Powerful new curve radius insights for any scale

– by Joe Fugate

Photos by the author

FIGURE 1: Here's one of the big problems a with a curve that's too sharp - poor coupler alignment. These cars can't couple automatically since the jaws don't engage. This article presents some new curve radius insights that came out of a discussion on the Layout Design Special Interest Group forum. Armed with these new insights, you'll be able to confidently select a minimum curve radius for your layout that works like expected with no nasty surprises. And best of all, these new guidelines work for any scale!

How sharp is too sharp?

We all know how it works: you pick the smallest possible curve radius so you can get more layout into your space.The tighter the curves, the more you can fit into your space, right?

But it doesn't take long to discover that using too tight of a curve radius makes your equipment perform badly. Some of your longer equipment may not run at all on a curve radius that small.

If things do run on that small radius curve, they may still look ridiculously toy-like. Or even if things look reasonably realistic on the curve radius you're using, you may still find things won't couple properly. How annoying!

We're going to examine some great new curve radius guidelines that came out of a discussion on the Layout Design Special Interest Group forum around curve radius. You can find a brief summary of these guidelines on the LD SIG's wiki.

As you may have guessed if you've been in the hobby very long, increasing your curve radius just enough so the equipment stays on the track is only part of the picture.

Your equipment may run fine on a sharp radius curve but look extremely toy-like in the process. To improve the look of your equipment on a curve, you'll need to increase the radius.

But there's a trade-off of course: the larger your minimum radius the less layout you can fit into your space.

Once you're using curves broad enough that your equipment both runs well and looks great – there's another major consideration to be aware of: your equipment may still not couple reliably on the curve.

To get reliable hands-off coupling, like in a yard that's built on a curve, you may need to broaden the curve still further.

The Curve Radius Secret

Is there some way to easily understand *when* to use a given curve radius on a track plan? Is it possible to easily know the absolute minimum curve radii to use for good tracking, good looks, and good coupling – so that we can still fit as much trackwork into our space as possible?

The answer is a resounding ***yes!***

It turns out that by looking at curve radius as a *ratio of equipment length*, it's possible to develop some universal curve radius guidelines around reliable tracking, visual realism, and reliable coupling.

As a bonus, these guidelines apply to all scales, since they're a ratio of equipment length to curve radius!

Let's take a look at these guidelines and then run some tests with actual equipment to see how well the guidelines hold up in actual practice.

NMRA RECOMMENDED PRACTICES?

As you might expect, the National Model Railroader's Association (NMRA) has recommended practices for curve radius.

Refer to NMRA RP 11 for these guidelines. RP 11 is decades old, somewhat general and subjective. Each scale has its own set of recommended radii values presented in table form.

I find the mathematical symmetry of the new guidelines presented here makes them easier to remember. With these guidelines I feel like I understand the tradeoffs better, too. ■

FIGURE 2: While these 80-foot passenger cars may track okay on a 19" radius curve, they look totally toy-like and ridiculous with their extreme overhang and offset. To pick the proper curve radius, this article discusses how to determine a ratio of your rolling stock length that meets your desired performance needs.

Curve radius insights, page 2

Contents Index

FIGURE 3: Curve Radius Guidelines

Ratio	Guideline description
2.0 x	Some equipment may track reliably, but 2x is generally considered pushing it.
2.5 x	Most equipment will track reliably if everything is of similar length.
3.0 x	All equipment should track reliably; coupler performance adequate if altered to allow 50% car width swing.
3.5 x	Equipment will look less toy-like when viewed from *inside* the curve.
4.0 x	Equipment will look less toy-like when viewed from *outside* the curve.
5.0 x	Most reliable coupling on curves with body-mounted couplers and near-scale draft gear boxes.

How the ratio guideline works

Using the curve radius guidelines in the table above, let's see how these ratio-based guidelines work.

The curve ratio is a factor of the rolling stock length. For instance, I measure my HO 40 foot box cars and I find they're 43 scale feet over the couplers – or 5.9 actual inches (150 mm).

If I take 5.9" and multiply it by 2, I get 11.8". I round to the nearest inch – 12" in this case. My 40 foot HO box cars should just barely track on a 12" radius curve (but that's pushing it).

Computing the other values gives me the following (rounded to the nearest inch):

HO 43 foot cars

- 2.0x 12" radius
- 2.5x 15" radius
- 3.0x 17" radius
- 3.5x 21" radius
- 4.0x 24" radius
- 5.0x 30" radius

In other words, my 40 foot HO box cars ought to track reliably on a 15" radius, and should track quite nicely on a 17" radius curve.

Further, the cars will look reasonably relistic when viewed from the inside of a 21" radius curve, and look good when viewed from the outside of a 24" radius curve.

And lastly, 40 foot HO box cars with body-mounted couplers should couple completely hands-off on 30" radius curves.

Truck-mounted (talgo) couplers or draft gear boxes modified to allow extra coupler swing fit the 3.0x rule rather than the 5.0x rule. However, truck-mounted couplers also can be a problem – see the truck-mounted couplers sidebar for details.

Let's examine these guidelines more closely using some actual equipment. While we're using 40 foot, 50 foot, and 80 foot HO cars, these same ratios should apply to any scale.

We'll start by looking at the 40 foot cars.

FIGURE 4: We're using these HO cars to do our equipment tests. In the picture going clockwise we have: Walthers 83 foot passenger cars, Athearn 53 foot outside-braced box cars, and Athearn 43 foot box cars. All cars have body-mounted magnetic couplers, although the Walthers passenger cars have special draft gear boxes that allow the couplers to swing up to 50% of the car width.

TRUCK-MOUNTED COULERS

Mounting couplers on the truck rather than the car body seems to solve some of the curve-related coupler reliability problems. And that's true, truck-mounted couplers do allow cars to couple more reliably on far tighter curves.

However, try backing a long train with all truck-mounted couplers. The couplers transfer lateral pressures to the wheel flanges, causing the the trucks to roll down the track at a slightly canted angle-of-attack.

As a result, the wheels find every flaw and imperfection in the rails and tend to derail. Most modelers prefer body-mounted couplers as the all-around best option for most reliable tracking. ■

Curve radius insights, page 3

Contents Index

FIGURE 5: Getting the cars on the track takes some care, and the flanges rub against the railheads with noticeable friction.

FIGURE 6: The cars track without friction at this radius, proving the 2.5x radius guideline works well in predicting car tracking behavior.

FIGURE 7: The cars roll freely at the 3.0x radius of 17”. The cars couple with a bit of coaxing to make sure the couplers are aligned.

FIGURE 8: As predicted, the cars look reasonably realistic on the 3.5x radius curve when viewed from the inside of the curve.

FIGURE 9: Once again as predicted, the cars look realistic at the 4.0x radius curve when viewed from the outside of the curve.

FIGURE 10: As the 5.0x guideline suggests, the coupler alignment on a 30” curve essentially matches that of straight track with 40 ft boxcars.

FIGURE 11: Here’s a side-by-side comparison of a 3.5x radius curve when viewed from both inside and outside the curve.

FIGURE 12: Viewing from the inside makes the curve appear less sharp – a handy trick when you know a curve will only be viewed from the inside.

50 foot cars

FIGURE 13: At the 2.0x radius, the cars track on this curve with some difficulty and the slightest lateral pressure pops the wheels off.

FIGURE 14: The 50 foot cars track much better on the 2.5x radius, rolling more freely, although coupling needs some help.

FIGURE 15: The cars roll quite smoothly on the 3.0x radius as predicted, although visually the curve still looks somewhat sharp.

FIGURE 16: The 3.5x radius curve, when viewed from the inside, looks reasonably realistic and gentle.

Curve radius insights, page 6

Contents Index

50 foot cars

FIGURE 17: As predicted, the 4.0x radius curve looks prototypically realistic when viewed from the outiside of the curve.

FIGURE 18: For all practical purposes, coupler alignment on the 5.0x curve for the 50 ft boxcars matches that of straight track.

FIGURE 19: On the 2.0x radius curve, the 50 foot car coupler jaws do not align and can only be made to couple with much effort.

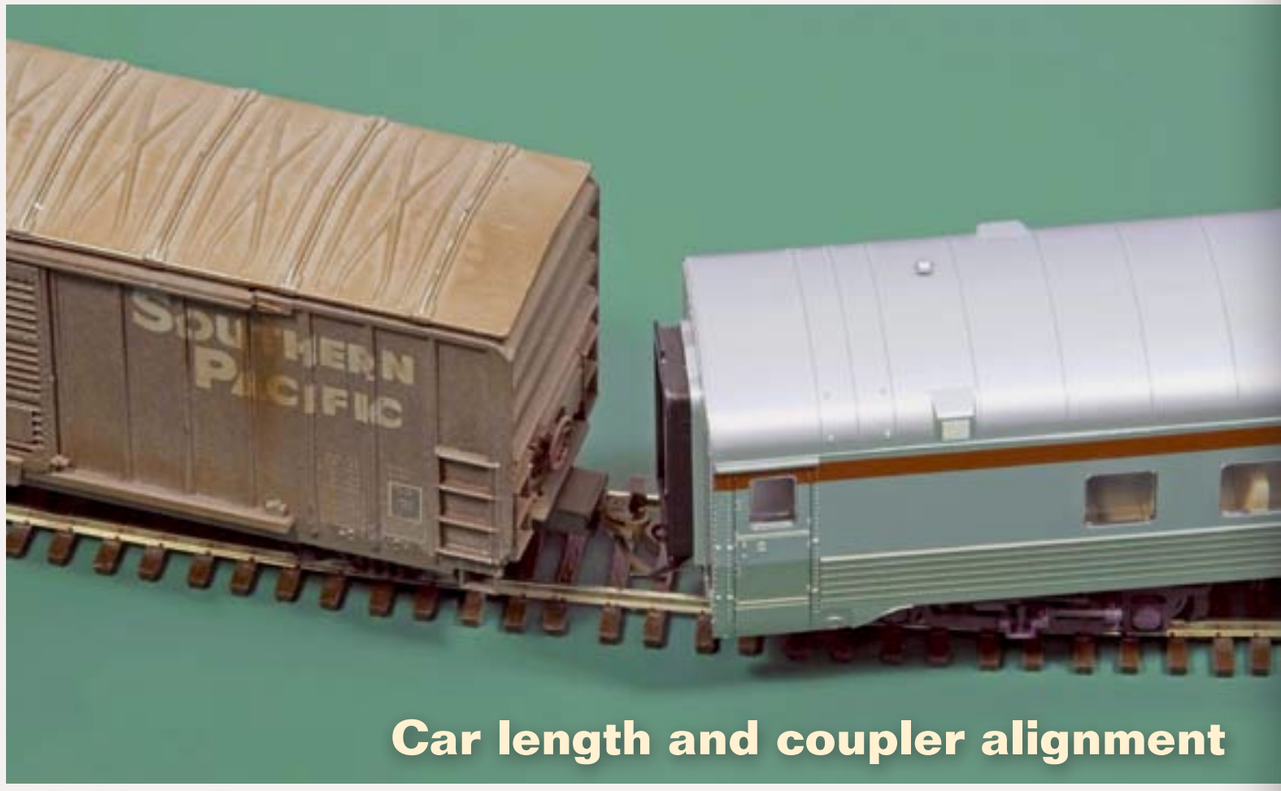

FIGURE 20: The coupler jaws completely miss each other when you mix a 50 foot and an 80 foot car on a 23” radius curve (50 ft = 3.0x, 80 ft = 2.0x).

80 foot cars

FIGURE 21: These 80 foot cars just barely stay on the track at the 2.0x radius, and fortunately there’s no underbody detail in the way of the truck rotation. Most commonly, the trucks hit underbody detail or corner steps when the curve radius becomes too sharp. Also at this radius, the cars will not couple (the diaphrams are in the way).

FIGURE 22: At the 2.5x radius, the cars finally will couple. They also track reasonably well at this radius, but they look totally unrealistic.

FIGURE 23: Once we reach the 3.0x radius, the cars roll very freely, with no tracking problems, although the overhang is still excessive.

FIGURE 24: Upon reaching the 3.5x radius, the 80 foot cars look noticeably better when viewed from inside the curve.

FIGURE 25: At the 4.0x radius, these 80 footers start to look more realistic, just as predicted by the guidelines.

FIGURE 26: Consistent with the 5.0x guidelines, the coupler alignment on a 58” curve essentially matches straight track for these 80 footers.

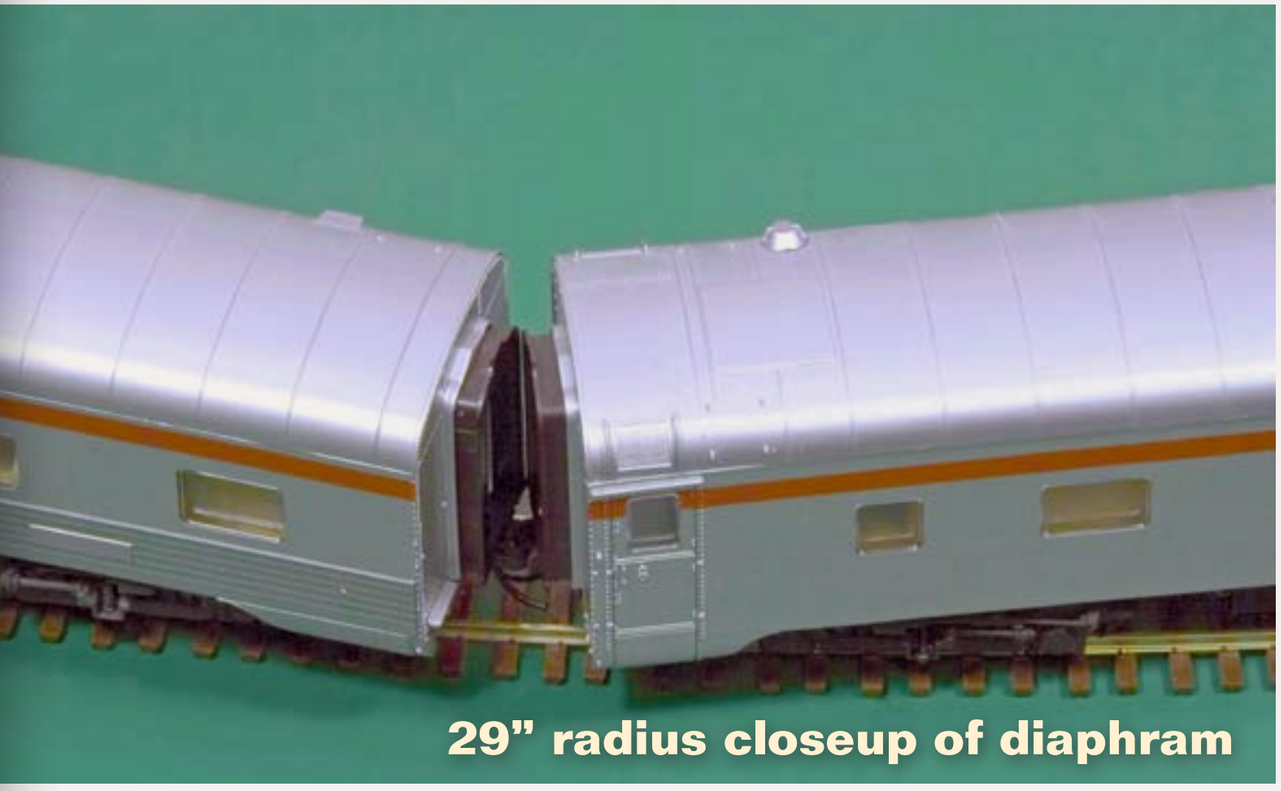

FIGURE 27: With passenger cars, we also need to get the diaphrams to line up. Obviously, it isn’t going to happen on the 2.5x curve.

FIGURE 28: The 5.0x curve diaphram alignment looks far better, but it’s still not perfect. Even 58” model curves are much sharper than the prototype.

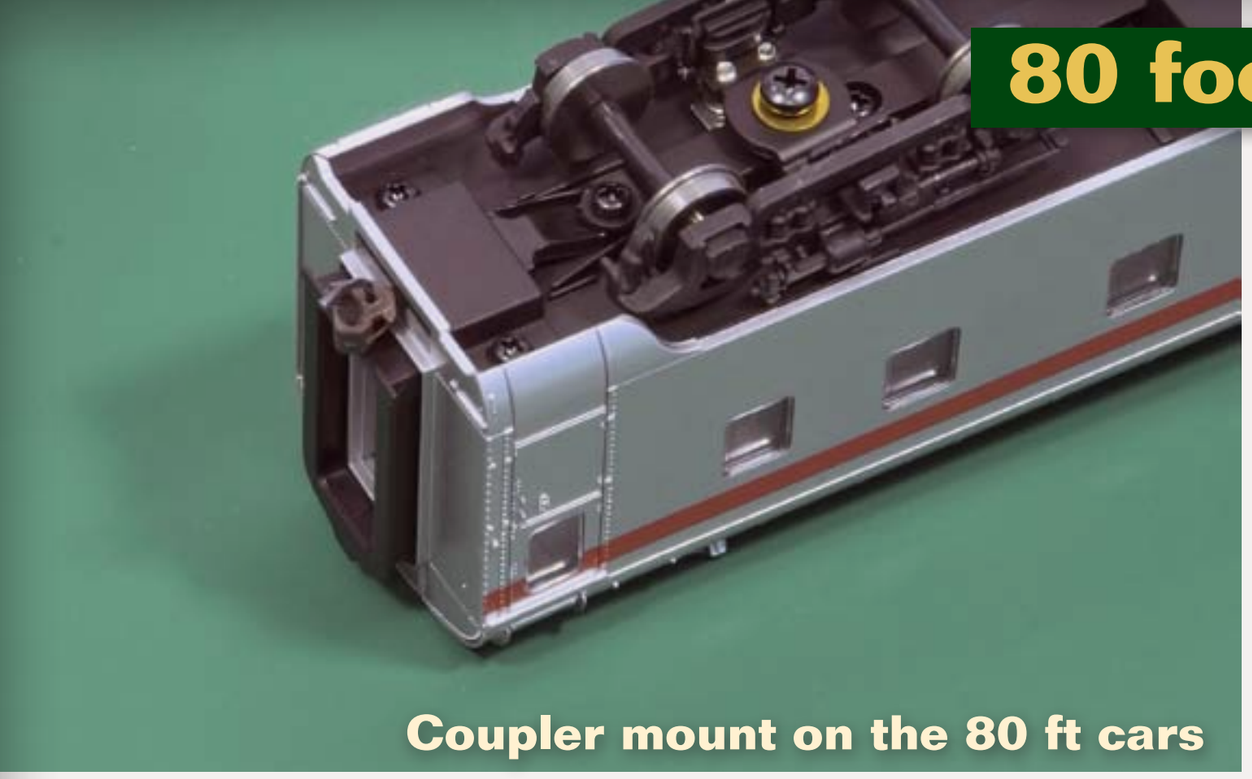

FIGURE 29: Walthers has designed the coupler draft gear on these passenger cars to swing wide, which makes the car coupler alignment more forgiving on sharper curves. While the couplers do perform better than expected on tight curves, the diaphrams do seem to be hampered by prototype curvature limitations (see figure 28).

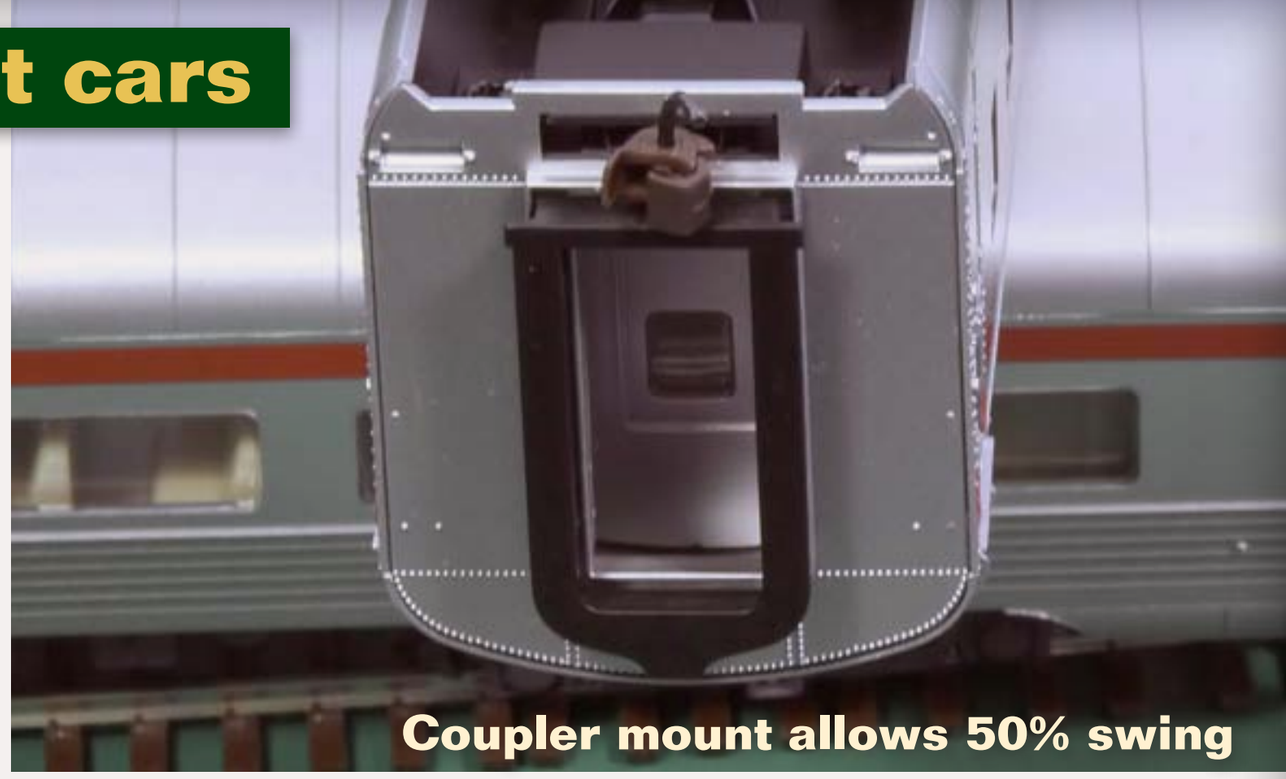

FIGURE 30: This photo shows the slotted coupler shank opening that Walthers designed into these 80 foot passenger cars. By allowing the couplers to swing up to 50% of the width of the car, these cars will couple down to 3.0x curvature with minimal coaxing. Below 3.0x, coupling becomes dicey, especially with shorter rolling stock (see figure 20).

Conclusions

From these actual equipment experiments, these ratio curve radius guidelines do an admirable job of predicting rolling stock performance on various curves.

As long as underbody detail or corner step detail doesn't get in the way, there's not much to prevent rolling stock from tracking down to 2.0x with few issues.

At 3.0x, you can expect everything to track reliably, and in some cases with a little coaxing, couplers may also work well. Mixing different rolling stock lengths, however, starts to introduce new problems.

To be sure couplers will work okay (with a little coaxing), you should use at least 3.0x of the longest rolling stock you plan to run. In HO with 80 foot cars, that's a 35" radius. Now we know why 36" is such a popular minimum radius in HO!

If you need to shave a few inches off these guidelines, you should experiment to see what the actual values are for your specific equipment.

Especially with locos, you should do some tests to be sure. But these guidelines often get you pretty close.

A question I've seen posted online lately has been what kind of curve radius the GE 44 tonner can run on. With these guidelines, you can predict pretty closely once you know the length of the loco.

The GE 44 ton loco measures out to 33'-5", or about 4.6" in HO. With this information, we can predict the following curve radius limits for this loco:

GE 44-ton loco

- 2.0x 9" radius
- 2.5x 12" radius
- 3.0x 14" radius
- 3.5x 16" radius
- 4.0x 18" radius
- 5.0x 23" radius

While the loco may be able to negotiate a 9" radius, we now know enough to stipulate that the 40 foot box cars will need a 12" radius or greater.

Armed with these new guidelines, now you can determine the best minimum radius for your track designs with confidence! ☑

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