25	0.25	
94	1.6		1.6	1.8		1.8	0.2	0.2	
95	0.5		0.5	0.4		0.4	-0.1	0.1	
96	-0.8	-1	-0.8	-0.3	-1.1	-0.7	0.1	0.1	
97	-0.7	-1	-1	-0.9	-0.5	-0.7	0.3	0.3	
98	-0.3	-0	-0.35						1
99	-0.5	-1	-0.5	-0.6	-0.8	-0.7	-0.2	0.2	
100	0		0	0.6		0.6	0.6	0.6	
Ave			0.01			-0.42	-0.42	0.75	6
Std.			0.667752			1.084907	1.011	0.8	

Not presteamed (B)

Sample	Warp before cut, cm			Warp after cut, cm			Dif	Abs Dif	Broke
	-- Warp -	Avg. Warp		-- Warp -	Avg. Warp				
1	-0.5	-1	-0.55	0	0	0	0.55	0.55	
2	-0.7	-1	-0.65	0	0	0	0.65	0.65	
3	0		0	-0.6	-0.8	-0.7	-0.7	0.7	
4	-0.9	-0	-0.65	-1.9	-1.2	-1.55	-0.9	0.9	
5	-0.6	-1	-0.55	0.4		0.4	0.95	0.95	
6	-1.1	-0	-0.75	-1.3	-0.5	-0.9	-0.15	0.15	
7	0		0	-0.4	-0.6	-0.5	-0.5	0.5	
8	-0.4	-0	-0.4	0		0	0.4	0.4	
9	-0.4	-0	-0.35	0		0	0.35	0.35	
10	0		0	0		0	0	0	
11	0		0	0		0	0	0	
12	0.7		0.7	0.9		0.9	0.2	0.2	
13	0		0	0		0	0	0	
14	0		0	0		0	0	0	
15	-0.3	-0	-0.3	0.3		0.3	0.6	0.6	
16	0		0	0		0	0	0	
17	0.3		0.3	0.4		0.4	0.1	0.1	
18	0		0	-0.9	-1.8	-1.35	-1.35	1.35	
19	-0.6	-1	-0.55	-0.5	-0.6	-0.55	0	0	
20	-1.8	-1	-1.2	0.3		0.3	1.5	1.5	
21	-1.7	-2	-1.75	-0.5	-1.5	-1	0.75	0.75	
22	0.3		0.3	-0.7	-0.6	-0.65	-0.95	0.95	
23	-1.1	-1	-1.15	-0.5	-0.9	-0.7	0.45	0.45	
24	-1.1	-2	-1.35	-1.1	-1.3	-1.2	0.15	0.15	
25	-0.4	-0	-0.35	0		0	0.35	0.35	
26	-0.6	-1	-0.65	-0.4	-0.5	-0.45	0.2	0.2	
27	0		0	0		0	0	0	
28	-1.4	-2	-1.45	-0.9	-1	-0.95	0.5	0.5	
29	-0.2	-1	-0.55	-0.3	-0.9	-0.6	-0.05	0.05	
30	-0.9	-1	-0.95						1
31	0		0	-1.5	-0.6	-1.05	-1.05	1.05	
32	0		0	-0.9	-0.8	-0.85	-0.85	0.85	
33	0.5		0.5	2.2		2.2	1.7	1.7	
34	0		0	1.5		1.5	1.5	1.5	
35	0		0	0.5		0.5	0.5	0.5	
36	0		0	0		0	0	0	
37	-0.6	-1	-0.75	0		0	0.75	0.75	
38	0		0	0.7		0.7	0.7	0.7	
39	0		0	0		0	0	0	
40	0.5		0.5						1
41	-0.4	-1	-0.65	-0.8	-0.4	-0.6	0.05	0.05	
42	-1.7	-1	-1.5	-0.8	-0.6	-0.7	0.8	0.8	
43	-1	-1	-0.9	-1.1	-0.5	-0.8	0.1	0.1	
44	-0.5	-0	-0.45	-0.9	-0.5	-0.7	-0.25	0.25	
45	0.3		0.3	0	-0.5	-0.25	-0.55	0.55	
46	0		0	0		0	0	0	
47	0		0	-0.4	-0.2	-0.3	-0.3	0.3	
48	0		0	-0.2	-0.4	-0.3	-0.3	0.3	
49	0		0	0		0	0	0	
50	0		0	0		0	0	0	
51	0		0	-0.3	-0.2	-0.25	-0.25	0.25	
52	0		0	0		0	0	0	

53	0		0	0	0	0	0	0	
54	0		0	0	0	0	0	0	
55	0		0	-0.7	-0.4	-0.55	-0.55	0.55	1
56	0		0						
57	0		0	-0.9	-1.3	-1.1	-1.1	1.1	
58	0		0	0		0	0	0	
59	-0.4	-1	-0.45	-0.4	-0.7	-0.55	-0.1	0.1	
60	0		0	-1.1	-1.2	-1.15	-1.15	1.15	
61	0		0	-0.7	-0.5	-0.6	-0.6	0.6	
62	-1.4	-1	-1.05	-1.6	-1	-1.3	-0.25	0.25	
63	-0.3	-1	-0.45	-0.8	-1.1	-0.95	-0.5	0.5	
64	-0.4	-0	-0.4	-0.4	-0.4	-0.4	0	0	
65	-0.3	-0	-0.3	-0.3	-0.3	-0.3	0	0	
66	0		0	0		0	0	0	
67	0.7		0.7	0		0	-0.7	0.7	
68	0		0	0		0	0	0	
69	0.5		0.5	-0.7	-0.1	-0.4	-0.9	0.9	
70	0		0	-0.2	-0.5	-0.35	-0.35	0.35	
71	0		0	-0.1	-0.3	-0.2	-0.2	0.2	
72	-0.5	-1	-0.5	0.6		0.6	1.1	1.1	
73	0.9		0.9	0.8		0.8	-0.1	0.1	
74	-1.1	-1	-0.85	-0.1	-0.4	-0.27	0.58	0.58	
75	-0.7	-1	-0.65	-0.6	-0.6	-0.6	0.05	0.05	
76	-0.5	-1	-0.65	-1.8	-2.3	-2.05	-1.4	1.4	
77	0		0	0		0	0	0	
78	0.5		0.5	0.5		0.5	0	0	
79	-0.4	-1	-0.55	-0.4	-0.8	-0.6	-0.05	0.05	
80	0.5		0.5	0		0	-0.5	0.5	
81	0		0	0.6		0.6	0.6	0.6	
82	0.7		0.7	0		0	-0.7	0.7	
83	0.7		0.7						1
84	-1	-1	-0.8	-0.9	-0.3	-0.6	0.2	0.2	
85	-0.6	-1	-0.8	-0.4	-0.4	-0.4	0.4	0.4	
86	-1	-1	-0.95	-0.6	-2.2	-1.4	-0.45	0.45	
87	-0.5	-0	-0.45						1
88	0		0	-1.2	-1.3	-1.25	-1.25	1.25	
89	0		0	-0.8	-0.6	-0.7	-0.7	0.7	
90	0		0	0		0	0	0	
91	-1.6	-1	-1.25	-1.6	-1	-1.3	-0.05	0.05	
92	0		0	-0.5	-0.5	-0.5	-0.5	0.5	
93	0		0						
94	-0.4	-1	-0.65	0.4		0.4	1.05	1.05	
95	2.3		2.3	3.1		3.1	0.8	0.8	
96	1		1	1.6		1.6	0.6	0.6	
97	0.5		0.5	1.7		1.7	1.2	1.2	
98	0		0	0		0	0	0	
99	-0.5	-1	-0.5	-0.3	-0.2	-0.25	0.25	0.25	
100	0		0	1.6		1.6	1.6	1.6	
Average			-0.19			-0.18	0.02	0.45	5
Std. Dev.			0.585208			0.790953	0.636	0.45	

Air Dried (C)

Sample	Warp before cut, cm			Warp after cut, cm			Abs		Broke
	-- Warp -		Avg. Warp	-- Warp -		Avg. Warp	Dif	Dif	
1	-0.3	-0	-0.35	0		0	0.35	0.35	
2	0		0	-0.5	0	-0.25	-0.25	0.25	
3	-0.7	-0	-0.55	-0.1	-0.7	-0.4	0.15	0.15	
4	-0.5	-0	-0.45	0		0	0.45	0.45	
5	0.8		0.8	-0.6	-0.4	-0.5	-1.3	1.3	
6	-0.5	-1	-0.6	-0.4	-0.7	-0.55	0.05	0.05	
7	0.4		0.4	-1.9	-1.1	-1.5	-1.9	1.9	
8	0		0	0.6		0.6	0.6	0.6	
9	0		0	-1.5	-1.2	-1.35	-1.35	1.35	
10	-0.6	-1	-0.55	-1	-0.9	-0.95	-0.4	0.4	
12	0		0	1.3		1.3	1.3	1.3	
13	0		0	-1.3	-1.4	-1.35	-1.35	1.35	
14	-0.9	-1	-0.85	-0.8	-2.5	-1.65	-0.8	0.8	
15	0		0	0.6		0.6	0.6	0.6	
16	0.4		0.4						1
17	0		0	-3.1	-2.4	-2.75	-2.75	2.75	
18	-0.4	-1	-0.5	-0.9	-0.5	-0.7	-0.2	0.2	
19	-0.2	-1	-0.4	-0.2	-0.6	-0.4	0	0	
20	-0.8	-0	-0.55	-1.3	-1.1	-1.2	-0.65	0.65	
21	0.9		0.9	-0.8	0	-0.4	-1.3	1.3	
22	-0.9	-1	-0.85	1.2		1.2	2.05	2.05	
Average			-0.08			-0.09	0.01	0.44	1
Std. Dev.			0.560528			0.844784	0.635	0.45	