

**Disclaimer**

This sheet is intended for designers, specifiers and other members of construction project teams wishing to reuse this building material or product. It is part of a collection of sheets aimed at bringing together the available information to date that is likely to facilitate the reuse of building materials and products.

This sheet has been produced by Rotor vzw/asbl within the framework of the Interreg FCRBE project - Facilitating the Circulation of Reclaimed Building Elements, supported by the entire project partnership. Sources of information include the experience of reclamation dealers and involved project partners, lessons learned from exemplary projects, available technical documentation, etc.

The sheets have been produced between 2019 and 2021. As the reclamation sector is evolving, some information, notably regarding pricing and availability, may change over the time. When the text refers to European standards, it is up to the project team to refer, if necessary, to their national implementations and local specificities.

It is important to note that the information presented here is not exhaustive or intended to replace the expertise of professionals. Specific questions are always project related and should be treated as such.

The complete collection of sheets (including the introductory sheet) is freely available from different reference websites (a.o. [opalis.eu](http://opalis.eu), [nweurope.eu/fcrbe](http://nweurope.eu/fcrbe), [futureuse.co.uk](http://futureuse.co.uk)).

Non-exhaustive directories of dealers in reclaimed building materials are available on [www.opalis.eu](http://www.opalis.eu) and [www.salvoweb.com](http://www.salvoweb.com).

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Interreg FCRBE partnership: Bellastock (FR), the Belgian Building Research Institute / BBRI (BE), Brussels Environment (BE), the Scientific and Technical Center of Building / CSTB (FR), Confederation of Construction (BE), Rotor (BE), Salvo (UK) and University of Brighton (UK).

The information contained in this document does not necessarily reflect the position of all the FCRBE project partners nor that of the funding authorities.

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**Material description**

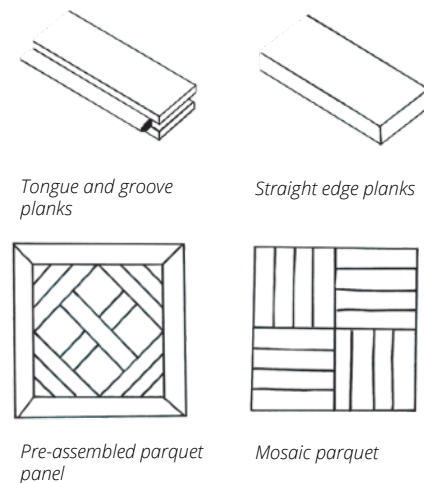
**By definition, a solid wood floor is an interior flooring system consisting of assembled planks and comprising a single layer of solid wood at least 2.5 mm thick.**

Within the framework of this document, we develop the specificities related to the reuse of solid wood floor elements whose original use is identical to the new intended use (i.e. *old wooden floors*). Other old wood flooring products are also available on the reclamation market but come from different applications. This is for example the case of wagon planks, barn wood planks, cheese boards or boards sawn from reclaimed beams (i.e. *old wooden floors*). Although there are some similarities between old hardwood flooring and old wooden floors, this sheet deals exclusively with the former. It also does not deal with the case of the reclamation of laminated wooden flooring, engineered wooden floors, edge strips, end-grain wooden floors and decking boards intended for outdoor use.

Old parquet floors are appreciated for their aesthetics and their reclamation is therefore frequent. Many professional suppliers have specialized in this field. Re-installation of the material can be complex if certain basic conditions are not met. In order to facilitate their reclamation, the elements generally undergo a series of preliminary operations in order to render some of their characteristics uniform. Depending on their condition, the planks may require a complete rework. These operations generally have a significant influence on the costs associated with the reclamation operation.

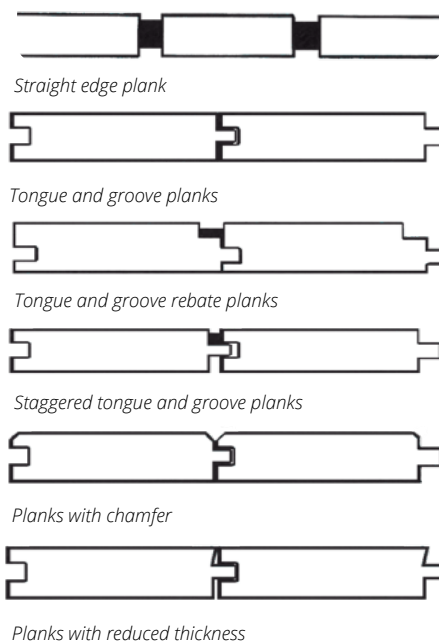
→ **Types.** The main types of reclaimed solid wood flooring are straight edge planks (sometimes called floor planks) and tongue and groove flooring. Pre-assembled parquet panels (Versailles parquet panels, Aremberg parquet panels, etc.) are also found but more infrequently. Mosaic parquet elements are much more rarely reclaimed.

→ **Dimensions.** Depending on the original pattern, the boards are generally characterised by the following dimensions: thickness = 10 to 30 mm, width = 70 to 300 mm, length = 0.5 to 5 m. These dimensions may vary from one batch to another as well as between several elements of the same batch.



→ **Profile.** The boards can be profiled as standard or following specific operations. Profiling can involve 2 or 4 edges and aims to give the planks a particular shape: straight edge, tongue and groove, rabbet, offset groove, with or without chamfer, with or without reduced thickness.

→ **Laying method.** The original method of laying wooden floors has a major influence on the possibilities of dismantling and recovery. Nailed floors are generally easier to recover than glued floors. In addition, the recovery of wooden floors laid with black bituminous glue dating from before the 1950s requires special measures to be taken (see box "Bitume or tar?"). In general, solid wood floors cannot be laid loose.



→ **Species of wood.** The old batches consist mainly of deciduous wood planks (oak, chestnut, beech, hornbeam, walnut, maple, etc.) or coniferous (pine, pitch pine, fir, larch, etc.). Tropical wood species are occasionally found, especially in batches of more recent origin (teak, mahogany, iroko, jatoba, padouk, etc.).

→ **Appearance.** The appearance of a reclaimed wood flooring depends on the intrinsic characteristics of the wood (natural colour, knots, uniqueness of the wood, presence of sapwood, biological alterations, cut, grain, etc.), signs of wear (cracks, scratches, traces of paint, traces of glue on the visible face or on the installation face, holes, etc.) and operations carried out on the boards (rough-hewn, sanded, planed, sandblasted, varnished, oiled, waxed, etc.).

→ **Specific denominations.** Wooden planks generally come from all over Europe and specific denominations are common (for example: "French oak boards", "gymnasium planks", "classic London boards", etc.).



**Laminated flooring**

Laminated flooring (sometimes called sprung-floor) is made up of several layers: a solid wood cladding (wear layer) glued to an HDF (high density fibreboard) or plywood support. In general, it is machined for a floating, fast and economical installation, or a glue-down installation. The reuse of this product is possible but strongly depends on the state of the wear layer. If this is too damaged by use or by planing (previous or to be completed), the durability of the element will be compromised. A solid wood plank, on the other hand, can usually be sanded or planed several times.



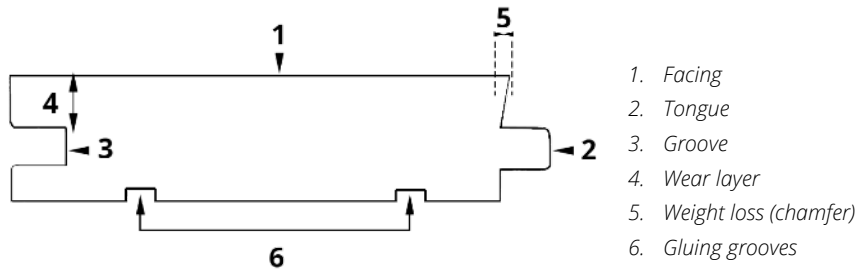
**Material reclamation**

Solid wood floors are frequently found in family homes and in certain larger infrastructures (gymnasiums, exhibition halls, museums, office buildings, etc.). Often easily removable, they are good candidates for reuse, either on-site or through the professional channels of material resellers. Their interest in these items will depend essentially on the model, the quantities and the general condition of the batch.

→ *Evaluation of the potential.* An “expert eye” generally makes it possible to estimate the potential for reclamation during an on-site visit or based on photos and technical information relating to the type of wood flooring, the nature of the substrate, the installation method, quantities, dimensions, etc. A disassembly test completes this information. The focal points will be among others:

- general condition: do the boards show significant damage (moisture damage, deformation, cracks, traces of mould, traces of insects, traces of an additional coating, etc.)? What is the condition of the topcoat and wear layer? Uniformity of dimensions? What is the installation method (glued/nailed)? Are the planks easy to remove without getting damaged? Are the tongue and grooves glued? Are they weakened? Is there a risk of the presence of dangerous substances (asbestos, lead, tar, etc.)?
- the available documentation (technical sheets, declaration of performance, maintenance logs, etc.) and the assessment of the conditions of use (use of premises, traffic intensity, hygrometric conditions, variations in nuances linked to differentiated exposure, maintenance conditions, etc.).
- Commercial interest, depending on model, quantity, resale potential, ease of resizing, etc.,
- logistical arrangements, including deadlines, handling, organization of transport, etc.

Slight surface damage such as scratches, traces of paint or traces of glue can in most cases be corrected by adequate sanding/



Anatomy of a tongue and groove floorboard.

planing. In general, it must be taken into account that the thickness of the wear layer after sanding/planing must be sufficient ( $\geq 2.5$  mm) to allow reclamation.

→ *Removal.* The careful dismantling of a solid wood floor must ensure the safety of workers and the integrity of the recovered elements. Particular attention must be paid to the risks linked to the presence of dangerous substances (asbestos, PAH, etc.) as well as to the risks linked to the possible presence of electrical wiring under the flooring. In a building affected by heavy work (demolition, renovations, asbestos removal, etc.), it is preferable to dismantle the wooden floors before starting this work. Otherwise, the necessary precautions must be taken to prevent them from being damaged by knocks, humidity, dirt, exposure to dangerous substances, etc.

In general, the removal depends on the original installation method. First, the skirting boards and door sills should be removed. Then, the planks are removed one by one, from one side of the room, using appropriate tools (crowbar, stripping pliers, pincers, wood chisel, etc.). The first planks are often complicated to remove without damage. In the case of tongue and groove floors, it is always advisable to start with the edge of the last row laid. The nailed floorboards are gradually raised over the entire length to the level of the nails. Particular attention will be paid to the tongue and grooves (avoid forcing, twisting or applying a lever arm at this point).

It is recommended to extract the nails from the boards when removing them using a pincer (+ wedge to avoid damaging the visible face) or a pneumatic nail punch. This step reduces the risk of deterioration of the planks during their transport and storage, and facilitates their subsequent re-working.

Traditionally, the nails are positioned in an inclined fashion at the level of the tongue, which can make their extraction difficult. The levelled nails will be more complicated to extract later.

A percentage of losses (20 to 40% of the removed surface) is generally admissible due to potential breakage and cuts.

After removal, the planks are visually sorted according to their condition (cracks, flatness, wear, condition of the grooves and tongues, presence of insects, etc.) and their characteristics (dimensions, left or right planks, etc.). Similar elements are preferably grouped, numbered and correctly identified in order to guarantee the uniformity and traceability of the batches. They are stored flat, on a pallet (no contact with the ground) and sheltered from bad weather.



Removal of a wooden floor nailed to joists

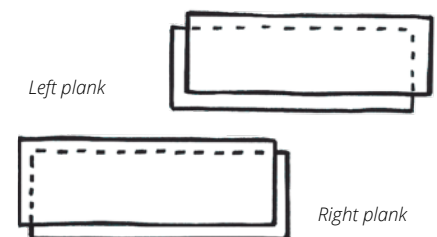


Diagram of left or right planks (tongue and groove)



→ **Operation.** Depending on their condition, solid wood floorboards may go through several operations before being re-installed. Most of the time, specialized suppliers have the necessary expertise and automatically carry out some of these operations. However, sometimes the wood is salvaged or sold in its original condition. It is then up to the buyer to anticipate the necessary steps.

- **Removal of metallic elements.** If this has not already been done during disassembly, nails, screws and other metal parts are removed using suitable tools (pliers, pneumatic nail punch). This laborious process is essential if woodworking is planned later, at the risk of damaging the machines. Using a metal detector makes it easier to locate metal objects.
- **Superficial cleaning.** By brushing, sanding or sandblasting according to requirements. Each process affects the appearance of the planks differently.
- **Cleaning of adhesive residues.** Depending on the type of glue and the ease of cleaning. This operation is carried out using manual (spatula and planer) or mechanical (planer) tools.
- **Cleaning the edges.** Often clogged by glue and varnish residues or by stubborn dirt, the edges on the right edge and the grooves/tongues are carefully cleaned using wood chisels. This is usually necessary to avoid complications during re-installation.



Tongue and Groove Cleaning Tools

- **Sawing and edging.** The planks can be cut to defined lengths and widths, or according to the requirements of the laying pattern (for example: Hungarian herringbone, herringbone, etc.). It is common for damaged ends of the planks to be cut off. It is also possible to reduce the thickness of the planks, for example to meet the requirements of underfloor heating or to remove bituminous adhesive residues.

- **Planing.** For repairing the wear layer, to remove traces of glue, or for batches with significant differences in thickness. In fact, wooden floorboards are stressed differently during their life. Typically, the centre of a living room is more stressed than its edges, which results in a more pronounced wear of the central planks. The recovered planks are then planed on one or two sides to obtain planks with a constant thickness. In this case, it is important to take into account the specific dimensions of the tongue and groove system, and to ensure that all planks are compatible for re-installation. At the end of this operation, the wear layer must have a minimum thickness of 2.5 mm to ensure good resistance over time and allow subsequent renovations.



Planing

- **Complete reworking** (dimensional calibration). In addition to being sawn and planed, the planks can be milled to rectify the tongue/groove system or to create a chamfer. Reworked planks are generally certified "ready to install".



Re-machining of tongue and groove

- **Drying.** According to the hygrometric state of the wood. The elements are generally dried naturally in a shed, taking the necessary storage arrangements (spacing between the elements, no contact with the ground, heating, ventilation, etc.). Artificial kiln drying can be used to reduce and stabilize the humidity level. Artificial drying helps eliminate potential pests (moulds, insects) and is often recommended for underfloor heating applications.

- **Repair.** Puttying or filling the holes can be carried out.
- **Finish.** Depending on the requirements, the type of original finish (oiled, varnished, waxed) and the condition of the reclaimed wooden flooring, the boards will need quite heavy sanding in order to apply the new finish (for example a formerly waxed floorboard and intended to be varnished must be sanded to bare wood otherwise stains will appear). This operation is most often carried out at the time of installation. It is advisable to turn to ecological finishing products and respect environmental and health regulations.
- **Insecticide treatment.** In case of risk of wood infestation. Infested planks should be discarded and the rest of the affected batch is preferably treated through impregnation. Several types of preventive or curative treatments exist, for example by soaking, sprinkling, brushing, autoclave, thermal, etc. They are governed by standards and recommendations for use, in particular with regard to the impregnability of wood species (see § Characteristics and fitness for use). Professional advice is recommended, especially if the wood has undergone this type of treatment before or if a topcoat is present.
- If necessary, the planks can be treated specifically to improve their reaction to fire (fireproofing).

#### Truly Reclaimed Label

As part of the European FCRBE project, to which these sheets are annexed, the organization Salvo Ltd. (UK) is working on the development of a "Truly Reclaimed" label, making it possible to certify the authentically recovered origin of materials (as opposed to artificially used materials). This label should see the light of day very soon for reclaimed wood products.





**Bitume or tar?**

It is not uncommon to find solid wood floors glued using bituminous or tarred glues. These adhesives were commonly used until the second half of the 20th century. Depending on their composition, they are likely to contain **asbestos** as well as a high content of PAHs (**Polycyclic Aromatic Hydrocarbons**). Unlike tar, bitumen contains little PAH (see table below). These toxic and carcinogenic substances are detected through samples and laboratory tests. It is recommended not to perform any disassembly before obtaining the result of these tests (asbestos inventory and HAP test).

Wooden flooring boards with remains of tar or asbestos glue cannot be reclaimed and must be treated as hazardous waste. As for bituminous adhesive residues, they can be removed by taking appropriate precautions (personal protective equipment, air extraction, dust removal, etc.). There are companies specialising in this operation. As the hardness and workability of bitumen is related to temperature, these operators generally prefer to plan bitumen removal in winter.

Glue type	Benzo (a) pyrene (PAH) content	Toxicity (risk)
Bitumen	<50mg/kg	Not dangerous
	> 50mg/kg	Dangerous!
Tar	> 4000 to 7000 mg/kg	Very dangerous !

For your information, there are tar-revealing sprays on the market for detecting PAH concentrations greater than 100 mg/kg.



Cleaning of bituminous adhesive residues  
© [www.parquetbitumenremoval.co.uk](http://www.parquetbitumenremoval.co.uk)

→ **Storage.** The planks are stored horizontally and stacked on pallets or in pallet boxes (for short lengths), properly strapped in and protected from external moisture. Good ventilation and a heated environment (relative humidity of the room = 40 to 65%, temperature = 20° C) make it possible to control the humidity of the wood in order to avoid subsequent deformations. Tongue-and-groove boards are preferably stored groove-to-groove. In general, it is advisable to avoid excessive overhangs, which could deform the boards under their own weight. The placement of spacers or the use of appropriately sized pallets can prevent this risk. The batches can be cellophane wrapped, taking care however to let the wood breathe.

→ **Transport and delivery.** All necessary precautions must be taken during transport and delivery (strapping, means of handling, protection against rain, loading, etc.).



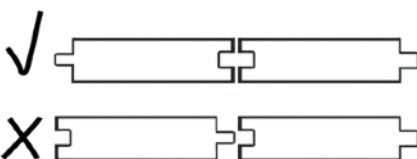
Pallet-box storage



Pallet storage



Transport



Groove-to-groove storage of tongue-and-groove boards

ÉCONOMIE CIRCULAIRE  
DES BÂTIMENTS

**Méthodologie  
de diagnostic et  
d'évaluation des  
performances  
pour le réemploi  
de parquets**

FONDATION  
BÂTIMENT  
ÉNERGIE

**Read more!**

Diagnostic and performance evaluation methodology for the re-use of parquet - Fondation Bâtiment Énergie (FBE), December 2020 (In French)  
<http://www.batiment-energie.org/doc/70/FBE-ECB-enjeu-A-parquets-v8.pdf>

**Applications and installation**

**The reimplementation of reclaimed “ready to install” solid wood floorboards is no different from that of new wood flooring. It raises the same points of attention, in particular and according to the targeted applications: choice of materials and fitness for use, installation method, properties and condition of the support, floor height, orientation of the boards and layout, thermal and acoustic insulation, fire resistance, underfloor heating, peripheral expansion joint, prevention of humidity risks, finishes, maintenance procedures, humidity and temperature condition during installation, installation times, costs, etc.**

Depending on the application, reference should be made to the European and national standards relating to the product (e.a. EN 14342), to rules of practice in force and to installation standards. According to the regulations in force, it is also necessary to take into account the thermal and acoustic requirements, protection against termites, fire resistance, etc.

Leaving some latitude on the dimensions, texture, colour of the wood and all the non-essential characteristics often makes it easier to find a batch on the reclamation market. This approach generally requires adopting more flexible design and installation strategies, which make it possible to highlight the heterogeneity of the batches while respecting the essential requirements. For example: random-width installation in free lengths or variable widths, etc. In general, it is recommended to be accompanied by a professional floor layer to assess the feasibility of the reclamation operation .

Despite their extensive knowledge of the materials and the valuable advice they can give, resellers of used solid wood flooring generally do not certify all the characteristics of the items they supply. On the other hand, some provide guarantees on aspects such as the uniformity of the batches, the dimensions of the elements, the maximum humidity level, the condition of the wood (without metal parts, mould, cracks, etc.) or even on its origin (some resellers thus affix the *FSC recycled* label which certifies that the wood comes from the dismantling of a building and

not from the cutting of trees, or the *Truly Reclaimed* label). Some suppliers are able to provide documentation on the product purchased (for more information, see the introductory sheet).

Depending on the intended use, the specifier may need to specify his expectations regarding the following characteristics:

→ *Species*. Depending on the intended use, the choice of wood species may be essential. Indeed, each species has its own characteristics, particularly in terms of sensitivity to knocks and scratches (hardness), humidity and deformation, insects and discoloration, etc. (see § *Characteristics and fitness for use*). The choice of naturally rot-resistant species (some tropical woods) should be considered for wet applications such as bathrooms.

→ *Condition*. Reclaimed solid wood floorboards may show minor alterations such as:

- traces of surface wear (nicks, cracks, holes, etc.)
- slight deformations that do not prevent installation (deflection, bending, torsion, swelling)
- slightly nicked or cut edges
- slight damage to the tongue and grooves that does not prevent re-installation
- stains, traces of paint or old finishes
- presence of nails and other metallic elements.

These deteriorations can influence the technical and aesthetic performances, as well as their reinstatement, but do not constitute a major obstacle for reuse (see § *Characteristics and fitness for use*). It is up to the designer/specifier to define the degree of imperfection tolerated, according to the defined use and the installation conditions, by specifying the degree of acceptable alterations.

Planks showing major deterioration such as significant deformation (deflection, bending, torsion, swelling), a wear layer less than 2.5 mm thick, traces of rotting and mould, heavily cracked tongue and groove, etc. must be systematically discarded. Planks with wormholes that are still active (presence of sawdust) must be treated appropriately.



*Care should be taken to ensure that there are no larvae of xylophagous insects which could spread to other wooden elements in the building. A visual inspection of the boards is recommended at the time of installation. For greater safety, it is also possible to get artificially dried planks (kiln drying process), aimed at providing an insecticidal preservation treatment or a heat treatment.*

→ *Types et dimensions*. Usually, the choice of a type of wooden floor depends on the pattern and the method of laying provided for. However, the opposite approach can also be considered: choosing the pattern and the installation method according to the possibilities offered by a batch of available wood floorboards! In general, the thickness of the boards must be uniform, particularly in the case of tongue and groove systems. Random-width flooring patterns allow greater flexibility in terms of width and length. Conversely, the herringbone and Hungarian herringbone patterns are more demanding. One solution may be to get precise dimensional characteristics or to provide for a transformation of the material (planing, edging, machining, etc.).







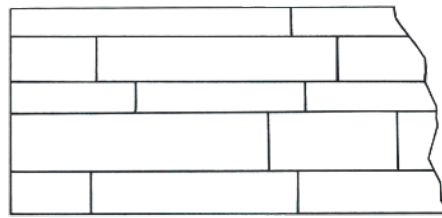
→ **Humidity.** In general, to avoid deformation of the wood due to moisture (movements, swelling, cracks, etc.), a maximum wood humidity level of  $10 \pm 3\%$  is recommended for installation. Many suppliers are able to meet this requirement. If necessary, this parameter can be measured using a moisture meter. Additional precautions are recommended to avoid variations in relative humidity and temperature during and after installation: acclimatization of the batch to ambient air, control of the humidity of the substrate, waterproof underlay, additional precautions for underfloor heating, etc.

→ **Finish.** According to the defined requirements: raw, brushed, sanded, planed, varnished, oiled, waxed, etc. If a new topcoat is applied, by the supplier or on site, it is recommended to use products that respect the environment and the quality of indoor air.

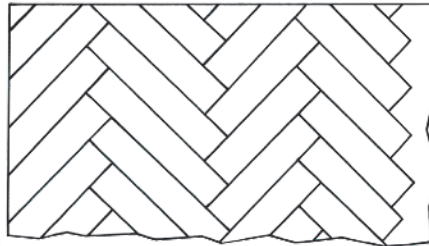
→ **Toxicity.** For indoor use, care should be taken to ensure that the wood has not been treated or exposed to toxic substances during its previous use, particularly if the application is likely to involve contact with humans/animals and/or food. In the absence of information on this subject, it is best to stick to the "precautionary principle" (see § *Characteristics and fitness for use*).

→ **Quantities.** It is important to purchase a sufficient quantity of planks from the outset. As each batch has unique aesthetic characteristics, it is not certain that an identical model will still be available with a subsequent order. In general, it is advisable to order a surplus of 10 to 15% depending on the condition of the batch and the design strategy chosen (up to 25% for heterogeneous batches). To increase the chances of meeting the offer available on the reclaimed market, the designer/specifier can choose to split the batch with different models.

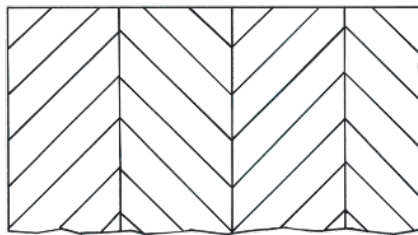
→ **Laying pattern.** There is a very wide variety of laying patterns. Opting for a pattern identical to the original one is a good way to avoid too much change in the boards. In some cases, more substantial machining can allow a successful reclamation operation (for example, a broken batten flooring transformed into a Hungarian herringbone flooring by sawing off the damaged corners). Some professional suppliers are also able to offer a layout assistance service. Examples of patterns:



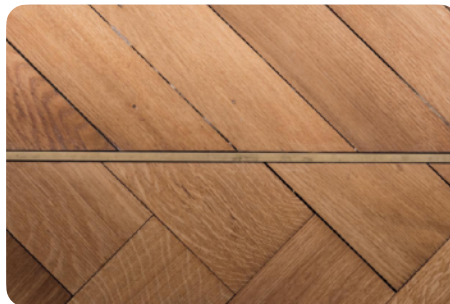
Free length and random-width flooring



Herringbone flooring



Hungarian herringbone flooring



Assembly details of different batches. (left) MAMOUT architecten & Atelier d'architecture AUXAU / Huis Renier-Chalon (BE) © Guy-Joël Olivier, (right) Librebook © ROTOR

**Design tip!**

To increase the chances of meeting the offer available on the reclamation market, the designer/specifier can choose to accept several different batches and distribute them in an organised manner in the building. For example, by providing a uniform batch for each separate space, or by ensuring elegant junctions when combining several batches. These design strategies generally result in interesting architectural qualities. They must be anticipated and be the subject of in-depth studies, in particular to ensure that the batches are compatible with each other.

→ **Fixing method and reversibility.** When the intended application allows it, nailed installation is to be preferred to glued installation, the latter possibly compromising future reclamation.

→ **Underfloor heating.** The combination of underfloor heating and solid wood flooring is not always easy. It is recommended to call in a specialist to determine the specific requirements of this system: wood species and suitable thickness, wood stability, relative humidity and drying of the boards, slenderness ratio of the boards, etc.

→ **Fire performance.** The reaction to fire class can be determined with regard to the type of wood and the thickness of the boards. Certain flame retardant treatments make it possible to improve this characteristic.



**Characteristics and fitness for use**

The reuse of reclaimed solid wood flooring generally requires mastering certain characteristics that allow compliance with the requirements relating to the intended application. The main characteristics, defined in particular in the harmonized standard EN 14342 (relating to new products) or in the installation standards, can for the most part be evaluated by professional flooring specialists. For your information, they are listed in Table 2.

In general, each species of wood can be characterised by a series of parameters relating to the expected level of performance. It is imperative to take this into account for more demanding applications. For the most common species of reclaimed solid wood flooring, table 1 shows some of these parameters relevant for flooring applications. Other parameters may be required as need be. It is relatively easy to find this additional information but also for other less common species (elm, walnut, etc.).

Table 1 : Characteristics of the most common types of wood in reclaimed solid wood flooring

	Density [kg/m <sup>3</sup> ]	Monnin / Janka hardness (1)	Stability in use (2)	Sensitivity to insects (3)	Impregnability class (4)
European oak <i>Quercus robur</i>	740	4,2 / 6049 N (mid-hard)	moderate	No/Yes	4
Chestnut <i>Castanea sativa</i>	640	2,9 / 3070 N (soft)	moderate	No/Yes	4
European maple <i>Acer spp.</i>	600	4,7 / 4850 N (mid-hard)	moderate	Yes/Yes	1
Beech <i>Fagus sylvatica</i>	710	4,2 / 7060 N (mid-hard)	moderate	No/No	1
Scots pine <i>Pinus sylvestris</i>	550	2,6 / 2940 N (soft)	moderate	No/No	3-4
Pitch pine <i>Pinus caribaea</i>	580	3,5 / 5000 N (mid-hard)	low	No/No	3-4
Fir/Spruce <i>Picea abies</i>	450	2,5 / 1910 N (soft)	moderate	No/No	3-4
Teak <i>Tectona grandis</i>	670	4,2 / 4450 N (mid-hard)	moderate	No/Yes	4

- (1) There are various methods for determining the hardness of wood, with different test arrangements (e.g. Monnin, Janka, Brinnell). The values below, taken from different sources, are given as an indication. They show the transversal sinking resistance at 12% Humidity. These are indicative data's because variations exist depending on the growing conditions of the trees.
- (2) Ability of wood not to warp under the influence of variations in humidity and temperature.
- (3) Heartwood/Sapwood - susceptibility to *Lyctus* attacks.
- (4) Only for heartwood, 1 = Impregnable -> 4 = Non-impregnable.

Wood species with a high density are generally harder. This is also accompanied, in most cases, by better resistance to wear and puncture. In traditional architecture, resinous species, less dense, such as pine or spruce, were often reserved for less stressed spaces (bedrooms, attics, etc.). Today, these species are often less expensive than deciduous trees or tropical species.



Reclamation of 50 m<sup>2</sup> of broken-batten floorboards. The planks were sawn through to remove the old bitumen glue. They were then reworked in order to be re-installed (glued installation) with a Hungarian herringbone pattern, Boom (BE) © Atelier Passe Partout





Table 2: Relevant characteristics (depending on the context) for the evaluation of the fitness for the use of reclaimed solid wood floors.

Characteristics	Comments
<b>Species</b>	The identification of the wood species is generally essential for the evaluation of the performance of a wood floor. This characteristic can be determined by professional suppliers or in the laboratory.
<b>Hardness</b>	The hardness of a wood species determines its resistance to fracture (see Table 1). It is essentially a function of the density of the species considered and the arrangement of the fibres. It is commonly expressed on a scale from 1 to 10 (Monnin hardness) or [N] (Janka hardness) or [N/mm <sup>2</sup> ] (Brinell hardness). This parameter must be considered with regard to the envisaged application. In general, "harder" species are more suitable for high stress applications (entrance hall, retail space, etc.).
<b>Wood stability</b>	This performance characterizes the way in which wood behaves when subjected to significant variations in humidity or temperature (see table 1). This notion integrates the importance of deformations ("wood movement") and the speed at which they take place. A stable wood species is likely to be more suitable for applications subject to large variations in humidity (e.g. bathrooms). Design and installation details are also to be considered (type of wood floor, installation method, dimensions, etc.)
<b>Use category</b>	The use category of new wooden floors is often determined with regard to the hardness of the species and the thickness of the surface of the boards (wear layer) (French standard XP B 53-669 or EN ISO 10874). In the case of reclaimed solid wood floors, it is relevant to refer to these standards, provided that the type of wood can be determined with precision and that the thickness of the residual wear layer takes account of the sanding/planing operations.
<b>Surface quality</b>	In some cases, aesthetic requirements may be given on the appearance of the wood and the admissible defects of the surface. These requirements should be detailed based on general criteria (presence of stains and holes, traces of paint, wood finish, etc.) or specific to the wood species considered (percentage of knots, variation in colour, presence of healthy sapwood, cracks, pockets of resin, variations in the slope of the grain, etc.). Whether a batch meets these requirements depends on many factors. Leaving some latitude on these non-essential characteristics (as long as they do not affect the solidity and wear resistance of the flooring) often makes it easier to find a batch on the reclamation market.
<b>Plank sizes and profiling system</b>	The dimensional characteristics are closely linked to the degree of sorting or to the operations carried out on the reclaimed solid wood floorboards. Depending on the type of floorboard, the laying method and the intended pattern, permissible deviations are to be considered. In general, completely reworked planks meet these requirements more easily. A visual or detailed examination of the batch is often sufficient to estimate these characteristics.  It should be ensured that the thickness of the boards corresponds to the intended use. The thickness of the wear layer must be greater than 2.5 mm.
<b>Geometric characteristics and acceptable deformations</b>	The requirements related to the straightness of the edges, the angularity, the flatness of the surface, the bending, the sagging or the warping of the boards are defined with regard to the type of flooring, the method of laying and the planned pattern. These characteristics are closely linked to the degree of sorting or to the operations carried out on the reclaimed solid wood floorboards. In general, completely reworked planks meet these requirements more easily. A visual or detailed examination of the batch is often sufficient to estimate these characteristics.
<b>Humidity level</b>	To avoid subsequent deformation, solid wood parquet boards must be installed at a balanced humidity level defined according to the application ( $H = 10 \pm 3\%$ ). This parameter essentially depends on the drying and storage conditions of the wood. A check can be carried out by using a moisture meter.
<b>Flexural strength and rigidity</b>	These characteristics are relevant to evaluate for self-supporting solid wood floors or for specific applications (e.g.: sports hall).



Characteristics	Comments
<b>Wear resistance</b>	The wear resistance of a wooden floor is evaluated with regard to the wood species used and the type of finish (for example, a varnished finish in 3 coats greatly improves the wear resistance). In general, dense woods (see Table 1) are less susceptible to wear. Assessment of this performance is particularly relevant for applications subject to intense traffic or likely to be exposed to large quantities of abrasive particles (entrance hall, etc.). A test assessment using a Taber abraser is possible (EN 13696).
<b>Puncture resistance</b>	This characteristic is assessed according to the intended use (for example: presence of heavy furniture, flimsy surface of the support points, etc.) and the hardness of the wood species. In general, dense woods (see Table 1) are harder and less sensitive to puncturing. A test assessment is possible (Brinell hardness measurement, EN 1534).
<b>Slippage</b>	The slip resistance of a wooden floor is evaluated with regard to the intrinsic characteristics of the material (grain, type of finish, etc.) as well as by its conditions of use (presence of water or particles, frequency of traffic and wear, maintenance, etc.). This characteristic is therefore likely to change over time. Its determination can be made by laboratory or on-site test measurements (SRT pendulum test).
<b>Reaction to fire</b>	<p>Specific requirements for the reaction to fire of coatings are determined by national regulations. These requirements depend, among other things, on the use of the premises (for example: private or community housing, emergency exits, etc.), on the height of the building, as well as by the ability of users to evacuate the premises in the event of fire (senior citizens' residence, hospital, etc.).</p> <p>The reaction to fire of construction products is defined by European standard EN 13501-1 (Euroclass) and is assessed in particular on the basis of a test carried out under the final application conditions, i.e. taking into account the entire construction system (support + underlay + wood floor + finish).</p> <p>In the case of solid wood floors, it is possible to assess the reaction to fire class without prior testing, through a series of predefined combinations, which take into account the type of floorboard, the wood species (density), minimum thickness and installation conditions (for more information, refer to standard EN 14342).</p> <p>It is therefore important for the designer/specifier to meet regulatory requirements in terms of reaction to fire by determining the materials and their method of implementation, with regard to the intended use.</p> <p>To a certain extent, it is conceivable to subject the floorboards to a fire retardant treatment which makes it possible to improve the reaction to fire and reduce the contribution to conflagration and the propagation of a fire. It is necessary to ensure the compatibility of the boards with existing solutions (impregnation, film-forming finish, varnish, etc.), in particular with regard to the impregnability characteristics of the wood.</p>
<b>Thermal properties</b>	The insulating properties of a wooden floor depend essentially on the type of wood and its thickness. The higher the density, the less insulating the floorboard. Tabulated values are used to calculate the thermal resistance of solid wood floors with regard to the type of wood and its thickness as well as the characteristics of the support and the underlay used. This performance assessment is particularly important in the case of underfloor or reversible heating.
<b>Acoustic properties</b>	Generally speaking, solid wood floors as such are not good sound insulators. The acoustic performance of a floor covering must be assessed taking into account the underlay and the support (for example: soundproofing screed, acoustic underlay, etc.).
<b>Toxicité</b>	Solid wood floorboards may have been treated with toxic products or have been in contact during their use with dangerous substances (for example: lead, asbestos, tar, PCP, etc.). Most of the time, even if it is possible to visually detect the presence or absence of traces of glues, preservative and finishing treatments, it is generally more complicated to determine the substances present. Laboratory tests may be required to assess the dangerousness of the contaminants present. A complete rework of the boards and/or the application of a film-forming finish (for example: vitrifying varnish) may be a solution. In the absence of information on this subject, it is best to stick to the "precautionary principle" or likely to interact with people, for interior applications. In general, it is advisable to turn to ecological finishing products and to respect environmental and health regulations.



Assessing the impact of reclaimed timber construction products on global warming is complex and difficult to generalize. The general principle is that construction timber can confine biogenic carbon. Reclamation is therefore a way of preserving these carbon stocks and preventing it from being released into the atmosphere (which would be the case if the wood was incinerated, for example). The overall environmental assessment of a reclaimed wooden element must, however, also take into account aspects such as the origin of the product and the distance travelled, the use of preservation treatment, etc. For more information, it is advisable to consult the specific paragraph devoted to this question in the introductory sheet.

**Availability**

The availability of reclaimed solid wood floors depends on the quantities required. As an indication, for uniform batches:

Frequent	0 → 50m <sup>2</sup>
Occasional	50 → 100m <sup>2</sup>
Rare	100 → 250m <sup>2</sup>

**Indicative prices (Excl. tax)**

A non-exhaustive sampling of the reclamation market in North West Europe (Belgium, France, Great Britain and the Netherlands) made it possible to extract some indicative prices. These vary according to the origin, the history, the dimensions, the patina, the quantities or the degree of preparation of the planks. Softwood (pine, spruce) flooring is generally less expensive than hardwood (oak, chestnut, beech, tropical species, etc.) but does not have the same properties.

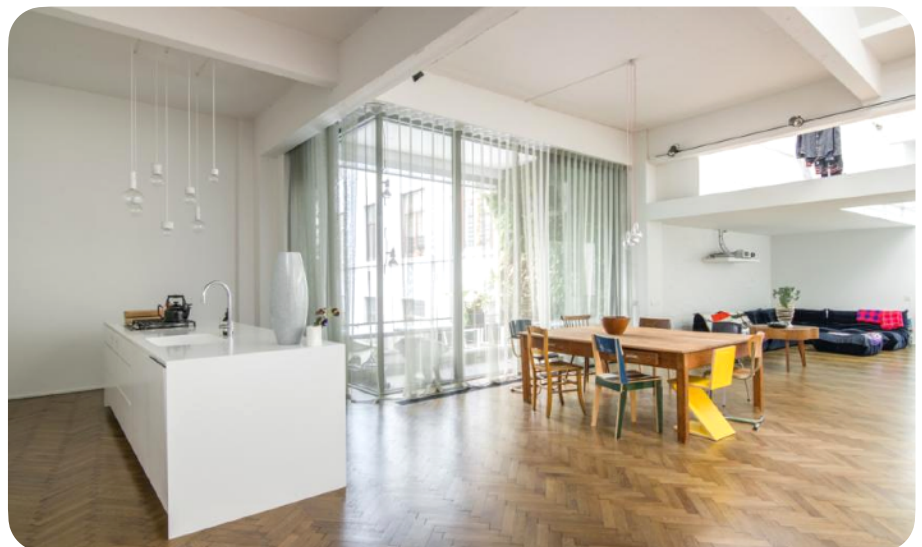
Some observed prices for private customers :

- Oak flooring (planks): 40 to 150 €/m<sup>2</sup>
- Pine flooring (planks): 10 to 50 €/m<sup>2</sup>
- Oak parquet (panels): > 160 €/m<sup>2</sup>
- Sports hall parquet: 50 to 100 €/m<sup>2</sup>

Depending on the condition of the original floorboards, several preparatory stages of the product for installation may be required. These steps are often necessary to allow an efficient and smooth installation. The cost generated can vary between 25 to 100 €/m<sup>2</sup>. Wanting to save money by buying an unprepared product is therefore not always a good idea, unless you have the necessary time, skills and tools!



Reclamation of 80 m<sup>2</sup> of oak floorboards, herringbone pattern, Librebook bookstore, Brussels (BE) © Rotor



Reclamation of 290 m<sup>2</sup> of oak floorboards, herringbone pattern, private project, Brussels (BE) © K2A architectes, Oana Crainic.

**For more information!**

Product sheet-application: solid wood floors for re-use as indoor flooring. The Brussels Building: Source of new Materials (BBSM). May 2021. (In French).

[https://www.bbsm.brussels/wp-content/uploads/2021/06/annexe-21-WP6\\_fiche-produit-application-parquet-en-bois-massif-de-reemploi-revetement-interieur.pdf](https://www.bbsm.brussels/wp-content/uploads/2021/06/annexe-21-WP6_fiche-produit-application-parquet-en-bois-massif-de-reemploi-revetement-interieur.pdf)



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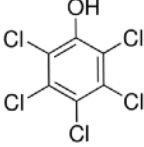

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**Hazardous substances and precautions**

Reclaimed solid wood floors may have been treated with toxic products or have been in contact with hazardous substances during their use. Most of the time, even if it is possible to visually detect the presence or absence of preservative and finishing treatments, it is generally more complicated to determine the exact nature of the substances present. Lead, asbestos, Polycyclic Aromatic Hydrocarbons (PAHs) and Pentachlorophenols (PCP) are among the hazardous substances likely to be encountered in reclaimed parquet boards. Their concentration in wood, their effectiveness and their residual harmful power are difficult to estimate without implementing specific laboratory tests. In the absence of information on this subject, it is best to stick to the “precautionary principle” or likely to come into direct contact with people for interior applications. In addition, sawing, planing, sanding, etc. must be carried out by taking the appropriate safety measures (personal protective equipment, dust extraction systems, waste disposal, etc.).

	<p>A <i>lead</i> diagnosis may be necessary to detect the presence of old lead paints on wooden floorboards. This diagnosis can be carried out either using a commercially available lead test kit, or by sending a sample of the paint to the laboratory or by having this test carried out by a professional. If the presence of lead is proven, it is strongly recommended to strip using a specialized operator. It is strongly advised against using a heat gun, sander or sandpaper to remove lead paint. Chemical stripping will be preferred, with adequate health and environmental provisions. An alternative to stripping can be to apply a new top coat so that the old coat of paint is completely encapsulated.</p>
	<p>Reclaimed wood floorboards may be contaminated with <i>asbestos</i> present in old, bituminous or tarred wood adhesives (see specific box) or old resilient flooring adhesives (if the flooring has been covered with vinyl by example). Contamination can also come from dust resulting from poorly carried out asbestos removal work. It is therefore advisable, as far as possible, to remove the floorboards before the asbestos removal work or to ensure that all protective precautions are taken if this work is carried out before removal. In all cases, inquire about the asbestos diagnosis if available.</p>
	<p>The contamination of wooden floorboards by <i>PAHs</i> is mainly due to the presence of old bituminous or tarred adhesives (see specific box).</p>
	<p><i>Pentachlorophenol (PCP)</i>. The use of this wood treatment agent (pesticide) has been regulated in Europe since the 1990s. However, there is a low risk of finding this persistent, toxic and endocrine disrupting pollutant in reclaimed solid wood floors. It is a substance which can be carcinogenic in high doses. The absence of direct contact with the material or the application of a film-forming finish (for example: vitrifying varnish) makes it possible to limit the risk.</p>
	<p>For more information, see the following document written by INRS which summarises the main wood treatment products (constituents, hazards, uses, preventive measures): <a href="https://www.inrs.fr/media.html?refINRS=ED%20981">https://www.inrs.fr/media.html?refINRS=ED%20981</a> (in French).</p>