DRYING NEW ZEALAND RADIATA PINE

Drying may be carried out by the full range of traditional and newer drying processes. The bulk of sawn lumber comprises highly permeable sapwood of high moisture content (150% m.c.) which dries rapidly. The less permeable heartwood has a lower moisture content (around 40%) but dries in a similar time. Extra care should be taken with stacking and weighting where appropriate, to minimise distortion in drying.

Lumber which has been pressure-treated with water-borne preservatives will dry more slowly and less evenly than untreated wood.

Air-drying stacks should be at least 300 mm above the ground, separated by 300 to 400 mm, and aligned parallel to the prevailing wind to promote rapid drying. Sticker stain is not a problem. Stickers should be of uniform thickness between 19 and 25 mm, evenly spaced and vertically aligned. Warping and surface checking are adequately controlled by good stacking, avoiding overhanging ends, and using covers.

Low-temperature drying processes, including the heat pump or dehumidifier, can be used for drying New Zealand radiata pine. Preliminary air drying to 60% moisture content reduces drying time, and results in a more even final moisture content. An airflow of 1.5 m/s is required and the compressor capacity of heat pump dryers may need to be increased up to 750 watts/m^3 lumber to avoid prolonged drying times for green lumber. Low-temperature drying schedules are specified in terms of relative humidity only (Table 10). The actual temperature is unimportant and may vary throughout the cycle. Case hardening is minimal and no stress relief is necessary.

Conventional kiln drying for New Zealand radiata pine differs little from that for other pine species. An airflow of 3 m/s is optimum, heat input rate needs to be higher than for hardwoods because of the higher level of moisture saturation and faster rate of drying, and venting capacity must be slightly greater. Otherwise, structural requirements are little different. Recommended kiln schedules are given in Table 10. They involve a single-step schedule with an equilibrium moisture content (e.m.c.) of 8–9% for untreated lumber or for lumber treated by processes other than Bethell (full cell), and a two-step schedule for material treated with water-borne preservatives by the Bethell process. When final moisture contents of lower than 12–14% are required, larger final wet bulb depressions of 15°-20°C should be used for New Zealand radiata pine.

There are two critical periods for drying:

(1) At the beginning there is a risk of surface checking if conditions are too severe.

(2) At the end of drying, a period of final high-humidity conditioning in the kiln is recommended to reduce drying stress and moisture content variability.

High-temperature drying, with extremely rapid drying rates (Table 11), may be used with New Zealand radiata pine and most widths of 25- and 50-mm-thick lumber can be dried, even for high-quality uses such as furniture. High-temperature drying is not recommended for square section or for pressure-treated lumber. Kiln construction must be of a high standard, with fan capacity sufficient to achieve a uniform airflow of at least 5 m/s through the load and heating system sufficient to reach operating temperature in 2 hours. Increasing airflow to 7 m/s will reduce drying time by a further 20%. A final period of steam conditioning is necessary to remove drying stress and reduce variability of moisture content. For successful conditioning, the lumber must first be allowed to cool to 100°C but conditioning must commence soon afterwards and it is important that fully saturated steam is used. Careful preparation of kiln stacks is essential and top weighting of 1000 kg/m^2 is recommended to control warping in the top layers. The weights must be left in place during reconditioning and a 24-hour cooling period.

Pressure-treated lumber which has been dried before treatment is slow to redry because of changes in the wood structure in the pretreatment drying. Lumber treated by the Bethell (full cell) process with high moisture saturation takes longer to dry than that treated by the Lowry process (which has lower moisture saturation). Treatment of partially seasoned wood by processes such as the APM method have little effect on drying rate but still render the material unsuitable for high-temperature drying. Diffusion-treated lumber can be dried in the same way as untreated lumber.

TABLE 10–*Drying schedules for New Zealand radiata pine*

Thickness (mm)	Untreated or preservative-treated	Moisture content	Relative humidity (%)	Temperature				Time for final conditioning
				Dry bulb		Wet bulb		
				(°C)	(°F)	(°C)	(°F)	
Low-temperature schedules								
25	Untreated and treated	Green* to 30%	70					
		30% to 20%	55					
		20% to 15%	45					
		15% to dry	35					
50	Untreated and treated by Bethell (full cell) process	Green to dry	60					
50	Pressure treated by Bethell (full cell) process	Green to 90%	75					
		90% to 20%	60					
		20% to dry	45					
Conventional kiln schedules								
25	Untreated and treated	Green to dry		77	170	66	150	
		Conditioning		82	180	81	178	At least 2 h
50	Untreated and treated by processes other than Bethell (full cell)	Green to dry		71	160	60	140	
		Conditioning		77	170	76	168	At least 4 h
50	Pressure treated by Bethell (full cell) process	Green to 90%		66	150	60	140	
		90% to 30%		71	160	60	140	
		30% to dry		71	160	55	130	
		Conditioning		77	170	76	168	At least 4 h
High-temperature schedule								
25–50	Untreated or diffusion treated			120	240	70	160	2 h per 25 mm thickness

* "Green" refers to the moisture condition of freshly peeled, sawn or preservative-treated, roundwood or lumber.

TABLE 11–*Expected drying times*

Thickness (mm)	Untreated or preservative-treated	Time
Low-temperature drying		
25	Untreated (or other than full cell)	8–12 days
25	Treated by Bethell (full cell) process	12–18 days
50	Untreated (or other than full cell)	12–24 days
50	Treated by Bethell (full cell) process	30–50 days
Conventional drying		
25	Untreated (or other than full cell)	2.5–4 days
25	Treated by Bethell (full cell) process	4–6 days
50	Untreated (or other than full cell)	4–8 days
50	Treated by Bethell (full cell) process	10–18 days
High-temperature drying		
25	Untreated or diffusion treated	10–14 hours
50	Untreated or diffusion treated	18–24 hours