Glulam Layup Combinations

APA

THE TABLES IN THIS SUPPLEMENT REPRESENT THE FULL OFFERING OF *APA EWS* LAYUP COMBINATIONS.
They are provided as a guide to manufacturers who produce beams in these combinations.

TABLE S-1

GRADE REQUIREMENTS FOR MEMBERS STRESSED PRIMARILY IN BENDING (MIXED GRADES)[1,2]

				Minimum Grade of Laminations[4,5,6,7] Percent/Grade/Species Each Zone[8]		
Combination Symbol	Balanced/ Unbalanced	Depth of Member	Tension Lam[3]	Outer Tension Zone	Inner Tension Zone	Core
1	2	3	4	5	6	7
Western Species (WS)						
EWS 16F-V3/WS	U	< 12 in.	–	10%L2/DF[10]	–	L3/DF
		12 to 15 in.	–	10%L2/DF[10]	–	L3/DF
		> 15 in.	–	5%L1/DF[10]	5%L2/DF	L3/DF
EWS 20F-E/ES1	B	4 lams	–	5%1.9E/ES	–	B/ES
		5 lams to 10-1/2 in.	–	25%1.9E/ES	10%C4/ES	D/ES
		12 to 15 in.	–	25%1.9E/ES	10%C4/ES	D/ES
EWS 20F-E/SPF1[11]	B	7-1/2 in.	–	1-B/SPF	1-C4/SPF	6-D/SPF
		9 in.	–	1-B/SPF	1-C4/SPF	8-D/SPF
		9-1/2 in.	–	2-B/SPF	1-C4/SPF	7-D/SPF
		11-7/8 in.	–	2-B/SPF	2-C4/SPF	8-D/SPF
		14 in.	–	3-B/SPF	2-C4/SPF	9-D/SPF
EWS 20F-E8/WS	U	< 12 in.	302-20	10%B/ES	15%C4/ES	D/ES
		12 to 13-1/2 in.	302-22	10%B/ES	15%C4/ES	D/ES
		> 13-1/2 to 19-1/2 in.	302-22	20%B/ES	10%C4/ES	D/ES
		> 19-1/2 to 24 in.	302-24	15%B/ES	10%C4/ES	D/ES
		> 24 in.	302-24	15%B/ES	10%C4/ES	D/ES
EWS 20F-E8M1/WS	B	< 12 in.	302-20	10%B/ES	15%C4/ES	D/ES
		12 to 13-1/2 in.	302-22	10%B/ES	15%C4/ES	D/ES
		> 13-1/2 to 19-1/2 in.	302-22	20%B/ES	10%C4/ES	D/ES
		> 19-1/2 to 24 in.	302-24	15%B/ES	10%C4/ES	D/ES
		> 24 in.	302-24	15%B/ES	10%C4/ES	D/ES
EWS 20F-V4/WS	U	< 12 in.	–	15%L1CL/DF[10]	15%L2/DF	L3/DF
		12 to 15 in.	–	20%L1CL/DF[10]	25%L2/DF	L3/DF
		< 12 in.	302-20	10%L1CL/DF[10]	–	L3/DF
		12 to 15 in.	302-20	10%L1CL/DF[10]	–	L3/DF
		> 15 in.	302-22	5%L1CL/DF[10]	10%L2/DF	L3/DF
EWS 20F-V8/WS	B	< 12 in.	–	15%L1CL/DF[10]	20%L2/DF	L3/DF
		12 to 15 in.	–	15%L1CL/DF[10]	20%L2/DF	L3/DF
		< 12 in.	302-20	10%L1CL/DF[10]	–	L3/DF
		12 to 15 in.	302-20	10%L1CL/DF[10]	–	L3/DF
		> 15 in.	302-22	5%L1CL/DF[10]	5%L2/DF	L3/DF
EWS 20F-V12/WS	U	< 12 in.	302-20	15%L1D/AYC	10%L2/AYC	L3/AYC
		12 to 15 in.	302-22	15%L1D/AYC	10%L2/AYC	L3/AYC
		> 15 in.	302-24	10%L1S/AYC	10%L1D/AYC	L3/AYC
EWS 20F-V13/WS	B	< 12 in.	302-20	15%L1D/AYC	10%L2/AYC	L3/AYC
		12 to 15 in.	302-22	15%L1D/AYC	10%L2/AYC	L3/AYC
		> 15 in.	302-24	10%L1S/AYC	10%L1D/AYC	L3/AYC
EWS 22F-V/POC1	B	4 lams to < 12 in.	302-20	20%L1/POC[12]	–	L2/POC
		12 to 15 in.	302-20	20%L1/POC[12]	–	L2/POC
		> 15 in.	302-22	20%L1/POC[12]	–	L2/POC
EWS 22F-V/POC2	U	4 lams to < 12 in.	302-20	20%L1/POC[12]	–	L2/POC
		12 to 15 in.	302-20	25%L1/POC[12]	–	L2/POC
		> 15 in.	302-22	25%L1/POC[12]	–	L2/POC
EWS 24F-E/CSP1	B	≤ 10-1/2 in.	Special	20%2.0E/CSP	5%1.8E/CSP	1.4E/CSP
		> 10-1/2 in.	rules[13]	5%2.0E/CSP	10%1.8E/CSP	1.4E/CSP

Footnotes on page 12.

Minimum Grade of Laminations[4,5,6,7]						
Percent/Grade/Species Each Zone[8]		Edge Knot/Slope-of-grain[9]				
Inner Comp. Zone	Outer Comp. Zone	Outer Tension Zone	Inner Tension Zone	Core	Inner Comp. Zone	Outer Comp. Zone
8	9	10	11	12	13	14
–	L3/DF[10]	–	–	–	–	–
–	L3/DF[10]	–	–	–	–	–
–	L3/DF[10]	–	–	–	–	–
–	5%1.9E/ES	1/6	–	–	–	1/6
10%C4/ES	25%1.9E/ES	1/6	–	–	–	1/6
10%C4/ES	25%1.9E/ES	1/6	–	–	–	1/6
1-C4/SPF	1-B/SPF	–	–	–	–	–
1-C4/SPF	1-B/SPF	–	–	–	–	–
1-C4/SPF	2-B/SPF	–	–	–	–	–
2-C4/SPF	2-B/SPF	–	–	–	–	–
2-C4/SPF	3-B/SPF	–	–	–	–	–
15%D4/ES	10%C6/ES	–	–	–	–	–
15%D4/ES	10%C6/ES	–	–	–	–	–
10%D4/ES	15%C6/ES	–	–	–	–	–
15%D4/ES	10%C6/ES	–	–	–	–	–
10%D4/ES	15%C6/ES	–	–	–	–	–
15%C4/ES	10%B/ES	–	–	–	–	–
15%C4/ES	10%B/ES	–	–	–	–	–
10%C4/ES	20%B/ES	–	–	–	–	–
10%C4/ES	15%B/ES	–	–	–	–	–
10%C4/ES	15%B/ES	–	–	–	–	–
5%L2/DF	10%L2/DF[10]	10% 1:14	–	–	–	–
10%L2/DF	10%L2D/DF	10% 1:14	–	–	–	–
–	10%L2/DF[10]	–	–	–	–	–
–	10%L2/DF[10]	–	–	–	–	–
–	5%L2/DF[10]	5% 1:14	–	–	–	–
20%L2/DF	15%L1CL/DF[10]	10% 1:14	–	–	–	10% 1:14
20%L2/DF	15%L1CL/DF[10]	10% 1:14	–	–	–	10% 1:14
–	10%L1CL/DF[10]	–	–	–	–	–
–	10%L1CL/DF[10]	–	–	–	–	–
5%L2/DF	5%L1CL/DF[10]	–	–	–	–	–
15%L2/AYC	10%L1D/AYC	–	–	–	–	–
15%L2/AYC	10%L1D/AYC	–	–	–	–	–
10%L2/AYC	10%L1D/AYC	5% 1:16	–	–	–	–
10%L2/AYC	15%L1D/AYC	–	–	–	–	–
10%L2/AYC	15%L1D/AYC	–	–	–	–	–
10%L1D/AYC	10%L1S/AYC	5% 1:16	–	–	–	5% 1:16
–	20%L1/POC[12]	5% 1:16	–	–	–	5% 1:16
–	20%L1/POC[12]	5% 1:16	–	–	–	5% 1:16
–	20%L1/POC[12]	5% 1:16	–	–	–	5% 1:16
–	10%L1/POC[12]	5% 1:16	–	–	–	–
–	10%L1/POC[12]	5% 1:16	–	–	–	–
–	10%L1/POC[12]	5% 1:16	–	–	–	–
5%1.8E/CSP	20%2.0E/CSP	1/6	1/3	1/2	1/3	1/6
10%1.8E/CSP	5%2.0E/CSP	1/6	1/3	1/2	1/3	1/6

TABLE S-1 (Continued)

GRADE REQUIREMENTS FOR MEMBERS STRESSED PRIMARILY IN BENDING (MIXED GRADES)[1,2]

Combination Symbol	Balanced/ Unbalanced	Depth of Member	Tension Lam[3]	Minimum Grade of Laminations[4,5,6,7] Percent/Grade/Species Each Zone[8] Outer Tension Zone	Inner Tension Zone	Core
1	2	3	4	5	6	7
Western Species (WS)						
EWS 24F-E/CSP2	B	≤ 12 in. >12 in.	Special rules[13]	20%2.0E/CSP 20%2.0E/CSP	10%1.8E/CSP 10%1.8E/CSP	1.4E/CSP 1.4E/CSP
EWS 24F-E/CSP3	U	≤ 10-1/2 in. >10-1/2 in.	Special rules[13]	20%2.0E/CSP 5%2.0E/CSP	5%1.8E/CSP 10%1.8E/CSP	1.4E/CSP 1.4E/CSP
EWS 24F-E/CSP4	U	≤ 12 in. >12 in.	Special rules[13]	20%2.0E/CSP 20%2.0E/CSP	10%1.8E/CSP 10%1.8E/CSP	1.4E/CSP 1.4E/CSP
EWS 24F-E/SPF1	B	≤ 10-1/2 in. >10-1/2 in.	Special rules[13]	20%2.0E/SPF 5%2.0E/SPF	5%1.8E/SPF 10%1.8E/SPF	1.4E/SPF 1.4E/SPF
EWS 24F-E/SPF2	B	≤ 12 in. >12 in.	Special rules[13]	20%2.0E/SPF 20%2.0E/SPF	10%1.8E/SPF 10%1.8E/SPF	1.4E/SPF 1.4E/SPF
EWS 24F-E/SPF3	U	≤ 10-1/2 in. >10-1/2 in.	Special rules[13]	20%2.0E/SPF 5%2.0E/SPF	5%1.8E/SPF 10%1.8E/SPF	1.4E/SPF 1.4E/SPF
EWS 24F-E/SPF4	U	≤ 12 in. >12 in.	Special rules[13]	20%2.0E/SPF 20%2.0E/SPF	10%1.8E/SPF 10%1.8E/SPF	1.4E/SPF 1.4E/SPF
EWS 24F-E/ES1	U	4 lams 5 lams to 10-1/2 in. 12 to 15 in. > 15 in.	302-20 302-20 302-22 302-24	5%1.9E/ES 25%1.9E/ES 25%1.9E/ES 25%1.9E/ES	– 10%C4/ES 10%C4/ES 10%C4/ES	B/ES D/ES D/ES D/ES
EWS 24F-E/ES1M1	B	4 lams 5 lams to 10-1/2 in. 12 to 15 in. > 15 in.	302-20 302-20 302-22 302-24	5%1.9E/ES 25%1.9E/ES 25%1.9E/ES 25%1.9E/ES	– 10%C4/ES 10%C4/ES 10%C4/ES	B/ES D/ES D/ES D/ES
EWS 24F-E15M1/WS	U	< 12 in. 12 to 15 in. > 15 in.	302-20[14] 302-22[14] 302-24	10%2.1E/HF 10%2.1E/HF 10%2.1E/HF	10%1.9E/HF 10%1.9E/HF 10%1.9E/HF	L3/HF L3/HF L3/HF
EWS 24F-V4/WS	U	< 12 in. 12 to 15 in. > 15 in. < 12 in. 12 to 15 in. > 15 in.	302-20 302-22 302-24 302-20 302-22 302-24	15%L1/DF 15%L1/DF 10%L1/DF 15%L1/DF 15%L1/DF 10%L1/DF	15%L2/DF 15%L2/DF 10%L2/DF 15%L2/DF 15%L2/DF 10%L2/DF	L3/DF L3/DF L3/DF L3/DF L3/DF L3/DF
EWS 24F-V4M1/WS[15]	U	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-22 302-24	15%L1/DF 10%L1/DF	15%L2/DF 10%L2/DF	L3/DF L3/DF
EWS 24F-V4M2/WS[16]	U	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-22 302-24	15%L1/DF 10%L1/DF	15%L2/DF 10%L2/DF	L3/DF L3/DF
EWS 24F-V5/WS	U	< 12 in. 12 to 15 in. > 15 in.	302-20 302-22 302-24	20%L1/DF 20%L1/DF 15%L1/DF	20%L1/HF 20%L1/HF 20%L1/HF	L3/HF L3/HF L3/HF
EWS 24F-V5M1/WS	U	4 lams 5 lams to < 12 in. 12 to 15 in. > 15 in.	302-20 302-20 302-22 302-24	30%L1/DF 10%L1/DF 15%L1/DF 15%L1/DF	– 10%1.8E/SPF or 10%L2/DF 10%1.8E/SPF or 10%L2/DF 10%1.8E/SPF or 10%L2/DF	1.4E/SPF 1.4E/SPF 1.4E/SPF 1.4E/SPF
EWS 24F-V5M2/WS	U	< 12 in. 12 to 15 in. > 15 to 27 in.	302-20 302-22 302-24	20%L1/DF 20%L1/DF 15%L1/DF	20%L1/HF 20%L1/HF 20%L1/HF	L3/HF L3/HF L3/HF

Footnotes on page 12.

Minimum Grade of Laminations[4,5,6,7]						
Percent/Grade/Species Each Zone[8]		Edge Knot/Slope-of-grain[9]				
Inner Comp. Zone	Outer Comp. Zone	Outer Tension Zone	Inner Tension Zone	Core	Inner Comp. Zone	Outer Comp. Zone
8	9	10	11	12	13	14
10%1.8E/CSP	20%2.0E/CSP	1/6	1/3	1/2	1/3	1/6
10%1.8E/CSP	20%2.0E/CSP	1/6	1/3	1/2	1/3	1/6
5%1.8E/CSP	20%L2D/DF	1/6	1/3	1/2	1/3	–
10%1.8E/CSP	5%L2D/DF	1/6	1/3	1/2	1/3	–
10%1.8E/CSP	20%L2D/DF	1/6	1/3	1/2	1/3	–
10%1.8E/CSP	20%L2D/DF	1/6	1/3	1/2	1/3	–
5%1.8E/SPF	20%2.0E/SPF	1/6	1/3	1/2	1/3	1/6
10%1.8E/SPF	5%2.0E/SPF	1/6	1/3	1/2	1/3	1/6
10%1.8E/SPF	20%2.0E/SPF	1/6	1/3	1/2	1/3	1/6
10%1.8E/SPF	20%2.0E/SPF	1/6	1/3	1/2	1/3	1/6
5%1.8E/SPF	20%L2D/DF	1/6	1/3	1/2	1/3	–
10%1.8E/SPF	5%L2D/DF	1/6	1/3	1/2	1/3	–
10%1.8E/SPF	20%L2D/DF	1/6	1/3	1/2	1/3	–
10%1.8E/SPF	20%L2D/DF	1/6	1/3	1/2	1/3	–
–	5%1.9E/ES	1/6	–	–	–	1/6
10%C4/ES	15%B/ES	1/6	–	–	–	–
10%C4/ES	20%B/ES	1/6	–	–	–	–
10%C4/ES	20%B/ES	1/6	–	–	–	–
–	5%1.9E/ES	1/6	–	–	–	1/6
10%C4/ES	25%1.9E/ES	1/6	–	–	–	1/6
10%C4/ES	25%1.9E/ES	1/6	–	–	–	1/6
10%C4/ES	25%1.9E/ES	1/6	–	–	–	1/6
10%1.9E/HF	10%2.0E/HF	1/6	1/2	1/2	1/2	1/3
10%1.9E/HF	10%2.0E/HF	1/6	1/2	1/2	1/2	1/3
10%1.9E/HF	10%2.0E/HF	1/6	1/2	1/2	1/2	1/3
10%L2/DF	10%L2D/DF	–	–	–	–	–
10%L2/DF	10%L2D/DF	–	–	–	–	–
10%L2/DF	10%L2D/DF	5% 1:16	–	–	–	–
10%L2/DF	10%L1/DF	–	–	–	–	–
10%L2/DF	10%L1/DF	–	–	–	–	–
10%L2/DF	10%L1/DF	5% 1:16	–	–	–	–
10%L2/DF	10%L2D/DF	–	–	–	–	–
10%L2/DF	10%L2D/DF	5% 1:16	–	–	–	–
10%L2/DF	10%L2D/DF	–	–	–	–	–
10%L2/DF	10%L2D/DF	5% 1:16	–	–	–	–
20%L2/HF	20%L2D/DF	–	–	–	–	–
20%L2/HF	20%L2D/DF	–	–	–	–	–
10%L2/HF	10%L2D/DF	5% 1:16	–	–	–	–
–	10%L2D/DF	5% 1:16	–	–	–	–
10%1.8E/SPF or 10%L2/DF	10%L2D/DF	5% 1:16	–	–	–	–
10%1.8E/SPF or 10%L2/DF	10%L2D/DF	5% 1:16	–	–	–	–
10%1.8E/SPF or 10%L2/DF	10%L2D/DF	5% 1:16	–	–	–	–
20%L2/HF	20%L2D/DF	5% 1:14	–	–	–	–
20%L2/HF	20%L2D/DF	5% 1:16	–	–	–	–
10%L2/HF	10%L2D/DF	5% 1:16	–	–	–	–

TABLE S-1 (Continued)

GRADE REQUIREMENTS FOR MEMBERS STRESSED PRIMARILY IN BENDING (MIXED GRADES)[1,2]

Combination Symbol	Balanced/ Unbalanced	Depth of Member	Tension Lam[3]	Minimum Grade of Laminations[4,5,6,7] Percent/Grade/Species Each Zone[8] Outer Tension Zone	Inner Tension Zone	Core
1	2	3	4	5	6	7
Western Species (WS)						
EWS 24F-V5M3/WS	U	< 12 in.	302-20	15%L1/DF	20%L2/HF	L3/HF
		12 to 15 in.	302-22	15%L1/DF	20%L2/HF	L3/HF
		15 to 24 in.	302-24	15%L1/DF	20%L2/HF	L3/HF
EWS 24F-V8/WS	B	< 12 in.	302-20	10%L1/DF	10%L2/DF	L3/DF
		12 to 15 in.	302-22	10%L1/DF	10%L2D/DF	L3/DF
		> 15 in.	302-24	10%L1/DF	5%L2/DF	L3/DF
EWS 24F-V8M1/WS[15]	B	9 lams to ≤ 15 in.	302-22	10%L1/DF	10%L2D/DF	L3/DF
		> 15 in. to 20 lams	302-24	10%L1/DF	5%L2/DF	L3/DF
EWS 24F-V8M2/WS[16]	B	9 lams to ≤ 15 in.	302-22	10%L1/DF	10%L2D/DF	L3/DF
		> 15 in. to 20 lams	302-24	10%L1/DF	5%L2/DF	L3/DF
EWS24F-V10/WS	B	< 12 in.	302-20	20%L1/DF	10%L2/HF	L3/HF
		12 to 15 in.	302-22	20%L1/DF	10%L2/HF	L3/HF
		> 15 in.	302-24	15%L1/DF	15%L2/HF	L3/HF
EWS 26F-E/DF1	U	9-1/2 in.	302-22	1-2.3E/DF + 1-L1/DF	1-L2/DF	1-L3/DF
		11-7/8 in.	302-24	2-2.3E/DF + 1-L1/DF	1-L2/DF	1-L3/DF
		14 in.	302-24	2-2.3E/DF + 1- L1/DF	1-L2/DF	3-L3/DF
		16 in.	302-26	3-2.3E/DF + 1- L1/DF	1-L2/DF	3-L3/DF
EWS 26F-E/DF1M1	B	9-1/2 in.	302-22	1-2.3E/DF + 1-L1/DF	1-L2/DF	1-L3/DF
		11-7/8 in.	302-24	2-2.3E/DF + 1-L1/DF	–	2-L2/DF
		14 in.	302-24	2-2.3E/DF + 1-L1/DF	1-L2/DF	2-L3/DF
		16 in.	302-26	3-2.3E/DF + 1-L1/DF	1-L2/DF	1-L3/DF
Southern Pine (SP)						
EWS 24F-V1/SP	U	< 12 in.	302-20[17]	10%N1D/SP	10%N2D/SP	N3M/SP
		12 to 15 in.	302-22	15%N1D/SP	15%N2M/SP	N3M/SP
		> 15 in.	302-24	15%N1D/SP	15%N2M/SP	N3M/SP
EWS 24F-V3/SP	U	< 12 in.	302-20[17]	10%N1D/SP	15%N2D/SP	N2M/SP
		12 to 15 in.	302-22	10%N1D/SP	15%N2D/SP	N2M/SP
		> 15 in.	302-24	10%N1D/SP	15%N2D/SP	N2M/SP
EWS 24F-V3M1/SP[15]	U	9 lams to ≤ 15 in.	302-22	10%N1D/SP	15%N2D/SP	N2M/SP
		> 15 in. to 20 lams	302-24	10%N1D/SP	15%N2D/SP	N2M/SP
EWS 24F-V3M2/SP[16]	U	9 lams to ≤ 15 in.	302-20[17]	10%N1D/SP	15%N2D/SP	N2M/SP
		> 15 in. to 20 lams	302-24	10%N1D/SP	15%N2D/SP	N2M/SP

Footnotes on page 12.

Minimum Grade of Laminations[4,5,6,7]						
Percent/Grade/Species Each Zone[8]		Edge Knot/Slope-of-grain[9]				
Inner Comp. Zone	Outer Comp. Zone	Outer Tension Zone	Inner Tension Zone	Core	Inner Comp. Zone	Outer Comp. Zone
8	9	10	11	12	13	14
20%L2/HF	10%L2D/DF	5% 1:16	–	–	–	–
20%L2/HF	15%L2D/DF	5% 1:16	–	–	–	–
20%L2/HF	10%L2D/DF	5% 1:16	–	–	–	–
10%L2/DF	10%L1/DF	–	–	–	–	–
10%L2D/DF	10%L1/DF	–	–	–	–	–
5%L2/DF	10%L1/DF	5% 1:16	–	–	–	5% 1:16
10%L2D/DF	10%L1/DF	–	–	–	–	–
5%L2/DF	10%L1/DF	5% 1:16	–	–	–	5% 1:16
10%L2D/DF	10%L1/DF	–	–	–	–	–
5%L2/DF	10%L1/DF	5% 1:16	–	–	–	5% 1:16
10%L2/HF	20%L1/DF	–	–	–	–	–
10%L2/HF	20%L1/DF	–	–	–	–	–
15%L2/HF	15%L1/DF	5% 1:16	–	–	–	5% 1:16
1-L2/DF	2-L1/DF	1/6	–	–	–	–
1-L2/DF	2-L1/DF	1/6	–	–	–	–
1-L2/DF	2-L1/DF	1/6	–	–	–	–
1-L2/DF	2-L1/DF	1/6	–	–	–	–
1-L2/DF	1-2.3E/DF + 1-L1/DF	1/6	–	–	–	1/6
–	2-2.3E/DF + 1-L1/DF	1/6	–	–	–	1/6
1-L2/DF	2-2.3E/DF + 1-L1/DF	1/6	–	–	–	1/6
1-L2/DF	3-2.3E/DF + 1-L1/DF	1/6	–	–	–	1/6
10%N2D/SP	10%N1D/SP	10% 1:14	10% 1:8	1:8	10% 1:8	10% 1:10
15%N2M/SP	15%N1M/SP[10]	5% 1:14 + 10% 1:10	15% 1:8	1:8	15% 1:8	5% 1:12 + 10% 1:10
15%N2M/SP	15%N1M/SP[10]	5% 1:16 + 5% 1:12 + 5% 1:10	15% 1:8	1:8	15% 1:8	5% 1:14 + 5% 1:12 + 5% 1:10
10%N2D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
10%N2D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:12
10%N2D/SP	10%N1D/SP	5% 1:14 + 5% 1:12	15% 1:8	1:8	10% 1:8	5% 1:12 + 5% 1:10
10%N2D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:12
10%N2D/SP	10%N1D/SP	5% 1:14 + 5% 1:12	15% 1:8	1:8	10% 1:8	5% 1:12 + 5% 1:10
10%N2D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
10%N2D/SP	10%N1D/SP	5% 1:14 + 5% 1:12	15% 1:8	1:8	10% 1:8	5% 1:12 + 5% 1:10

TABLE S-1 (Continued)

GRADE REQUIREMENTS FOR MEMBERS STRESSED PRIMARILY IN BENDING (MIXED GRADES)[1,2]

Combination Symbol	Balanced/ Unbalanced	Depth of Member	Tension Lam[3]	Minimum Grade of Laminations[4,5,6,7] Percent/Grade/Species Each Zone[8] Outer Tension Zone	Inner Tension Zone	Core
1	2	3	4	5	6	7
Southern Pine (SP)						
EWS 24F-V5/SP	B	< 12 in. 12 to 15 in. > 15 in.	302-20[17] 302-22 302-24	10%N1D/SP 10%N1D/SP 10%N1D/SP	5%N2D/SP 5%N2D/SP 5%N2D/SP	N2M/SP N2M/SP N2M/SP
EWS 24F-V5M1/SP	B	< 12 in. 12 to 15 in. > 15 in.	302-20 302-22 302-24	10%N1D/SP 10%N1D/SP 10%N1D/SP	15%N2D/SP 15%N2D/SP 15%N2D/SP	N2M/SP N2M/SP N2M/SP
EWS 24F-V5M2/SP[15]	B	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-22 302-24	10%N1D/SP 10%N1D/SP	15%N2D/SP 15%N2D/SP	N2M/SP N2M/SP
EWS 24F-V5M3/SP[16]	B	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-22 302-24	10%N1D/SP 10%N1D/SP	15%N2D/SP 15%N2D/SP	N2M/SP N2M/SP
EWS 26F-V1/SP	U	7 lams to < 12 in. 12 to 15 in. > 15 in.	302-22 302-24 302-26	10%N1D/SP 10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP 15%N2D/SP	N1M/SP N2D/SP N2M/SP
EWS 26F-V2/SP	U	7 lams to < 12 in. 12 to 15 in. > 15 in.	302-22 302-24 302-26	10%N1D/SP 10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP 15%N1D/SP	N2D/SP N2D/SP N2D/SP
EWS 26F-V3/SP	U	7 lams to < 12 in. 12 to 15 in. > 15 in.	302-22 302-24 302-26	10%N1D/SP 10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP 15%N1D/SP	N1M/SP N1M/SP N1M/SP
EWS 26F-V3M1/SP[15]	U	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-24 302-26	10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP	N1M/SP N1M/SP
EWS 26F-V3M2/SP[16]	U	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-24 302-26	10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP	N1M/SP N1M/SP
EWS 26F-V4/SP	B	7 lams to < 12 in. 12 to 15 in. > 15 in.	302-22 302-24 302-26	10%N1D/SP 10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP 15%N1D/SP	N1M or N2D/SP N1M or N2D/SP N1M or N2D/SP
EWS 26F-V4M1/SP[15]	B	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-24 302-26	10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP	N1M or N2D/SP N1M or N2D/SP
EWS 26F-V4M2/SP[16]	B	9 lams to ≤ 15 in. > 15 in. to 20 lams	302-24 302-26	10%N1D/SP 10%N1D/SP	15%N1D/SP 15%N1D/SP	N1M or N2D/SP N1M or N2D/SP
EWS 28F-E1/SP[18]	U	≤ 13-3/4 in. >13-3/4 in.	302-28 302-30	10%2.3E/SP + 10%N1D 2.3E/SP 5%2.3E/SP + 5%N1D 2.3E/SP	10%N1D/SP 15%N1D/SP	N2M/SP N2M/SP
EWS 28F-E1M1/SP[18]	U	≤ 13-3/4 in. >13-3/4 in.	302-28 302-30	10%2.3E/SP + 10%N1D 2.3E/SP 5%2.3E/SP + 5%N1D 2.3E/SP	10%N1D/SP 15%N1D/SP	N2M/SP N2M/SP

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Minimum Grade of Laminations[4,5,6,7]						
Percent/Grade/Species Each Zone[8]		Edge Knot/Slope-of-grain[9]				
Inner Comp. Zone	Outer Comp. Zone	Outer Tension Zone	Inner Tension Zone	Core	Inner Comp. Zone	Outer Comp. Zone
8	9	10	11	12	13	14
5%N2D/SP	10%N1D/SP	10% 1:14	5% 1:8	1:8	5% 1:8	10% 1:14
5%N2D/SP	10%N1D/SP	10% 1:15	5% 1:10	1:8	5% 1:10	10% 1:15
5%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:12	5% 1:10	1:8	5% 1:10	5% 1:16 + 5% 1:12
15%N2D/SP	10%N1D/SP	5% 1:14 + 5% 1:10	15% 1:8	1:8	15% 1:8	5% 1:14 + 5% 1:10
15%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:10	15% 1:8	1:8	15% 1:8	5% 1:16 + 5% 1:10
15%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:12	15% 1:8	1:8	15% 1:8	5% 1:16 + 5% 1:12
15%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:10	15% 1:8	1:8	15% 1:8	5% 1:16 + 5% 1:10
15%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:12	15% 1:8	1:8	15% 1:8	5% 1:16 + 5% 1:12
15%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:10	15% 1:8	1:8	15% 1:8	5% 1:16 + 5% 1:10
15%N2D/SP	10%N1D/SP	5% 1:16 + 5% 1:12	15% 1:8	1:8	15% 1:8	5% 1:16 + 5% 1:12
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
10%N2D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:12
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:12
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:12
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:12
10%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	10% 1:8	10% 1:10
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:12
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
15%N1D/SP	10%N1D/SP	10% 1:14	15% 1:8	1:8	15% 1:8	10% 1:14
10%N1D/SP	10%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12	10% 1:12	1:8	10% 1:12	10% 1:12
15%N1D/SP	10%N1D 2.3E/SP	1/5 & 5% 1:16 + 5% 1:12	15% 1:12	1:8	15% 1:12	10% 1:12
15%N1D/SP	10%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12	10% 1:12	1:8	15% 1:12	10% 1:12
15%N1D/SP	15%N1D 2.3E/SP	1/5 & 5% 1:16 + 5% 1:12	15% 1:12	1:8	15% 1:12	15% 1:12

TABLE S-1 (Continued)

GRADE REQUIREMENTS FOR MEMBERS STRESSED PRIMARILY IN BENDING (MIXED GRADES)[1,2]

Combination Symbol	Balanced/ Unbalanced	Depth of Member	Tension Lam[3]	Minimum Grade of Laminations[4,5,6,7] Percent/Grade/Species Each Zone[8] Outer Tension Zone	Inner Tension Zone	Core
1	2	3	4	5	6	7
Southern Pine (SP)						
EWS 28F-E2/SP[18]	B	≤ 13-3/4 in.	302-28	10%2.3E/SP + 10%N1D 2.3E/SP	10%N1D/SP	N2M/SP
		> 13-3/4 in.	302-30	5%2.3E/SP + 5%N1D 2.3E/SP	15%N1D/SP	N2M/SP
EWS 28F-E2M1/SP[18]	B	≤ 13-3/4 in.	302-28	10%2.3E/SP + 10%N1D 2.3E/SP	10%N1D/SP	N2M/SP
		> 13-3/4 in.	302-30	5%2.3E/SP + 10%N1D 2.3E/SP	15%N1D/SP	N2M/SP
EWS 30F-E1/SP[18]	U	≤ 13-3/4 in.	302-28	10%2.3E/SP + 10%N1D 2.3E/SP	10%N1D/SP	N2M/SP
		> 13-3/4 in.	302-30	5%2.3E/SP + 5%N1D 2.3E/SP	15%N1D/SP	N2M/SP
EWS 30F-E1M1/SP[18]	U	≤ 13-3/4 in.	302-28	10%2.3E/SP + 10%N1D 2.3E/SP	10%N1D/SP	N2M/SP
		> 13-3/4 to 18 in.	302-30	5%2.3E/SP + 5%N1D 2.3E/SP	15%N1D/SP	N2M/SP
EWS 30F-E2/SP[18]	B	≤ 13-3/4 in.	302-28	10%2.3E/SP + 10%N1D 2.3E/SP	10%N1D/SP	N2M/SP
		> 13-3/4 in.	302-30	5%2.3E/SP + 5%N1D 2.3E/SP	15%N1D/SP	N2M/SP
EWS 30F-E2M1/SP[18]	B	≤ 13-3/4 in.	302-28	10%2.3E/SP + 10%N1D 2.3E/SP	10%N1D/SP	N2M/SP
		> 13-3/4 to 18 in.	302-30	5%2.3E/SP + 10%N1D 2.3E/SP	15%N1D/SP	N2M/SP
EWS 30F-E2M2/SP	B	9-1/2 in.	–	1-1.50 in. 2.4E LVL[19]	1-1.30 in. N1D2.3E/SP	3-1.30 in. N2M/SP
		11-7/8 in.	–	1-1.75 in. 2.4E LVL[19]	1-1.40 in. N1D2.3E/SP	4-1.40 in. N2M/SP
		14 in.	–	1-1.50 in. 2.4E LVL[19]	1-1.50 in. N1D2.3E/SP[21]	6-1.34 in. N2M/SP
		16 in.	–	1-1.75 in. 2.4E LVL[19]	1-1.50 in. N1D2.3E/SP[21]	7-1.36 in. N2M/SP
EWS 30F-E2M3/SP	B	7-1/4 in.	–	1-1.06 in. 2.4E LVL[20]	1-1.28 in. N1D2.3E/SP	2-1.28 in. N2M/SP
		7-1/2 in.	–	1-1.06 in. 2.4E LVL[20]	1-1.34 in. N1D2.3E/SP	2-1.34 in. N2M/SP
		9-1/4 in.	–	1-1.25 in. 2.4E LVL[20]	1-1.35 in. N1D2.3E/SP	3-1.35 in. N2M/SP
		9-1/2 in.	–	1-1.375 in. 2.4E LVL[20]	1-1.35 in. N1D2.3E/SP	3-1.35 in. N2M/SP
		11-1/4 in.	–	1-1.75 in. 2.4E LVL[20]	1-1.30 in. N1D2.3E/SP	4-1.30 in. N2M/SP
		11-7/8 in.	–	1-1.75 in. 2.4E LVL[20]	1-1.40 in. N1D2.3E/SP	4-1.40 in. N2M/SP
		14 in.	–	1-1.75 in. 2.4E LVL[20]	1-1.31 in. N1D2.3E/SP	6-1.31 in. N2M/SP
		16 in.	–	1-1.75 in. 2.4E LVL[20]	1-1.50 in. N1D2.3E/SP	7-1.36 in. N2M/SP
		18 in.	–	1-1.75 in. 2.4E LVL[20]	2-1.32 in. N1D2.3E/SP	7-1.32 in. N2M/SP
		20 in.	–	1-1.64 in. 2.4E LVL[20]	2-1.39 in. N1D2.3E/SP	8-1.39 in. N2M/SP
		22 in.	–	2-1.32 in. 2.4E LVL[20]	2-1.40 in. N1D2.3E/SP	8-1.39 in. N2M/SP
		24 in.	–	2-1.32 in. 2.4E LVL[20]	2-1.33 in. N1D2.3E/SP	10-1.33 in. N2M/SP
		26 in.	–	2-1.32 in. 2.4E LVL[20]	2-1.38 in. N1D2.3E/SP	11-1.38 in. N2M/SP
		28 in.	–	2-1.64 in. 2.4E LVL[20]	2-1.43 in. N1D2.3E/SP	11-1.43 in. N2M/SP
		30 in.	–	2-1.64 in. 2.4E LVL[20]	3-1.38 in. N1D2.3E/SP	11-1.38 in. N2M/SP

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Minimum Grade of Laminations[4,5,6,7]						
Percent/Grade/Species Each Zone[8]		Edge Knot/Slope-of-grain[9]				
Inner Comp. Zone	Outer Comp. Zone	Outer Tension Zone	Inner Tension Zone	Core	Inner Comp. Zone	Outer Comp. Zone
8	9	10	11	12	13	14
10%N1D/SP 15%N1D/SP	10%2.3E/SP + 10%N1D 2.3E/SP 5%2.3E/SP + 5%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 5% 1:12	10% 1:12 15% 1:12	1:8 1:8	10% 1:12 15% 1:12	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 5% 1:12
10%N1D/SP 15%N1D/SP	10%2.3E/SP + 10%N1D 2.3E/SP 5%2.3E/SP + 10%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 10% 1:12	10% 1:12 15% 1:12	1:8 1:8	10% 1:12 15% 1:12	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 10% 1:12
20%N1D/SP 15%N1D/SP	+ 10%N1D 2.3E/SP + 15%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 5% 1:12	10% 1:12 15% 1:12	1:8 1:8	20% 1:12 15% 1:12	10% 1:12 15% 1:12
20%N1D/SP 15%N1D/SP	+ 10%N1D 2.3E/SP + 15%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 5% 1:12	10% 1:12 15% 1:12	1:8 1:8	20% 1:12 15% 1:12	10% 1:12 15% 1:12
10%N1D/SP 15%N1D/SP	10%2.3E/SP + 10%N1D 2.3E/SP 5%2.3E/SP + 5%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 5% 1:12	10% 1:12 15% 1:12	1:8 1:8	10% 1:12 15% 1:12	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 5% 1:12
10%N1D/SP 15%N1D/SP	10%2.3E/SP + 10%N1D 2.3E/SP 5%2.3E/SP + 10%N1D 2.3E/SP	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 10% 1:12	10% 1:12 15% 1:12	1:8 1:8	10% 1:12 15% 1:12	1/3 & 10% 1:12 + 10% 1:12 1/5 & 5% 1:16 + 10% 1:12
1-1.30 in. N1D2.3E/SP	1-1.50 in. 2.4E LVL[19]	–	1:12	1:8	1:12	–
1-1.40 in. N1D2.3E/SP	1-1.75 in. 2.4E LVL[19]	–	1:12	1:8	1:12	–
1-1.50 in. N1D2.3E/SP[21]	1-1.50 in. 2.4E LVL[19]	–	1:12	1:8	1:12	–
1-1.50 in. N1D2.3E/SP[21]	1-1.75 in. 2.4E LVL[19]	–	1:12	1:8	1:12	–
1-1.28 in. N1D2.3E/SP	1-1.06 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.34 in. N1D2.3E/SP	1-1.06 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.35 in. N1D2.3E/SP	1-1.25 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.35 in. N1D2.3E/SP	1-1.375 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.30 in. N1D2.3E/SP	1-1.75 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.40 in. N1D2.3E/SP	1-1.75 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.31 in. N1D2.3E/SP	1-1.75 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
1-1.50 in. N1D2.3E/SP	1-1.75 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
2-1.32 in. N1D2.3E/SP	1-1.75 in. 2.4E LVL[20]	–	1:12	1:8	1:12	–
2 -1.39 in. N1D2.3E/SP	1-1.64 in. 2.4E LVL[20]	–	1/5, 1:16	1:8	1/5, 1:16	–
2 -1.40 in. N1D2.3E/SP	2-1.32 in. 2.4E LVL[20]	–	1/5, 1:16	1:8	1/5, 1:16	–
2 -1.33 in. N1D2.3E/SP	2-1.32 in. 2.4E LVL[20]	–	1/5, 1:16	1:8	1/5, 1:16	–
2 -1.38 in. N1D2.3E/SP	2-1.32 in. 2.4E LVL[20]	–	1/5, 1:16	1:8	1/5, 1:16	–
2 -1.43 in. N1D2.3E/SP	2-1.64 in. 2.4E LVL[20]	–	1/5, 1:16	1:8	1/5, 1:16	–
3 -1.38 in. N1D2.3E/SP	2-1.64 in. 2.4E LVL[20]	–	1/5, 1:16	1:8	1/5, 1:16	–

Footnotes:

(1) The combinations in this table are primarily applicable to members stressed in bending due to a load applied perpendicular to the wide faces of the laminations.

(2) The combinations are applicable to arches, compression members, tension members and bending members. For bending members, Footnote No. 3 applies. All combinations are applicable to members with four or more laminations. The tension lamination requirements in Footnote No. 3 do not apply to arches, compression members or tension members.

(3) In addition to the grade requirements tabulated for the outer tension zone, the grading restrictions as contained in AITC 302 tension lamination requirements are applicable to the outer 5 percent of the total depth of bending members. These tension lamination requirements are shown in Column 4. For EWS 20F-V4/WS and EWS 20F-V8/WS from 4 lams to 15 inches in depth, the required 302-20 tension laminations used with L1/DF outer tension zone laminations need not be upgraded to 1:14 slope-of-grain. Where 302-20 tension laminations are used in conjunction with L2, L2D or L3 outer tension zone laminations, the required slope-of-grain is 1:12. The 302- tension lamination required for some bending members is permitted to be omitted provided Footnote No. 6 to Table 1 of Y117 applies. This reduction does not apply to arches which do not require special tension laminations.

(4) Percent values are based on the total depth of the member. All fractional numbers of laminations shall be rounded upward to the next whole number. For the inner tension and compression zones, the resulting excess of percentage resulting from rounding upward of the outer zone is permitted to be subtracted from the inner zone requirements. The actual depth of the member shall be used to determine the tension lamination requirements from Column 4. In no case shall the tension lamination requirements in Footnote No. 3 be less than 5 percent of the total depth of the member in inches.

(5) The following substitutions of E-Rated Douglas fir-larch lumber are permitted for EWS 24F-V4/WS and EWS 24F-V8/WS with at least 7 laminations in depth:

Douglas Fir-Larch Visual Grade	Member Location	Douglas Fir-Larch E-Rated Substitution Grades
L1	Tension Side	2.2E-2 (2.2E-3 in outer tension zone)
	Comp. Side	2.2E-2, 2.0E-3
L2D	Tension Side	2.2E-2 (2.2E-3 in outer tension zone), 2.0E-3
	Comp. Side	1.9E-2*
L2	Tension Side	1.9E-6, 2.0E-3
	Comp. Side	1.9E-2

*7- and 8-lam beams shall be 1.9E-6. The substitution of 1.9E-2 for an L2D does not apply to the outermost compression lam.

(6) The combinations in this table have been established based on procedures given in ASTM D 3737 as modified by subsequent research.

(7) Where specified to have an extreme fiber in bending stress on the compression side which results in tension on the compression (top) side greater than the value given in Column 5, Table 1 of Y117 (except for balanced combinations but not exceeding 200 psi higher than the value in Column 5) tension-zone end-joint spacing restrictions shall be applied to both the tension and compression zones.

(8) Grade designations are as follows:

Visually Graded – Western Species (DF = Douglas fir-Larch; HF = Hem fir; AYC = Alaska yellow cedar; POC = Port Orford cedar)
L1 is L1 laminating grade (dense for Douglas fir-larch and Douglas fir south)
L1D is L1 dense laminating grade for hem-fir and Alaska cedar
L1S is a special grade of Alaska cedar
L1CL is L1 close grain laminating grade
L2D is L2 dense laminating grade (dense)
L2 is L2 laminating grade (medium grade)
L3 is L3 laminating grade (medium grade for Douglas fir-larch, Douglas fir south and hem-fir)

Visually Graded – Southern pine (SP)
N1D is No. 1 dense structural joists and planks or structural light-framing grade or No. 1 boards both graded as dense
N2D is No. 2 dense structural joists and planks or structural light-framing grade or No. 2 boards both graded as dense
N1M is No. 1 structural joists and planks or structural light-framing grade or No. 1 boards both with a medium-grain rate-of-growth
N2M is No. 2 structural joists and planks or structural light-framing grade or No. 2 boards both with a medium-grain rate-of-growth
N3M is No. 3 structural joists and planks or structural light-framing grade or No. 3 boards both with a medium-grain rate-of-growth

E-Rated Grades – All Species (examples)
2.0E-6 has 2.0E with 1/6 edge characteristic
1.8E-3 has 1.8E with 1/3 edge characteristic
1.4E-2 has 1.4E with 1/2 edge characteristic

E-Rated Grades – Eastern Spruce (ES)
B/ES has a minimum long-span E of 1.55×10^6 psi
C6/ES has a minimum long-span E of 1.6×10^6 psi
C4/ES has a minimum long-span E of 1.4×10^6 psi
D4/ES has a minimum long-span E of 1.4×10^6 psi
D/ES has no minimum long-span E requirement

These Eastern Spruce referenced herein shall apply to the following species grown in the United States or Canada: White spruce, Black spruce, and Red spruce. In addition to the minimum long-span E given above, these laminating lumber shall be graded in accordance with the requirements in CSA Standard O122.

(9) Where slope-of-grain is not tabulated, it shall be the slope-of-grain required for the grade. Slope-of-grain is not specified for E-rated lumber except for tension laminations, but slope near the ends of the piece shall not be steeper than slopes of grain in the remainder of the piece.

(10) When required to have 650 psi compression-perpendicular-to-grain design value for Douglas fir-larch or 740 psi for southern pine, at least one 2-inch nominal-thickness lamination of dense Douglas fir-larch for western species, or dense southern pine for southern-pine species, shall be used in place of the tabulated lamination in the bearing area, provided the next inner lamination is medium grain Douglas fir-larch or southern pine.

(11) The layup requires the use of 1x laminations with a maximum nominal width of 4 inches. Only one ripping is permitted to achieve the specific beam width without varying the basic grade requirements of the full-width laminating lumber.

(12) L1/POC lam used in the outer tension and compression zones requires a specific gravity of 0.41 or greater based on oven-dry weight and as-received volume.

(13) In addition, the 2.0E lam material shall be visually graded in accordance with the E-rated tension-lam provisions of AITC 117 (alternate provisions for 302-24 tension lam) with the exception that general slope-of-grain restrictions are not applicable.

(14) The outer 5% tension lamination(s) shall have a slope-of-grain not steeper than 1:16.

(15) This combination contains wane. Wane lumber is allowed for use with the following restrictions: (a) Maximum wane is 1/6 of the finished member width; (b) No wane is allowed for the outer top and bottom lams; (c) No wane is allowed for the 302 tension lams; (d) No wane is allowed in the central 40% of the member depth; (e) Maximum wane is 1/2 the lam thickness for No. 1 or L1 and 2/3 the thickness for No. 2 or L2; (f) Wane is allowed only on one side of the finished member; and (g) The first interior lam from the top or bottom shall have the wane located away from the outside lam.

(16) This combination contains wane. Wane lumber is allowed for use with the following restrictions: (a) Maximum wane is 1/6 of the finished member width; (b) No wane is allowed for the outer top and bottom lams; (c) No wane is allowed for the 302 tension lams; (d) Maximum wane is 1/2 the lam thickness for No. 1 or L1 and 2/3 the thickness for No. 2 or L2; (e) Wane is allowed only on one side of the finished member; and (f) The first interior lam from the top or bottom shall have the wane located away from the outside lam.

(17) The 302-grade tension laminations are included in AITC 117. When used in the indicated depth range with this combination, the laminating lumber shall have a slope-of-grain not steeper than that shown in Column 10 for the outer tension zone. This footnote applies to the 302-20 requirement of EWS 24F-V1/SP, EWS 24F-V3/SP, and EWS 24F-V5/SP.

(18) For the manufacture of 28F and 30F (30F is limited to a nominal beam width of 6" or less) southern pine members, quality control procedures for daily QC monitoring of the average and minimum MOE of the E-rated grades shall be established. End joints for the tension laminations shall be qualified at 1.67 x 3,000 = 5,010 psi. Following initial qualification, daily QC shall be maintained through the use of a statistical process control methodology. The visually-graded and E-rated laminations shall meet the following requirements:

Grade	Grade Requirements
2.3E-5&16 Tension Lam	Must meet all requirements for 302-24 tension lam; Average MOE ≥ 2.3 x 10^6 psi with the 5th percentile ≥ 1.96 x 10^6 psi; Edge characteristics ≤ 20%; Centerline characteristics ≤ 25%; Slope-of-grain ≤ 1/16; Both ends shall be dense.
2.3E-3&12 Tension Lam	Must meet all requirements for 302-24 tension lam; Average MOE ≥ 2.3 x 10^6 psi with the 5th percentile ≥ 1.96 x 10^6 psi; Edge characteristics ≤ 33%; Centerline characteristics ≤ 33%; Slope-of-grain ≤ 1/12; Both ends shall be dense.
N1D 2.3E	Average MOE ≥ 2.3 x 10^6 psi with the 5th percentile ≥ 1.96 x 10^6 psi; Slope-of-grain ≤ 1/12.
N1D	Average MOE ≥ 2.0 x 10^6 psi with the 5th percentile ≥ 1.67 x 10^6 psi; Slope-of-grain ≤ 1/12.

(19) 2.4E LVL used in this layup combination is laminated veneer lumber with a minimum average long-span E (flatwise) of 2.4 x 10^6 psi and a characteristic tensile strength (5th percentile with 75% confidence) of 5,400 psi. The allowable compressive stress perpendicular-to-grain of the LVL shall not be less than 650 psi.

(20) 2.4E LVL used in this layup is laminated veneer lumber with a minimum average long-span E (flatwise) of 2.4 x 10^6 psi and a characteristic tensile strength (5th percentile with 75% confidence) of 6,400 psi. The allowable compressive stress perpendicular-to-grain of the LVL shall not be less than 650 psi.

(21) The N1D2.3E/SP is permitted to be replaced by L1D2.3E/DF in this layup combination, which shall meet all requirements for dense L1/DF. In addition, the L1D2.3E/DF shall have a minimum average long-span E of 2.3 x 10^6 psi with the 5th percentile of no less than 1.96 x 10^6 psi. The slope-of-grain shall be no steeper than 1:14.

TABLE S-2

GRADE REQUIREMENTS FOR MEMBERS STRESSED PRIMARILY IN AXIAL TENSION OR COMPRESSION (Uniform Grade)[1,2]

Combination Symbol	Minimum Grade of Laminations[3]	Species	Tension Laminations If Required[1,4]		
			4 lams to < 12 in. deep	12 in. to 15 in. deep	> 15 in. deep
Western Species (WS)					
EWS 1	L3	DF	302-20	302-20	302-20
EWS 2	L2	DF	302-20	302-20	302-20
EWS 3	L2D	DF	302-20	302-22	302-24
EWS 5	L1	DF	302-20	302-22	302-24
EWS 22[5]	L3	SW	302-20	302-20	302-20
EWS 69	L3	AYC	302-20	302-20	302-20
EWS 70	L2	AYC	302-20	302-20	302-20
EWS 71	L1D	AYC	302-20	302-22	302-24
EWS ES 11	C4	ES	302-20	302-20	302-20
EWS ES 12	1.9E6	ES	302-20	302-20	302-20
EWS POC 1[6]	L1	POC	302-20	302-20	302-22
EWS POC 2	L2	POC	302-20	302-20	302-20
Southern Pine (SP)					
EWS 47	N2M14	SP	302-20	302-20	302-20
EWS 48	N2D14	SP	302-20	302-20	302-20
EWS 49	N1M16	SP	302-20	302-20	302-22
EWS 50	N1D14	SP	302-20	302-22	302-24

Footnotes:

(1) The tension laminations are required only when the F_{bx} values given in Column 13 of Table 2 of Y117 are increased in accordance with Footnote No. 6 to Table 2.

(2) The allowable wane permitted in some grades in Table S-1 is not allowed for combinations in this table.

(3) Grade designations are the same as Footnote No. 8 to Table S-1.

(4) If required, the outer 5 percent of laminations on the tension side of bending members shall be replaced with the tension lamination shown in this table. Percent values are based on the total depth of members. Laminations of different thicknesses shall be permitted to be used in the same member provided that the total thickness of tension lamination(s) equals or exceeds 5 percent of the depth.

(5) Footnote No. 8 to Table 2 of Y117 applies.

(6) L1/POC lam used in the outer tension and compression zones requires a specific gravity of 0.41 or greater based on oven-dry weight and as-received volume.

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