

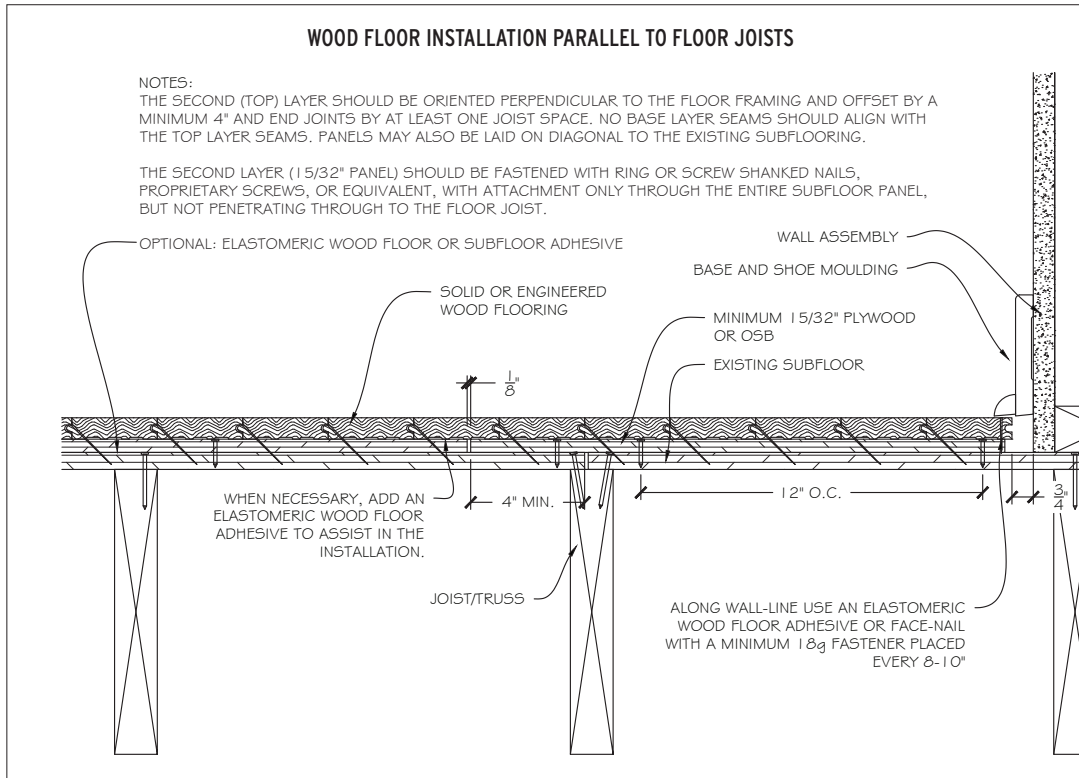
INSTALLATION METHODS: Nail-Down

Many types of floors can be nailed down in many different situations. No matter the specific job requirements, there are several items that need to be addressed and followed during each installation. When available, the flooring and nailer manufacturer's instructions should always be followed. This includes all recommendations and requirements that give instruction on preparation, installation, or use of the wood floor. Where manufacturer instructions are unavailable, lack information, or they reference NWFA Guidelines, use the following information.

PART I

Substrate Requirements

- A. Wood flooring may be nailed down over most wood subfloors (except particleboard), as long as they meet the minimum requirements as detailed in the Wood Subfloors chapter.
- B. Inspect the substrate to ensure it meets all requirements for the flooring being installed. This includes:
 1. Type of wood panel subflooring.
 2. Subfloor thickness and floor joist/truss spacing requirements.
 3. Integrity of the subfloor: All substrates must be sound and free from squeaks and vertical deflection.
 4. Flatness: The standard for flatness on a wood substrate with a nail down installation method is $\frac{1}{4}$ " in 10', or $\frac{3}{16}$ " in 6'.
 5. Moisture test the subfloor in relation to the flooring being used. (See Moisture Testing Wood chapter for testing information.)
 - a. When testing for moisture, both the wood flooring and the subfloor should be evaluated.
 - b. **IMPORTANT:** Never install a wood floor over a known moisture condition. A known moisture condition is one that you are aware of, and could pose future damage to the flooring, the building, or the occupants. It is compulsory practice to always test for moisture regardless of conditions so that any unknown conditions can become known conditions, which then can be handled appropriately.
- C. Over solid board subfloors laid on diagonal, install $\frac{3}{4}$ " solid and engineered wood flooring perpendicular to the subfloor board direction or perpendicular to the floor joist/truss direction.
- D. Over solid board subfloors laid perpendicular to the floor joists, install the $\frac{3}{4}$ " wood flooring on a diagonal to the subfloor board and joist direction. For any wood floor less than $\frac{3}{4}$ " thick, for parquet flooring, or where the desired wood flooring direction differs from what is required, these subfloors must be overlaid with a minimum $\frac{19}{32}$ subfloor panel. (Refer to the Wood Subfloors chapter on Double-Layer Subfloor Systems for more detailed information.)



- E. When wood flooring is required to be installed parallel to the floor joists, follow one of these two methods:
1. Add a second layer of minimum 15/32" plywood underlayment to the existing subfloor. (Refer to the Wood Subfloors chapter on Double-Layer Subfloor Systems for more detailed information.)
 2. Brace between joists/floor trusses. This should be completed by a qualified professional.
- F. For nailing directly to screeds/sleepers, refer to the Screeds/Sleepers chapter for more detailed installation methods.

2. Length of wood flooring fasteners may range from 1" to 2 1/2".
3. Fasteners may have a smooth shank or a barbed shank.

B. Cleats

1. Used as the primary fastener, and designed specifically for wood floor installations, blind-nailed through the tongue of the board using manual or pneumatic flooring nailers.
2. Cleats are designed and cut specifically for the installation of wood flooring. When the flooring/subflooring shrink/swell from season to season, the ribs/barbs engage the wood fibers and thus increase the resistance to withdrawal.
3. Wood flooring cleats are available in different options:
 - a. 16g, 18g, and 20g.
 - b. Lengths ranging from 1" to 2".
 - c. L-cleats and T-cleats, dependent upon the nailer being used.
4. In general, cleats may be driven into the flooring at closer intervals (tighter nailing schedule) than staples, without damage to the tongue of the flooring being installed.



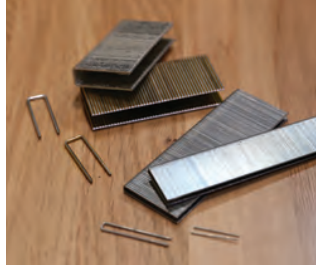
**PART II
Fasteners**

The purpose of the flooring fastener is to hold the wood floor in place through the duration of its' service life. The fastener functions by displacing the wood fibers as it is driven into the board. The pressure exerted against the shaft of the fastener is what provides the fastener retention.

- A. The components of a flooring fastener:
1. Gauge (g) of a flooring fastener is a measure of its diameter. The higher the number, the thinner the fastener.

C. Staples

1. Used as the primary fastener on many wood floor installations, blind-nailed through the tongue of the board using pneumatic flooring nailers.
2. Because each staple penetrates the wood at two points, with two prongs, staples can have a tendency to split the tongues of the flooring when the air pressure from the compressor is set too high for the species being nailed.
3. Staples are available in different options:
 - a. 1/2" crown staples available in 15.5g.
 - b. Narrow crown (1/4") staples available in 16g-20g.
 - c. Lengths for wood flooring ranging from 1 1/4" to 2".



D. Cut-nails

1. Like nails made during the 19th century, cut nails are sheared by machine from steel plates, producing a nail with a distinctive wedge shape that ends in a blunt point. It is this particular profile that gives the nail its authenticity. Cut on all sides to produce four edges, they're also called "square" nails.
2. These fasteners historically were used to install wood floors, but mostly are used for decorative purposes today.
3. These nails are manually driven into the flooring.



E. Casing nails

1. Slightly larger than the finish nail with increased holding power, these fasteners are normally hand-driven into the top of the tongue (blind-nailed) or used as a face nail where additional hold power is required.
2. Strong attachment to the subfloor, often not requiring supplemental adhesive.
3. Most-commonly used against pull-up walls.
4. When driven through the face of the board, these nails have a pronounced head that can leave a larger hole in the installed flooring, requiring wood filler.



F. Finish nails

1. A slender nail with a small globular head, used for finish work.
2. Strong attachment to the subfloor.
3. Nails normally are 15g-16g, and up to 2 1/2" in length.
4. Most-commonly used against pull-up walls.
5. These nails normally are used with pneumatic nailers.
6. These nails can leave a larger hole in the installed flooring, requiring wood filler.



G. Brad nails

1. A thin brad of the same thickness throughout, but tapering in width and having a slight projection at the top of one side instead of a head.
2. Brads often require supplemental elastomeric wood flooring adhesive to allow for adequate attachment to the subfloor.
3. Most commonly used against pull-up walls.
4. These nails are used with pneumatic nailers.
5. Brads are typically 18g, up to 2" in length with a smaller head, requiring small amounts of filler.



H. Pin nails

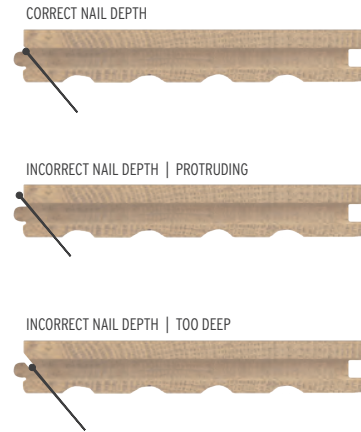
1. A sewing needle-like fastener that is used in fine carpentry to attach two items, often while adhesive is setting up.
2. Pin nails typically are 23g, up to 2" in length, headless pins, often requiring very little, if any, filler.
3. These nails are used with pneumatic nailers.
4. Pin nails are not acceptable fasteners for use with wood flooring unless used in conjunction with an elastomeric wood flooring adhesive.



PART III Fastener Schedules

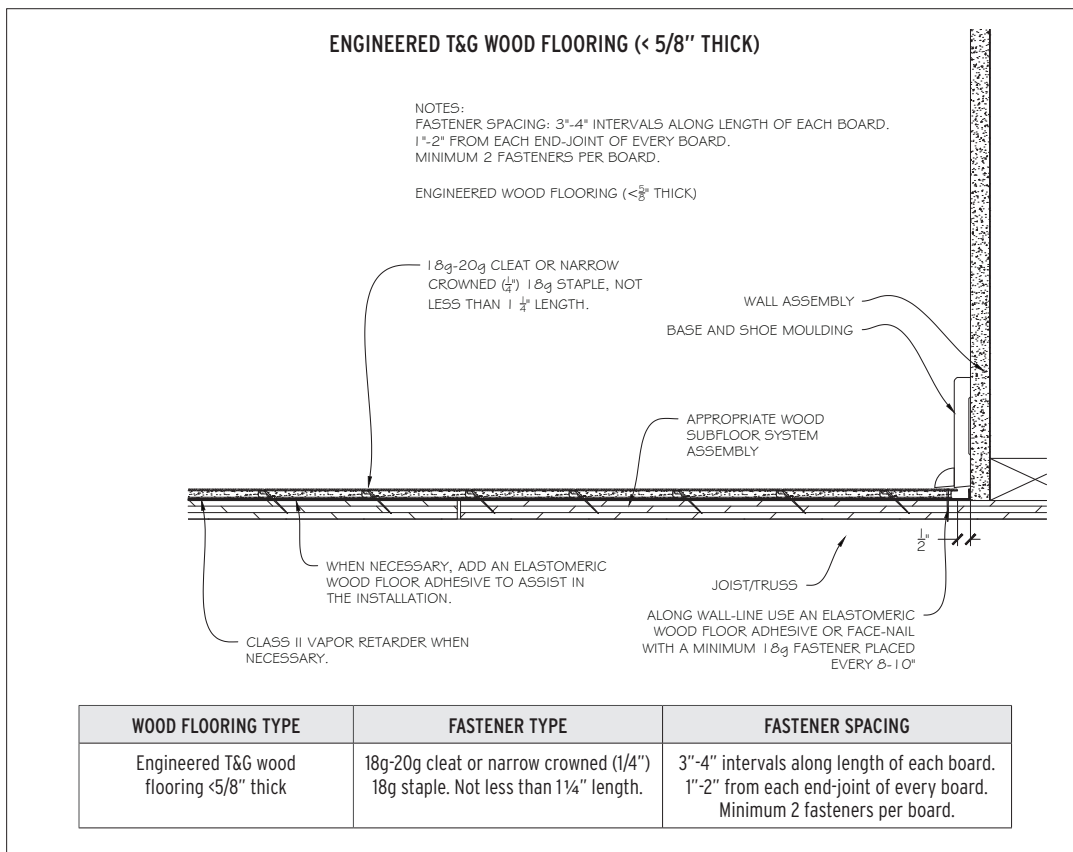
Different types of wood floors require different flooring nailers, different fastener types, and different nailing schedules. Before beginning the installation, first identify the type of wood flooring being installed and then implement the appropriate, manufacturer-recommended flooring nailer and fastener type. Unless otherwise directed by the flooring manufacturer, the following guidelines should be followed:

- A. Use a flooring nailer specifically designed and adjusted for the wood flooring being installed. Check with the flooring manufacturer for which fastener and nailer is required for the flooring being installed.
- B. The flooring nailer should drive the fastener through the top of the tongue, into the nailing groove/pocket, along the length of the board, with the crown/head of the fastener seated flush, in a way that it is not over-driven or under-driven.



- C. Fasteners placed at intervals less than the required blind-nail spacing requirements are acceptable as long as the tongue and core material of the flooring is not compromised or split during installation.

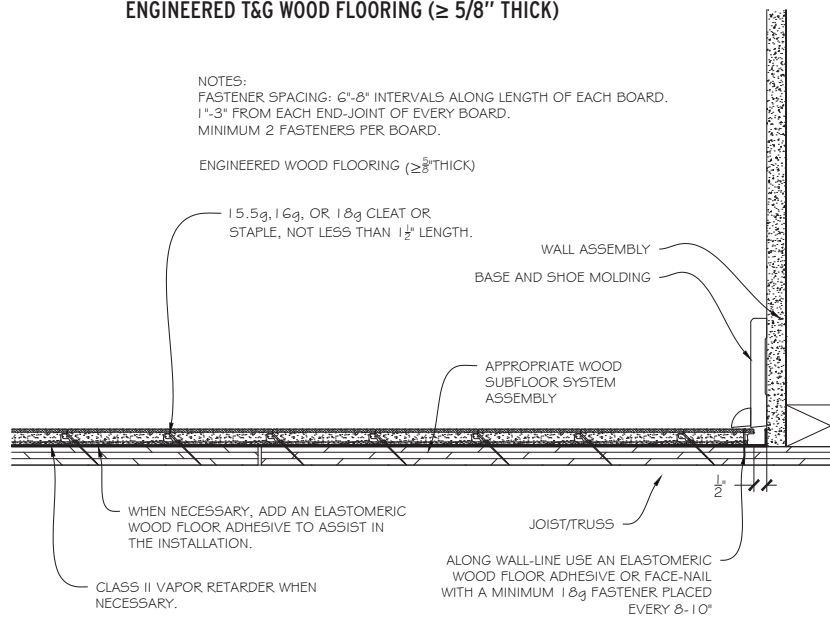
Standard Fastener Schedules (unless otherwise recommended by the flooring manufacturer)



ENGINEERED T&G WOOD FLOORING ($\geq 5/8"$ THICK)

NOTES:
 FASTENER SPACING: 6"-8" INTERVALS ALONG LENGTH OF EACH BOARD.
 1"-3" FROM EACH END-JOINT OF EVERY BOARD.
 MINIMUM 2 FASTENERS PER BOARD.

ENGINEERED WOOD FLOORING ($\geq 5/8"$ THICK)

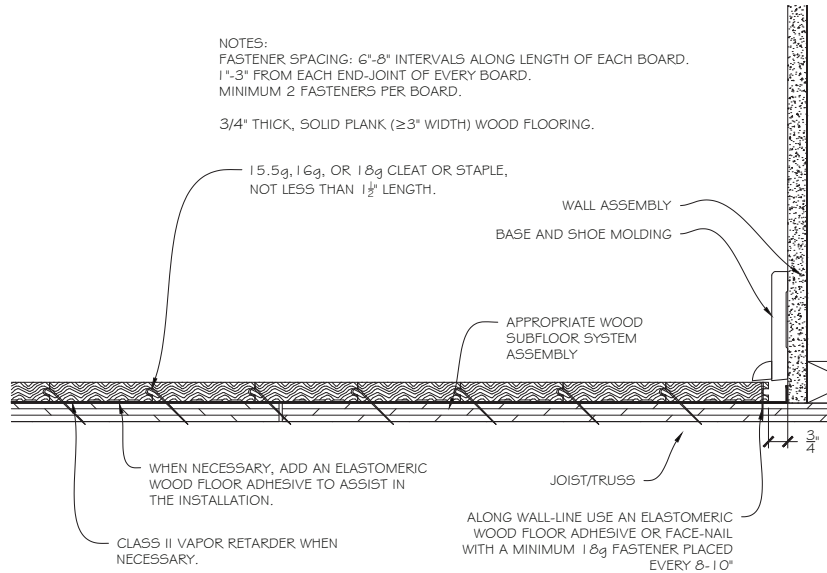


WOOD FLOORING TYPE	FASTENER TYPE	FASTENER SPACING
Engineered T&G wood flooring $\geq 5/8"$ thick	15.5g staple or 16g - 18g cleat. Not less than 1 1/2" length.	6"-8" intervals along length of each board. 1"-3" from each end-joint of every board. Minimum 2 fasteners per board.

SOLID PLANK T&G FLOORING 3/4" THICK ($\geq 3"$ WIDTH)

NOTES:
 FASTENER SPACING: 6"-8" INTERVALS ALONG LENGTH OF EACH BOARD.
 1"-3" FROM EACH END-JOINT OF EVERY BOARD.
 MINIMUM 2 FASTENERS PER BOARD.

3/4" THICK, SOLID PLANK ($\geq 3"$ WIDTH) WOOD FLOORING.

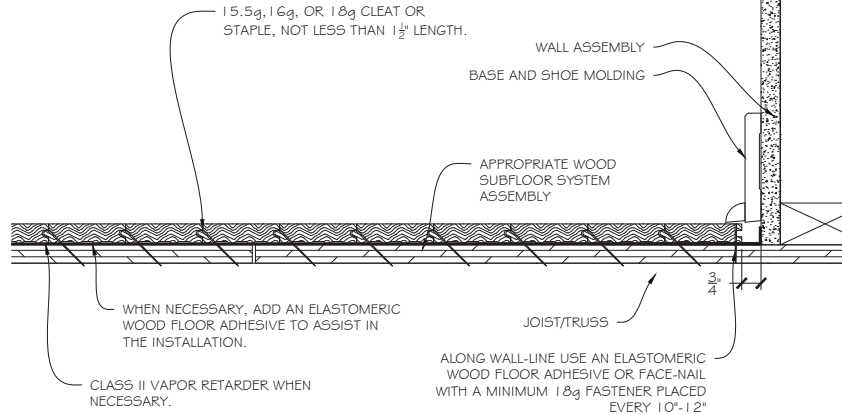


WOOD FLOORING TYPE	FASTENER TYPE	FASTENER SPACING
Solid plank T&G wood flooring 3/4" thick ($\geq 3"$ widths)	15.5g staple or 16g - 18g cleat. Not less than 1 1/2" length.	6"-8" intervals along length of each board. 1"-3" from each end-joint of every board. Minimum 2 fasteners per board.

SOLID STRIP T&G FLOORING 3/4" THICK (<3" WIDTHS)

NOTES:
 FASTENER SPACING: 8"-10" INTERVALS ALONG LENGTH OF EACH BOARD.
 1"-3" FROM EACH END-JOINT OF EVERY BOARD.
 MINIMUM 2 FASTENERS PER BOARD.

3/4" THICK, SOLID STRIP (<3" WIDTH) WOOD FLOORING.

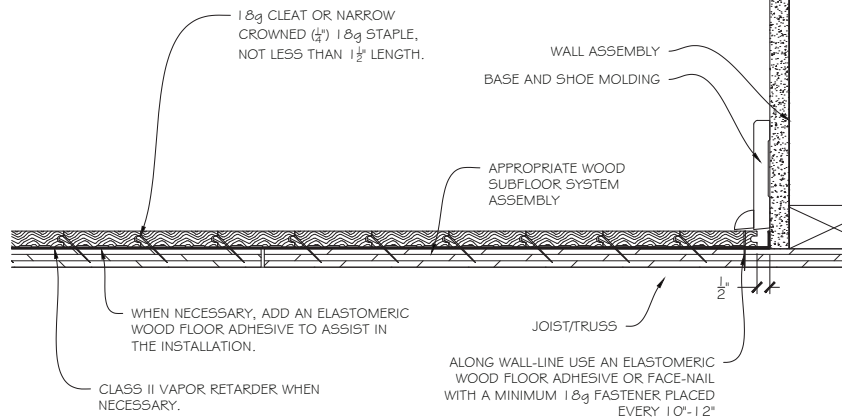


WOOD FLOORING TYPE	FASTENER TYPE	FASTENER SPACING
Solid strip T&G wood flooring 3/4" thick (<3" widths)	15.5g staple or 16g - 18g cleat. Not less than 1 1/2" length.	8"-10" intervals along length of each board. 1"-3" from each end-joint of every board. Minimum 2 fasteners per board.

SOLID STRIP T&G FLOORING >1/2" AND <3/4" THICK (<3" WIDTHS)

NOTES:
 FASTENER SPACING: 6"-8" INTERVALS ALONG LENGTH OF EACH BOARD.
 1"-3" FROM EACH END-JOINT OF EVERY BOARD.
 MINIMUM 2 FASTENERS PER BOARD.

>1/2" AND <3/4" THICK, SOLID STRIP (<3" WIDTH) WOOD FLOORING

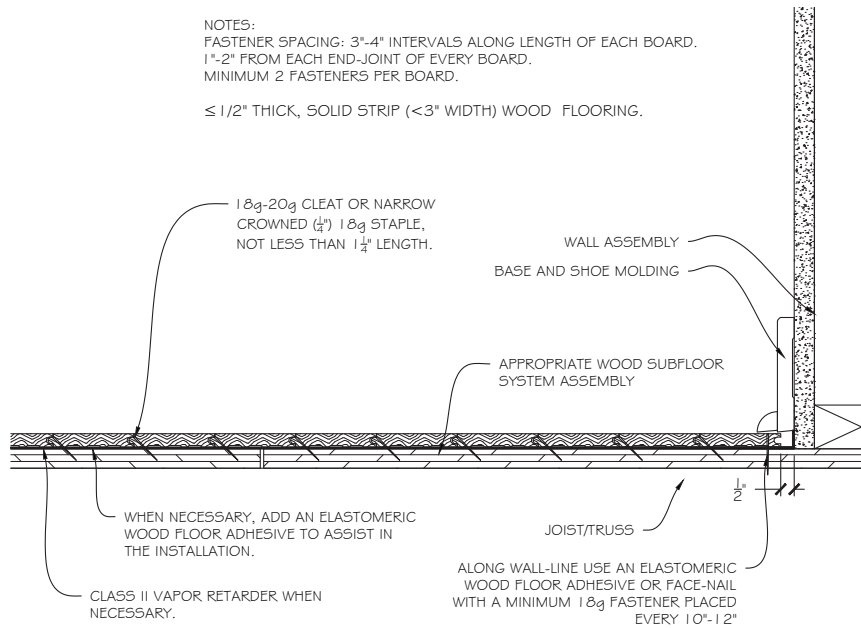


WOOD FLOORING TYPE	FASTENER TYPE	FASTENER SPACING
Solid T&G wood flooring >1/2" and <3/4" thick (<3" widths)	18g cleat or staple. Not less than 1 1/2" in length.	6"-8" intervals along length of each board. 1"-3" from each end-joint of every board. Minimum 2 fasteners per board.

SOLID STRIP T&G FLOORING ≤1/2" THICK (<3" WIDTHS)

NOTES:
 FASTENER SPACING: 3"-4" INTERVALS ALONG LENGTH OF EACH BOARD.
 1"-2" FROM EACH END-JOINT OF EVERY BOARD.
 MINIMUM 2 FASTENERS PER BOARD.

≤ 1/2" THICK, SOLID STRIP (<3" WIDTH) WOOD FLOORING.

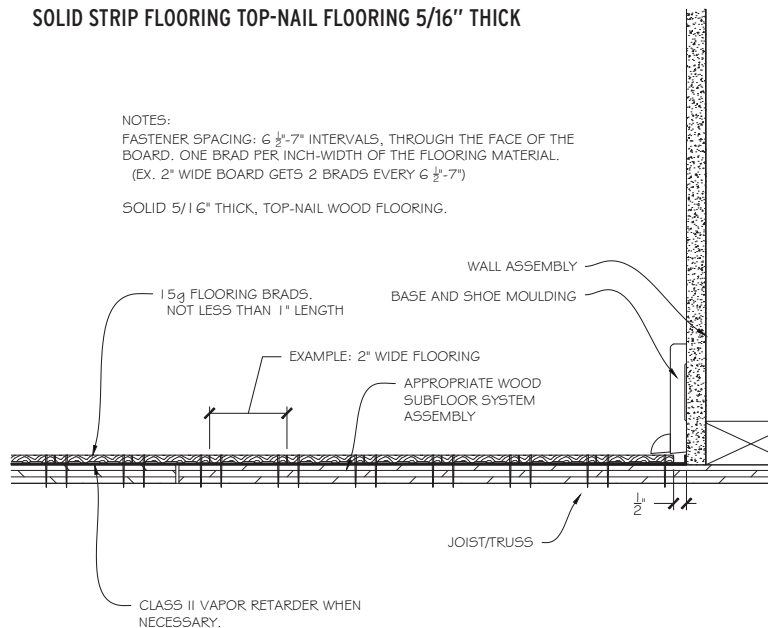


WOOD FLOORING TYPE	FASTENER TYPE	FASTENER SPACING
Solid T&G wood flooring ≤1/2" thick (<3" widths)	18g-20g cleat or narrow crowned (1/4") 18g staple. Not less than 1 1/4" in length.	3"-4" intervals along length of each board. 1"-2" from each end-joint of every board. Minimum 2 fasteners per board.

SOLID STRIP FLOORING TOP-NAIL FLOORING 5/16" THICK

NOTES:
 FASTENER SPACING: 6 1/2"-7" INTERVALS, THROUGH THE FACE OF THE BOARD. ONE BRAD PER INCH-WIDTH OF THE FLOORING MATERIAL.
 (EX. 2" WIDE BOARD GETS 2 BRADS EVERY 6 1/2"-7")

SOLID 5/16" THICK, TOP-NAIL WOOD FLOORING.



WOOD FLOORING TYPE	FASTENER TYPE	FASTENER SPACING
Solid square-edge top-nail wood flooring 5/16" thick	15g flooring brads. Not less than 1" in length.	6 1/2"-7" intervals, through the face of the board. For every inch of flooring material width, 1 brad should be used (e.g., 2" wide board gets 2 brads every 6 1/2"-7"). Any board width greater than even-inch increments should be rounded up (e.g., 1 1/4" board gets 2 brads every 6 1/2"-7"). Note: For aesthetic purposes, new top-nailed flooring matching up to existing top-nailed flooring should follow the same fastener schedule as currently exists.

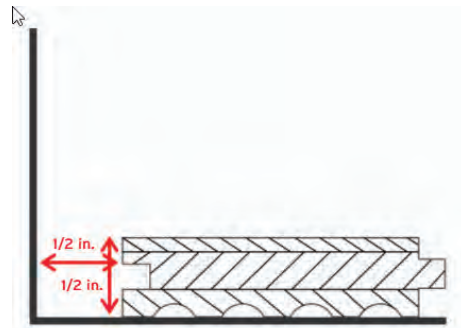
D. Face-nailing may occur where a flooring nailer or finish nailer cannot adequately drive a fastener into the tongue of the board.

1. When face-nailing along starter rows or pull-up rows, use a minimum 18g fastener.
 - a. For solid or engineered strip flooring (<3" widths), face-nails should be placed at 10"-12" intervals.
 - b. For solid or engineered plank flooring (≥3" widths), face-nails should be placed at 8"-10" intervals.
2. The type of fastener used will dictate the size of the hole left in the face of the board, the amount of necessary filler, and whether adhesive should also be used. To fill face-nail holes, use a wood-filler that matches the overall appearance of the finished wood floor. This is necessary anywhere face-nailing is required.
3. An elastomeric wood floor adhesive may be used as an alternative to, or in addition to, the use of face-nails on starting and pull-up walls.
 - a. Where flooring adhesive is used as an alternative to, or as an assistant to, the face nail, it may be applied to the subfloor or to the backside of the board itself in a variety of methods, such as the serpentine (sine-wave) pattern, parallel or lengthwise stripes, ends and grooves, or in a full-spread application. Regardless of the application method, the adhesive must cover the entire length and width of each board and be pressed down firmly to ensure the flooring is adhered adequately to the subfloor.
 - b. When using elastomeric wood flooring adhesive along pull-up walls as a primary fastening mechanism, use of an 18g or 23g pin-nail may be used to hold the flooring in place while the adhesive sets-up.

PART IV Nail-Down Installation

- A. Remove any existing base, shoe-mould, or doorway thresholds. These items can be replaced after installation.
- B. Undercut door casings and jambs.
- C. Snap a working line parallel to the starting wall (following wall-layout or center-layout methods), accounting for necessary expansion space.
- D. **Expansion space:**
 1. Maintain proper expansion space based on the material being installed at all vertical obstructions. Unless otherwise directed by the flooring manufacturer, expansion space left between the flooring and vertical obstructions

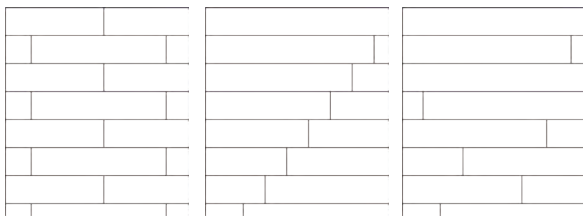
generally is equal to the thickness of the material being installed. (Example: ½" thick material requires ½" expansion.)



2. To minimize expansion on floor spans wider than 20 feet, spacing between rows (within the flooring system) may be needed, depending on the wood species being installed, climate zone, interior climate controls, and time of year.
 - a. Expansion may be built into the solid wood floor using the dimensional change coefficient (DCC) of the species being installed.
 - b. Determine the DCC of the species being installed (refer to Moisture and Wood technical publication no. A100). Multiply the DCC by the width of the material being installed. Then determine approximately how much you expect the flooring to change moisture content (MC) from one season to the next, and multiply this change in MC by the product of the width and DCC. This will give you an approximation of how much each plank of flooring could expand/contract from season to season. Use this information to determine approximate internal expansion spacing necessary for the long-term performance of the wood floor.
 - c. Example: Red Oak DCC = .00369.
A 5" solid red oak plank that experiences a 4% change in moisture content, may shrink or swell tangentially approximately .0738".
 $.00369 \times 5" = .01845 \times 4\% \text{ change} = .0738"$ of change in dimension.
3. Where additional internal spacing is required with some solid wood floors, use washers, edge trimmer spline, or other removable spacers to leave expansion space within the flooring system. The end-user must be made aware of these built-in spaces prior to installing them in the floor.
- E. Install a vapor retarder as necessary (see Underlayments: Moisture Control chapter for more detail). Transfer working lines onto any affixed vapor retarder being used.

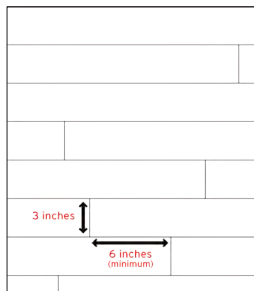
F. Racking:

1. With solid or engineered wood flooring installed over a wood subfloor with a joist systems that meets or exceeds minimum requirements, properly staggered end joints are an appearance/aesthetic consideration only.
2. With ¾" strip or plank wood floors installed over bare joists, solid board subfloors, "perpendicular car decking," screeds/sleepers, or panel-type subfloor/joist systems that do not meet minimum requirements, the layout of the entire floor, and end joint placement are not only an appearance/aesthetic consideration, but also add a structural element adding rigidity and stiffness to the finished installation.
3. When racking (or laying out the floor) prior to installation, be sure to work from multiple bundles or packages to ensure variation.
4. Flooring warranties typically do not cover materials with visible defects once they are installed. Installation is acceptance of product aesthetic quality.
5. Distribute lengths randomly and pull from multiple bundles.
6. Avoid "H" patterns when possible.
7. Avoid any discernible pattern in adjacent runs such as blatant stair-steps or equal end-joint offsets in sequential rows. Cutting a variety of starter boards from full length boards will assist on "randomizing" joints in products of equal or limited lengths.

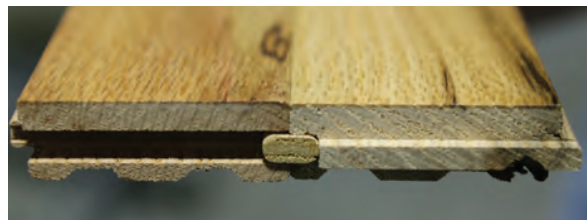


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8. End joints of adjacent boards should not be installed in close proximity to each other. In general, end-joint staggering row-to-row should be a minimum of twice the width of the flooring being installed (e.g., 6" stagger for 3" wide material). Wider-width materials may be more-difficult to maintain these staggers due to the product length limitations.



- G. Pre-cut, and lay out a starter row along the entire length of the working line.
- H. Install and adequately secure this as your anchor row. This starter row should be secured to the subfloor to provide a stationary point to be pushed against so flooring doesn't move during installation of the remaining floor. Face-nail only where necessary. Otherwise, blind-nail at the recommended schedule and glue with an elastomeric adhesive.
- I. Runs of flooring generally should be installed straight. Unless otherwise required, the installed wood flooring should not deviate from a straight line more than 3/16" in 10'.
- J. Flooring mallets, tapping blocks, and pull-bars may be used to drive flooring tight during installation. Be certain to only use tools that do not damage the flooring.
- K. Set your compressor to the flooring nailer manufacturer recommended PSI setting for the wood being installed.
 1. When the air pressure from the compressor is set too high for the species being nailed, staples have a tendency to drive the fastener below the nail pocket, potentially splitting the tongues of the flooring, resulting in a less-effective fastener.
 2. When running multiple nailers from one compressor, individual regulators may help regulate the air to each tool.



- L. **Spline/Slip-Tongue:** Spline or slip-tongue is used to maintain T&G within the entire flooring system. Use spline/slip-tongue to fit the specific flooring profile.
 1. Use spline anytime the flooring direction changes, at all headers or flush transitions, and when reversing installation direction such as starting in the center of a layout or back-filling.
 2. To install a spline/slip-tongue:
 - a. Cut to length.
 - b. Apply poly vinyl acetate (PVA)/carpenters glue to the bottom side of the receiving groove.
 - c. Insert the slip-tongue.
 3. Use the groove side of a piece of scrap flooring to secure the slip-tongue while nailing the board into place using the proper nailing schedule for the flooring being installed.

PART V

Glue-Assisted Nail-Down

Where the flooring manufacturer suggests glue-assisted installation or where the glue-assisted installation method is required, some key factors must be addressed:

A. Moisture

1. When using the glue-assist method, you will no longer be able to install a traditional sheet-good vapor retarder. When nailing down wood flooring over a conditioned space that is maintained at the same conditions as the living/interior space, no vapor retarder is necessary. Wood floors installed in these conditions may be nailed with a glue-assist directly to the subfloor without use of a vapor retarder.
2. Where wood flooring is being installed over unconditioned space, use of a liquid-applied, or similar Class II vapor retarder that is compatible with the flooring adhesive may be used to allow for a glue-assist directly to the subfloor.
3. **IMPORTANT:** Never install a wood floor over a known moisture condition. A known moisture condition is one that you are aware of, and could pose future damage to the flooring, the building, or the occupants. It is best practice to always test for moisture regardless of conditions so that any unknown conditions can become known conditions, which then can be handled appropriately.

B. Glue-Assisted Nail-Down Installation Method

1. Where mechanical fasteners on a nail-down installation are the primary installation method, the nailing schedule should remain the same as normal installation for the flooring being installed. The addition of adhesive is not intended as a replacement fastener mechanism, rather supplemental to the mechanical fastener. Where the adhesive is applied using a full-spread application, the fastener schedule is not to be considered the primary fastening method.

2. Due to the reduction in the amount of fasteners used per square foot of flooring width, wide plank (>5" widths) solid and engineered wood flooring should be installed using the glue-assisted installation method, when site conditions allow, unless otherwise recommended by the flooring manufacturer.
3. The adhesive used should be a wood flooring adhesive with elastomeric qualities to allow for normal movement within the flooring system. The adhesive must also be compatible with the subflooring and any liquid-applied vapor retarder system used.
4. The wood subfloor must be thoroughly vacuumed, and free of any debris to ensure adhesion between the subfloor and the wood floor.
5. Test the adhesive to determine the most-effective application method, and for compatibility with the subfloor. The adhesive application method should add supplemental holding power to the installation.
6. The wood flooring adhesive may be applied to the subfloor or the backside of the board itself in a variety of methods to supplement the mechanical fastener.
 - a. With any of the following application methods, use a notch trowel, or apply a continuous, minimum ¼" wide, uniform bead of adhesive directly to the subfloor, or to the back of the board using a glue gun to dispense the adhesive.
 - b. The adhesive should be applied in a manner that covers the entire width and length of each plank, to within a minimum of 1" from the edges and ends of each board.

c. Listed are a few common methods and applications for each:

SERPENTINE (SINE-WAVE) PATTERN



PARALLEL STRIPES PATTERN



ENDS AND GROOVES PATTERN



LENGTHWISE PARALLEL STRIPES PATTERN



- i. **Serpentine (sine-wave) pattern:** The serpentine (sine-wave) pattern, where the full curve (peak-to-peak) is performed approximately twice the width of the board. The adhesive should cover the entire length and width of each board.
 - ii. **Parallel stripes pattern:** The parallel stripes may run perpendicular to, or on diagonal to, the length of each plank being installed. Each stripe should be placed at approximately 6"-8" intervals.
 - iii. **Ends and grooves pattern:** Adhesive is applied to the subfloor or to the underside of the board in the location within 1" from both ends of the board and along the full length of the back, groove-side of the board.
 - iv. **Lengthwise parallel stripes pattern:** Adhesive is applied to the subfloor or to the underside of the board in the location within 1" of each long side edge and down the middle of the board.
7. **IMPORTANT:** When using a trigger-activated flooring nailer with the glue-assisted installation method, the installer must either stand on the floor, or apply a downward pressure to the surface of each board as it is being nailed. This will ensure the flooring does not lift away from the subfloor causing unnecessary vertical movement or hollow noises.
- C. **Nail-Assisted Glue-Down Installation Method**
 1. Glue-down is the primary installation method. The adhesive application should remain the same as normal installation for the flooring being installed (see Glue-Down Installation Methods chapter). The addition of mechanical fasteners is not intended as a replacement fastening mechanism, rather a supplemental method.
 2. With full-spread installations over wood subfloors or screeds/sleepers, it is sometimes necessary or helpful to blind-nail the flooring periodically in order to hold the flooring in place while the adhesive sets-up.
 - a. This method may be appropriate where flooring needs to be driven tight during the installation.
 - b. There is no recommended nailing schedule for this method, as the fasteners are strictly used as a supplement to the glue-down method.