

Grading dry cocowood boards

Only high density boards (>700 kg/m³ air dry density) are suitable for flooring products in the international market.

Cocowood boards must be graded visually, by personnel trained to assess hardness/density by using vascular bundle patterns. In summary:

Steps

1. Understand the visual grading parameters for cocowood: straightness, bundle pattern, density homogeneity / evenness and straight boards.
2. Become skilled in recognising the relationship between cocowood density, bundle patterns and position in the stem. Graders must be experienced in this.
3. Create a cocowood density grading tool and train graders in visual grading parameters.
4. Grade cocowood boards using the density grading tool:
 - a. density—differentiate between dissimilar bundle patterns and associate with cocowood density
 - b. homogeneity—assess density homogeneity in boards
 - c. grade and sort boards for appropriate flooring markets.

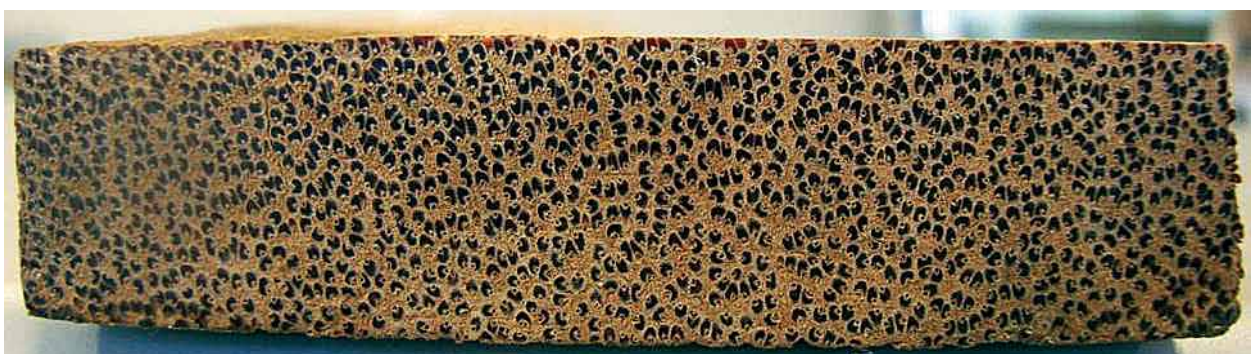
1. Visual grading parameters

- **Straightness** indicates minimal spring, twist or bow.
- **Density** indicates hardness and is graded using vascular bundle patterns (surface area of vascular bundles relative to ground tissue, see below) in the end-grain.

Homogeneity: Boards that have a relatively homogenous density (15% variation or less) and straight grain (variation less than 8°) are suitable for high value flooring products.

The buyer decides on the allowable proportion of lower density material in each board. The buyer and manufacturer may have different thresholds, and these need to be negotiated before the wood is graded.

Industry generally tolerates a 10% allowance for subjective variation in visually-graded product. To allow for this, the industry benchmark is to add 10% to the order.



End section of a high density cocowood board, showing the high relative surface area of vascular bundles.

2. Relationship between cocowood density, bundle patterns and stem position

Visual grading is determined by the **vascular bundle patterns** in the end-sections of cocowood boards, so it is important to ‘read’ these patterns correctly.

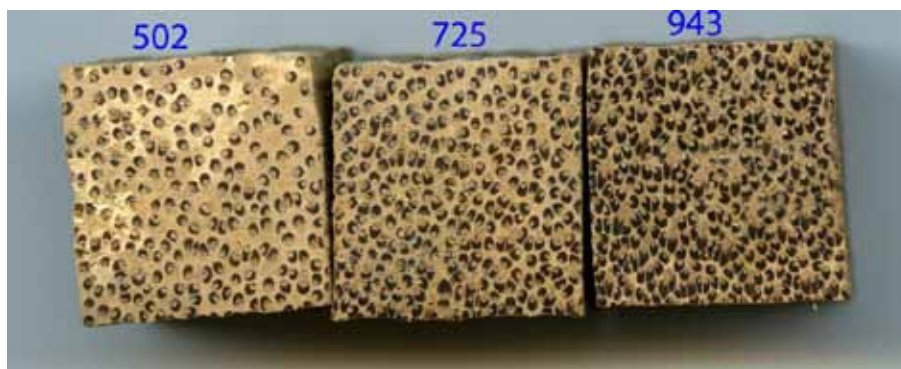
Some definitions

Cocowood density is correlated with the **‘bundle pattern’**.

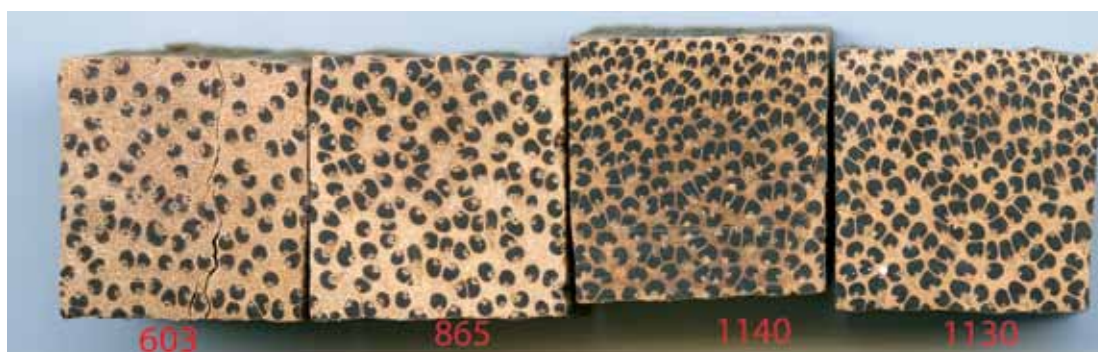
Bundle pattern = *surface area of vascular bundles relative to ground tissue*

= *size + concentration (number of bundles per unit surface area)*

Bundle pattern	High density cocowood -typical patterns	Medium / low density cocowood- typical patterns
size + concentration (number of bundles per unit area)	<ul style="list-style-type: none"> • Large, darker bundles & medium concentrations • Smaller bundles in high concentrations 	<ul style="list-style-type: none"> • Large bundles in low concentrations • Smaller bundles in low to medium concentrations



Bundle patterns for cocowood sections with three different densities: 502 kg/m³, 725 kg/m³ and 943 kg/m³. Cocowood sections are 18 x 18 mm and dried to 12% moisture content.

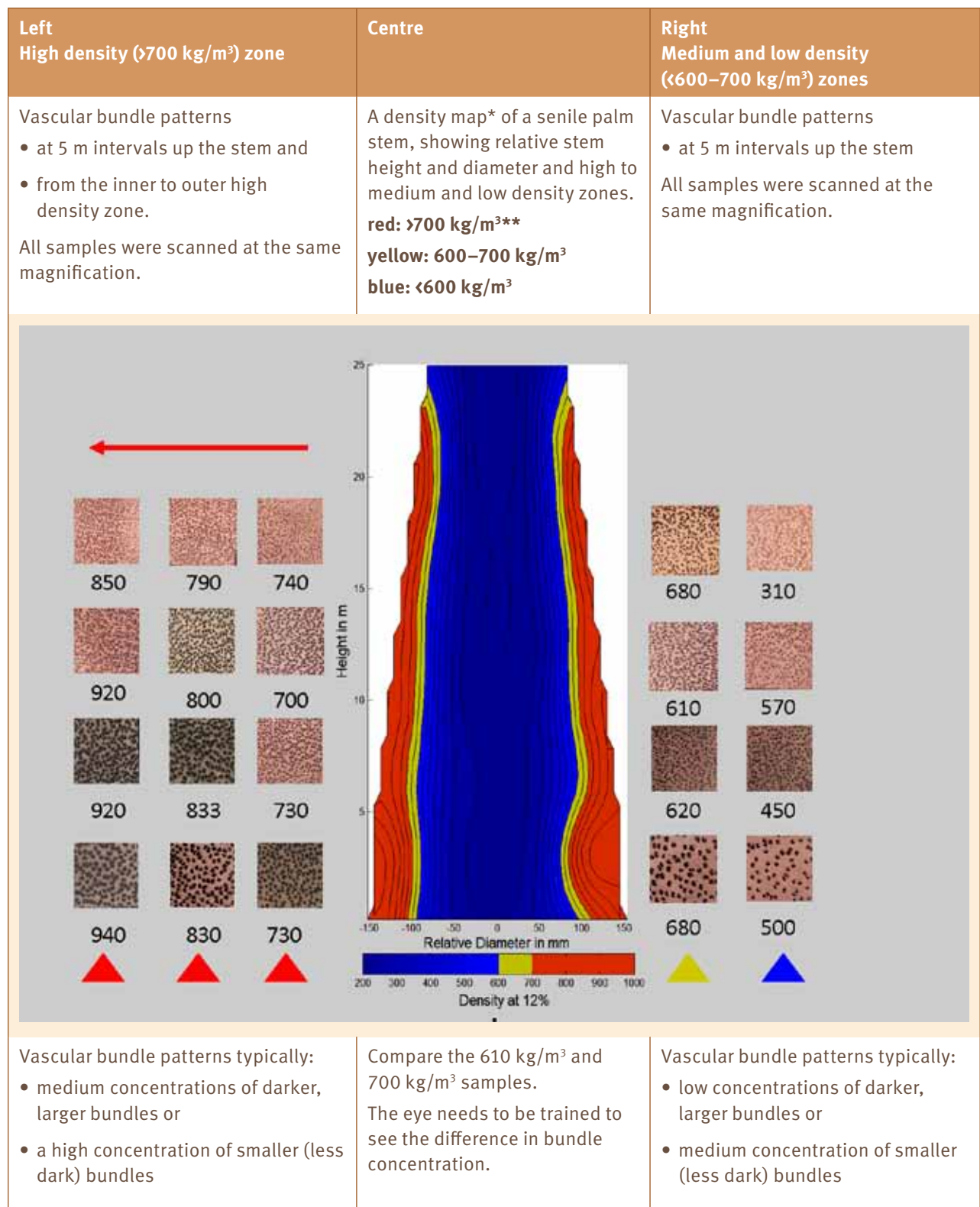


Bundle patterns for cocowood sections with four different densities: 603 kg/m³, 865 kg/m³, 1130 kg/m³ and 1140 kg/m³. Cocowood sections are 18 x 18 mm and dried to 12% moisture content.



ACTUAL SIZE
(18m x 18mm)

This figure shows bundle patterns and density for sections of cocowood in relation to their position in the palm stem.



Bundle patterns and densities of cocowood sections displayed according to their position in a single palm stem, which is represented by a map of fibre density distribution.

*The map was created from 140 cocowood samples with known density and position in a 100 year old palm.

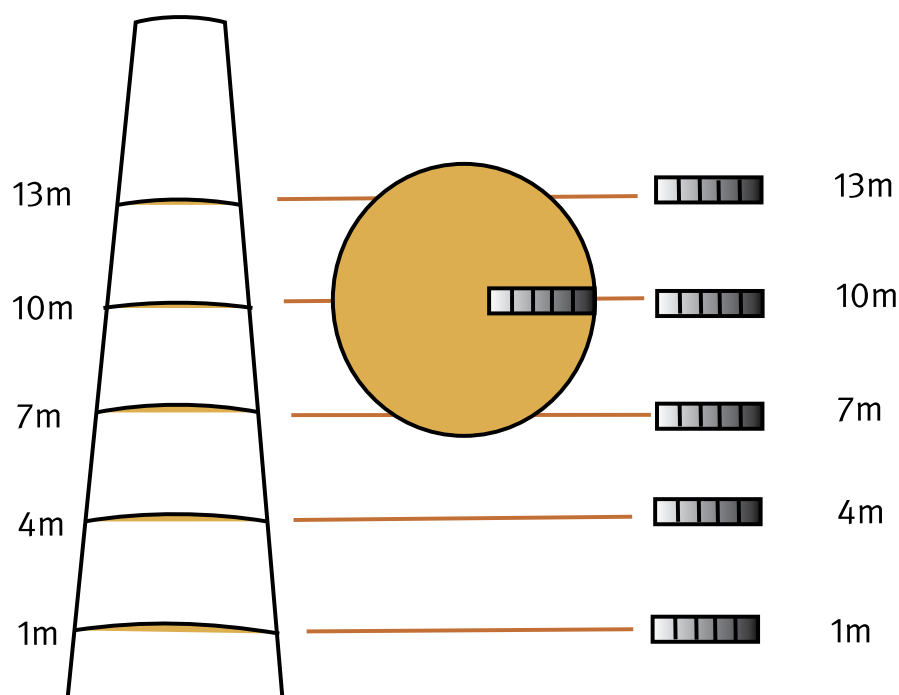
**Air dried density (kg/m³) was measured for each sample.

3. Create a cocowood grading tool

This is a visual cue to help the grader associate vascular bundle patterns with cocowood density and hardness. It is a table of photographs showing the relationship between bundle patterns and position in the palm stem.

Graders need to become skilled in recognising the variation in bundle patterns related to density. This requires training to differentiate between patterns in vascular bundles in cocowood cross-sections. Creating a series of these cocowood grading tools is part of the training.

- Cut discs at 5 m intervals from a **mature** palm stem at: 1 m, 4 m, 7 m, 10 m and 13 m. Older palms have the full range of density zones.
- De-bark the discs.
- Cut 5 samples (each 20 x 20 mm), starting at the outside edge, progressing radially, towards the centre.
- Dry and weigh each sample and calculate air dry density for each one.
- Glue the samples (end-face up to show bundle patterns) on a board, arranged relative to the position of the parent discs in the stem. This arrangement will capture the change from harder (outside material) to less hard (transitional) and softer material (inner core).
- Identify (and mark) the relevant grading threshold for high density on this tool.



cut 5 discs from palm stem & debark

cut 5 samples (each 20 x 20 mm) starting from the outer edge, towards the centre

arrange samples as a chart- to correspond with height and position in the disc

4. Grade boards using the cocowood density grading tool

- Grade each board using the density grading tool. Differentiate between dissimilar bundle patterns and associate with cocowood density.
- Assess the evenness of density (homogeneity) throughout each board.
- Sort boards for appropriate flooring markets.