Collapse free pre-drying of *Eucalyptus regnans* F. Muell.

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Collapse is often the source of differential shrinkages which can lead to internal checking. Previous work indicates that the amount of collapse present in dried eucalypt sawn timber is strongly reliant on the temperature of drying. This work tests the idea of drying at temperatures below a collapse threshold temperature to avoid collapse altogether. Successful preliminary tests were conducted on *Eucalyptus regnans* F. Muell.

**Materials and methods**

**2.1 Materials**

Collapse threshold temperature tests were made on samples of naturally regenerated *Eucalyptus regnans* F. Muell. from the Western Tiers region of Tasmania. The last recorded major fire in this area occurred in 1881. Collapse threshold temperature tests and a full kiln trial were also carried out on 20 m³ of 1939 regrowth *Eucalyptus regnans* F. Muell. (alpine mountain ash) from the Powell Town region of Victoria.

Basic density of the Tasmanian *E. regnans* was 580 ± 30 kg/m³, green to dry shrinkage was approximately 9% with 0.5% shrinkage at 30% MC (FSP) and 5.5% shrinkage at 10% MC (EMC) with no collapse.

Basic density of the Victorian *E. regnans* was measured at 484 ± 25 kg/m³ and normal shrinkage (green to dry) measured...
on 0.6 mm thick transverse slices was approximately 7% with 0.5% shrinkage at an FSP of 30%, and 4.5% shrinkage at an EMC of 10%.

2.2 Slicing technique
A cube of timber of approximately 20 mm side length was cut well away from the end and edges of a green board, to ensure that little drying had occurred. It was then trimmed so that its faces were exactly radial and tangential, and then sliced tangentially into slices between 0.8 mm and 1.5 mm thick, separating EW and LW. Each slice was placed in a wire bridle to prevent out-of-plane deformation. Two marks were made on the slice separately tangentially by approximately 20 mm. The slice was then allowed to dry at the selected dry bulb temperature without forced air flow. The slice was periodically weighed and the distance between the two marks recorded. After attainment of EMC, slices were oven dried and cooled in a desiccator and final measurements taken. The same procedure was followed for R-T slices, which were tested simultaneously to ensure the same drying conditions.

For each slice the data was plotted as MC vs shrinkage. The R-T slices were assumed to give normal shrinkage, and the L-T slices to give total shrinkage. Thus, the difference between the two curves was taken to be collapse shrinkage. The difference between normal shrinkage observed in earlywood and latwood of R-T slices was negligible.

2.3 Board technique
For the Creswick experiments, sections of 100 × 25 mm board approximately 200 mm long were dried in a laboratory oven at various temperatures. They were not endcoated. The first two sections (from different boards) were dried at 40 °C for approximately 24 hours. After this, the ends were docked approximately 50 mm and the freshly cut surfaces examined for internal checking. They were both found to have small checks in several earlywood bands. The board surfaces exhibited some “washboarding” (see Fig. 3). The collapse threshold temperature was thus known to be less than 40 °C. The test was then repeated at progressively lower temperatures until the samples were found to be free of collapse, with no internal checks at all. The highest temperature at which the samples were free of collapse was chosen as the collapse threshold temperature.

A similar procedure was followed for the Tasmanian timber. The timber was dried in an insulated chamber of 0.25 m³ with a small 12 V fan blowing along the end-coated boards.

Final centre moisture contents were typically around 60% – if internal checking was going to form, it was usually seen by then, particularly closer to the surface, where the MC was substantially lower.

3.2 Victorian E. regnans
The board technique yielded a value for the collapse threshold temperature of 30 °C. The timber at the Creswick kiln trial was dried to approximately 40% centre MC in three weeks at temperatures below 30 °C. At the end of this period, there was no visible collapse. The timber was then left under cover in the open air for another month. Some of the timber displayed collapse after this (see Fig. 4). This is almost certainly due to the high ambient temperatures of up to 40 °C which occurred at Creswick during the drying from 40% MC to FSP outside the kiln.

Some of the shrinkage measurements taken on slices are shown in Fig. 2. Each trace represents at least two individual shrinkage measurements.

It is not possible to define a collapse threshold temperature from Fig. 2.

4 Discussion
It seems that internal checking is caused by differential shrinkages induced by collapse. Thus, to avoid internal checking, it is necessary to avoid these differential shrinkages. The simplest

Fig. 2. Shrinkage curves, Victorian E. regnans. L-T: longitudinal-tangential section, R-T: radial-tangential section
Bild 2. Schwindungsverlauf von Eucalyptus regnans aus Victoria. L-T: Längs-/Tangentialschnitt; R-T: Radial-/Tangentialschnitt

Fig. 1. Shrinkage curves, Tasmanian E. regnans. L-T: longitudinal-tangential section, R-T: radial-tangential section
Bild 1. Schwindungsverlauf von Eucalyptus regnans aus Tasmanian. L-T: Längs-/Tangentialschnitt; R-T: Radial-/Tangentialschnitt

carried out on two 2.4 m boards docked into 300 mm sections. One of these boards was also used for the shrinkage tests.

3 Results

3.1 Tasmanian E. regnans
Figure 1 shows a selection of the measured shrinkage curves. Each curve represents at least two shrinkage measurements. These measurements show that the collapse threshold temperature of this timber is approximately 26 °C.

The initial MC of the earlywood slices was much higher than that of the latwood slices: this seems to be a reasonable means of judging the effectiveness of the separation of EW and LW in the slicing. The transverse slices do not collapse as all of the fibres have been damaged in slicing.

The board sections that were rapidly dried resulted in a predicted collapse threshold temperature of approximately 24 °C using 2 °C increments. The board section tests were