

PRO TIP

Step up to a larger joist whenever you come close to the maximum span acceptable.

I usually use a 2×8, except on landings and other small areas.

IN DETAIL

“On center” —or *o.c.*—is a term commonly used by carpenters to describe the distance from the center of one joist to the next. But joists are seldom laid out that way. Instead, measure “centers” using either the same left- or right-hand face for all the joists except the end ones.

IN DETAIL

Douglas fir deck joists span 12 ft. from the ledger to the beam, then cantilever another 3 ft. If I hope to use 2×6 Western red cedar for decking, I know my joists could be 24 in. o.c., according to the decking span tables (see the chart on p. 103). From the joist span table (see the chart on the facing page) in the live load column (under 40 psf with #2 Douglas fir joists 24 in. o.c.), I find that 2×10 joists can span up to 12 ft. 7 in. I could also use 2×8 joists with a maximum span of 12 ft. 5 in. if the joist spacing were 16 in. o.c. Using 2×8s would require five extra joists, which may cost \$20 more than using 2×10s but would be easier to install. In addition, closer joist spacing tends to give a deck a sturdier feel.

Laying Out and Installing Joists

On most decks, the joists are attached to the ledger at one end, extend away from the house, and are capped at the other end with either a beam or a single board called a rim joist. Other parts of the joist system include headers (short beams made of doubled joist material that span framing discontinuities and support cut joists) and blocking (short pieces of joist material installed perpendicular to regular joists to help stabilize the system or reinforce particular areas such as railing attachment points).

Joists need to be sized and spaced with considerations for loading, span, wood type, and decking material. Like all other deck framing, joists are subject to rot and should be made from treated or rot-resistant wood. Sometimes joist framing is covered around the perimeter with a finish material called a skirt or fascia.

Sizing joists

With cost in mind, I initially choose the smallest and least number of joists that will do the job properly from the span table. In this case, the live load for this deck is 40 psf, but remember that live loads vary according to use. Wood species is also an important factor, as some woods are definitely stronger than others. Again, this difference is taken into account in the various span tables.

Although span tables are conservative, I prefer to step up to a larger joist whenever I come anywhere close to the maximum span acceptable; very seldom do I use anything smaller than a 2×8, except on small areas like landings. Overbuilding may cost a bit more, but it will give you a deck that feels solid.

Spacing joists closer will increase their span, because the load will be spread over more joists. If you are close to the maximum span, you will have



Deck joists are installed and ready for finishing framing details such as blocking and bracing.

to evaluate the economic advantages of choosing more closely spaced, smaller joists or choosing to use larger-sized joists that are spaced further apart. The type of decking that you are using will also influence your joist spacing. Decking such as 1½-in. thick cedar or pressure-treated wood is strong enough to span joists that are 24 in. o.c., while some of the newer composite decking materials require joist spacing to be 16 in. or even 12 in. o.c. (see the chart on the facing page). If your decking choice requires you to place joists closer together than the span tables call for, you might be able to reduce the size of the joists.

Joist layout

Sizing the joists also helps determine the spacing between them. Usually they are placed 16 in. or 24 in. o.c., so this spacing—called the layout—needs to be marked on the ledger for one end of the joist and either the beam or rim joist at the other.

Layout isn't complicated, but it does require a consistent approach. Make sure that your starting point on the ledger and rim joist is referenced off of a joist common to both. On a simple rectangle, this is usually the outside joist, but on more complicated decks with angles, it may need to be an interior joist that is uncut and perpendicular to both rim and ledger.

Choosing the exact location to begin your layout will depend on such considerations as what



Mark $\frac{3}{4}$ in. to one side of a joist center for the edge of the joist and hanger. Place an "X" to the joist side of the mark to avoid confusion.



From the layout mark, use a square to draw a line across the ledger face to help align the joist hanger.

Span Table for Joists

Species	Joist Size	Maximum Span between Posts or Supports		
		12 in. o.c.	16 in. o.c.	24 in. o.c.
Douglas Fir, Southern Yellow Pine	2×6	10 ft. 4 in.	9 ft. 3 in.	7 ft. 6 in.
	2×8	13 ft. 7 in.	12 ft. 4 in.	10 ft. 5 in.
	2×10	17 ft. 4 in.	15 ft. 7 in.	12 ft. 9 in.
	2×12	20 ft.	18 ft. 1 in.	14 ft. 9 in.
Hem-fir	2×6	9 ft. 8 in.	8 ft. 10 in.	7 ft. 4 in.
	2×8	12 ft. 9 in.	11 ft. 7 in.	10 ft. 2 in.
	2×10	16 ft. 3 in.	14 ft. 9 in.	12 ft. 4 in.
	2×12	19 ft. 10 in.	17 ft. 7 in.	14 ft. 4 in.
Redwood, Western Red Cedar	2×6	8 ft. 10 in.	7 ft. 3 in.	6 ft.
	2×8	11 ft. 7 in.	10 ft. 5 in.	8 ft. 6 in.
	2×10	14 ft. 9 in.	12 ft. 9 in.	10 ft. 5 in.
	2×12	17 ft. 1 in.	14 ft. 9 in.	13 ft. 6 in.

All joists should be #2 grade or better. These values assume 40 lb./sf. live load (10 lb./sf. dead load included). They permit a deflection of $\frac{1}{360}$ of the joist's maximum span when fully loaded.



Lay out joist locations on the beam, starting at a point analogous with the ledger starting point so layout marks will correspond.

PRO TIP

Layout requires a consistent approach. Make sure that your starting point on the ledger and rim joist is referenced off a joist common to both.

IN DETAIL

Joist hangers are U-shaped metal brackets that make butt connections between two boards easy and secure. Hangers are available in different sizes for different size joists, for doubled joists, and for beams, and come in different strengths for regular and heavy-duty loads. All hangers used on deck construction should be galvanized; stainless-steel hangers should be considered for severe or coastal environments. Fasteners used with joist hangers should be of the same material, and properly sized for the hanger.

Cantilevering Joists

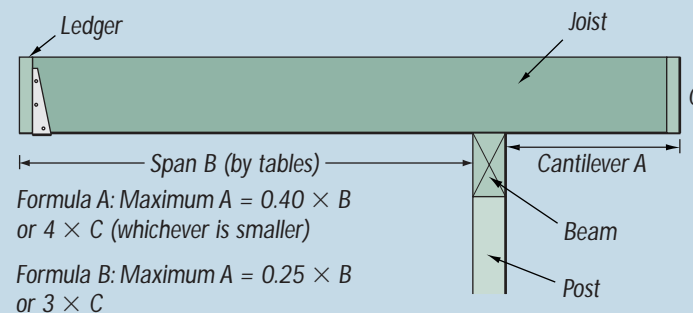
Cantilevering is an effective technique that I use on almost all of my decks. It allows me to add several feet to the width of a deck without exceeding the maximum span rating for the joists; it sometimes allows me to use a smaller size joist by decreasing the span between ledger and beam. And cantilevering lets me be less fussy when locating the posts, beams, and foundation work. However, there are a few guidelines that limit the distance that a joist can extend unsupported past the beam, and these assume there will be no unusual loading out at the end other than occupants.

Under the right conditions, it's technically okay for joists to cantilever up to about 40% of the distance they are spanning between supports, as

long as the cantilever doesn't exceed four times the joist depth. For example, a joist spanning 10 ft. between supports could theoretically cantilever another 4 ft. past the supporting beam, for a total joist length of about 14 ft. But if the joists are 2×10s (with an actual width of 9.5 in.), then your cantilever would be limited to 38 in. ($4 \times 9.5 = 38$).

Unless you like bouncy construction, I would limit the cantilever to about 25% of supported joist length. In fact, I never exceed three feet of cantilever. This makes the deck feel solid even when you are standing out over the cantilevered ends. If you want to cantilever more than three feet, I suggest stepping up to the next larger size joist, even if it exceeds requirements.

Large cantilevers require joists to be well anchored at the opposite end.

**Cantilevers**

The maximum length of a cantilever is based on the length of joist that is supported and the width of the joist. Technically joists can be cantilevered up to 40% of the amount that's supported but not more than four times the joist width (formula A). To avoid callbacks about bouncy decks, I prefer a more conservative figure of 25% the amount supported or three times the joist width (formula B).

railing style you choose and whether the ends of the decking are to be covered with a fascia board or left overhanging the end joist. Don't forget that your end joist may not be installed on the ledger yet, so you may need to add an additional 1½ in. for this. Then find the mark at 12 in., 16 in., or 24 in. (depending on the span tables) for the first joist inside the end joist.

When I start my layout, I don't mark the center of the joist, but rather one side or the other by

adding or subtracting ¾ in. (half the width of a 2× joist). I make my layout mark here, and indicate which side of the mark the joist falls on with an "X." On the layout mark, I use a square to draw a perpendicular line across the ledger face to help align the joist hanger. Then I continue the layout all the way to the end, always marking the same face of all the joists. Once the ledger is laid out, I go ahead and lay out the beam the same way, starting with the same joist and making

sure that my layout marks correspond with those on the ledger.

Installing joists

After layout is complete, I install metal joist hangers to support the joists at the ledger and at all other square butt connections. Although some carpenters prefer to install the hangers after the joists have been temporarily toenailed in place, I think that preinstalling the hangers is faster. First, I slip a small scrap of joist material into the hanger as a guide and hold one edge of the block on the layout line and flush with the top of the ledger. This block not only helps with alignment, but also keeps me from nailing the two legs of the hanger too close together. After putting in a couple of nails to hold the hanger in place, I then remove the block and finish nailing. This method works best if all the joists are close to the same width.

With the joist hangers in place, the joists can be measured, cut to length, and nailed in the hangers; remember to install them with their crowns facing up. Cutting all the joists before installation is a necessity when the joists are hung from hangers at both ends. But keep in mind that when joists are hung only at the ledger end and cantilevered over a beam at the other, their ends will only be aligned if the ledger is straight. I find it quicker and more accurate to first install all the joists with one square end in the hangers, but to leave the other ends “wild” and uncut to final length.

Setting the first joist accurately is important because it can serve as a reference for joist layout, particularly when joists are cantilevered over a supporting beam. One way to make sure that the joist is square to the ledger is to align it parallel to the layout string (set during foundation layout; see pp. 34–35) that runs parallel to the house and out to a batter board. Another method I use to square the joist up with the ledger is to use a big, commercially available aluminum square. After setting



Here a scrap of joist is used to help set the hanger height and keep the side flanges the correct distance apart. Attach the hangers with 1½-in. long galvanized nails made specifically for metal connectors.



Hanger installed and ready for joist.

PRO TIP

Even though 8d nails may be handy and seem to fit, don't use them to fasten metal joist hangers—they just aren't strong enough.

TRADE SECRET

Take a look at most tape measures and you'll notice that the numbers are highlighted every 16 in., usually in red and with little double-headed arrows. This is to help you avoid addition mistakes when laying out 16-in. joist centers. However, 24-in. centers are easier to keep track of, so your tape may only have an arrow to indicate these.

IN DETAIL

If you're installing your decking at a 45-degree angle, the decking will be spanning more distance than if measured perpendicular to the joists. You will need to space the joists closer together to reduce this longer span and meet the table recommendations. A good rule of thumb is to reduce the maximum joist spacing for a particular decking installed on the perpendicular by about one step when laying it on the diagonal. For example, if the recommended spacing is 24 in. o.c., reduce it to 16 in. o.c. for diagonal decking (or go from 16 in. o.c. to 12 in. o.c.)



Set the first joist square to the ledger, using a foundation layout string for reference.



Checking for a square corner between the first joist and ledger is simplified when using this commercially available, folding aluminum square.

the first end joist with a string or a square, I set the opposite side parallel to the first by measuring out along both the beam and the ledger. To quickly double-check that everything is square, I measure the diagonals from corner to corner to make sure they are the same. If they are not, then I adjust the joist before laying out the rest.

Once all (or most) of the joists are in place (but not yet fastened to the supporting beam), I can measure their length from the ledger, mark the ends of my two outside joists, and snap a straight chalkline between them to mark the length across the top of the rest of the joists. Then I draw a square cutline on the face of each joist (using the



After setting the outside joists, check the diagonals to make sure they are equal.

snapped line for reference) and cut all the joists at one time.

On most decks that I build, the last joist on each end laps over the ends of the ledger rather than butting into it like the rest. This hides the end grain of the ledger, while the ledger provides good nailing for securing the end joist. I use 16d galvanized nails, predrilling the holes so that I don't split the ends. For additional support, I clip a regular joist hanger in half and use it on the inside of the connection.

If the rim and end joists are going to be exposed on the finished deck, I miter the outside corners because I think that it looks better than a butt joint. You should stitch mitered corners together with nails or screws from both sides, predrilling and keeping the holes as far back from the ends as possible to avoid splits.



After joists are fastened to the ledger and cantilevered over the beam, they need to be trimmed evenly for the rim. Joists on opposite sides are measured for length and marked, and the marks connected with a snapped line.



A square cutline is extended down the face of the joist from the chalkline on top.