

Speed-Matching Dissimilar Locomotives (or What I Did On My Summer Vacation) By Dan Fretz

As some of you may know, I am a sucker for locomotives. No Springfield show is complete unless I go home with one or two new locos, and I often manage to find other opportunities during the year to add to my fleet with sales and pre-orders. Unfortunately, most of these locomotives remained new and unused in their boxes on storage shelves in my basement, while I ran the same pair of Chessie System B30-7s at the Module Group shows for years. I came to the realization that this was, in fact, ridiculous, so this past January at the Amherst show, I decided to *not* purchase any new locomotives and instead use some of the *new* locos that I already owned!

I have a checklist of things that I always do to a locomotive before I'll put it into service: install Kadee couplers and any included detail parts, weather it and, finally, speed-match. Because of how I've acquired or upgraded my locomotives over the years, I own many different locomotive/decoder manufacturer combinations. This makes speed matching much more difficult, but I am not inclined to spend additional money on replacing perfectly good decoders in order to settle on a "standard" decoder for my entire roster, which would likely be outdated anyway before I could get all the locos converted.

The speed-matching steps I describe below might seem overly complicated, but it really is quite a detailed process to get dissimilar locomotives to work well together. I hate it when locos in a multiple unit (MU) configuration push and pull against each other, and when MUs pull apart while running and a locomotive takes off running by itself. I want MUs that are smooth-running, with clean acceleration and braking behavior at all speeds, so a very close match is a must.

My goal is *flexibility*: I want to be able to MU any number of my locomotives, in any combination, without having to keep track of which ones need to go together and in what direction each one needs to face in relation to the others. Keeping track of those details would be a nightmare to figure out, and a second nightmare to maintain as new locomotives are added to my roster. To reach this goal, the speed match needs to be much better than "close enough."

In trying to figure out the best way to do this, I found that online information and magazine articles are typically written for the "plain vanilla" case of speed matching a pair of identical locomotives. The general explanation is to set the start, maximum and mid-voltage values (CVs 2, 5 and 6, respectively), and you are done. Well, no, not really.

I have generally found this basic approach to be completely inadequate, leading to poor results with mixed loco/decoder combinations. In many cases, I've found that it doesn't work all that well with identical locomotives either. There are a number of reasons for this, all of which I learned through a lot of frustrating trial-and-error and having to start over many, many times.

- First, the problem with using only CVs 2, 5 and 6 is that some decoder brands *do not even support* all three of those CVs! For example, older QSI decoders do not support CV6, and the popular Soundtraxx Tsunamis do not support *either* CV5 *or* CV6. In these cases, a different solution is required even for some "plain vanilla" cases of identical locomotives.
- Second, I have frequently found that two locomotives that are speed-matched at the low end *and* at the high end don't necessarily match in the *middle*, even when both locos are programmed to use a linear speed curve, and sometimes even when the locos are from the same manufacturer. There are many factors at play which can cause this behavior but, whatever the reason, it happens *a lot* and can be quite tedious to resolve completely. Mid-voltage adjustment via CV 6 is defined to correct this behavior, but it is not adequate to meet my goals.
- Third, I quickly discovered that a locomotive often does not run at the same speed in both directions at the same speed step. This greatly complicates the speed matching effort if you want the flexibility of being able to consist arbitrary locomotives facing in either direction with respect to each other. The simple CV2/5/6 solution does not address this issue at all, which means that even with identical locomotives with decoders that support all three CVs, the results are sometimes only an approximate speed match.

There are relatively straightforward solutions to the first two problems, but that last issue is the killer and must absolutely be the first problem solved. Otherwise, you will *not* succeed. To illustrate why, let's take just two locomotives. Assume that you have MU'ed the two locos facing in the same direction, and have already successfully speed-matched them in the forward direction, via adjustments to CVs 2, 5 and 6, the speed table, or the Forward Trim setting (all to be discussed below).

Now you run the MU in reverse. If either of the locomotives does not run at the same speed in the reverse direction as it had in the forward direction, the locos will not match speeds when the MU is in reverse. At this point, the only way to match them is to modify the Reverse Trim value of one or both locomotives. You cannot change the CV 2/5/6 settings or speed table because that will mess up the matching you already did in the forward direction. So let's say you make those adjustments and now have them matched in both the forward and reverse directions when facing the same way. But this doesn't ensure that they run at the same speed in both directions.

As a last step, you MU them so they are facing in *opposite* directions. At this point, they will *only* be speed-matched if *both* locomotives run at the same speed in both directions at the same speed step. If not, *there is no way to speed match them!* Any change to the CV 2/5/6 values, speed table or Forward Trim will break the forward/forward match that you've already done, and any change to the Reverse Trim will break the reverse/reverse match. I got myself into this corner and had to start over multiple times before I realized what was happening.

Preliminaries

Before starting this project, there are a few things you will need. First, you need an oval of track, unless you already have a very large layout with adequate running room. The locomotives cover a lot of ground quickly when speed matching at medium and higher speeds. I initially tried using my three modules, but 12 feet of track is not even close to being long enough to match anything but the slowest speeds. So I built a portable, 4'x8' box frame into which I laid 2" foam, attached in the middle by a piano hinge to make storage easy when not in use (See photos 1 & 2). I took the opportunity to practice laying curves with easements, and managed about a 22.5" radius by bringing the track along the side to within about an inch of the edge. However, a temporary loop of sectional track on a table could be adequate if you ensure that there is good electrical continuity around the loop. Consider soldering 3 or 4 consecutive pieces together, so that there are only a few places that depend on the joiners for the electrical connection.

Secondly, this process is considerably easier with Decoder Pro. Decoder Pro is one of the programs that are part of JMRI (Java Model Railroad Interface) and is available for free at <http://jmri.sourceforge.net>. This tool is easy to install and use, and has quite a lot of online support and documentation as well. It simplifies modification of CVs, and enables easy and quick changes to CVs while the locomotive is moving ("programming on the main"), thereby allowing you to see immediate response to your changes. Additionally, it gives you the ability to conveniently save and restore all CV settings for each locomotive. The only thing I needed to buy was a USB-to-Serial Port cable to connect the command station to my laptop.

Finally, you will want a programming track that is convenient for initial setup of the decoder. The programming track is also necessary to read the decoder to verify CV settings because, when operating in "programming on the main" mode, CVs are write-only and cannot be read. A programming track can simply be a few feet of straight track to which you can clip leads from the DCC command station. Check your DCC system manuals to determine if you will also need a programming track booster (e.g., the Soundtraxx PTB-100) between the command station and the programming track.

A quick note on speed steps: I always do this project with the locomotives set for 128 speed steps for the best operation, but there are only 28 speed step CVs to work with (CVs 67-94). These can be set manually or with the 28 corresponding sliders provided by Decoder Pro. In this article, I will refer to the speed shown on the throttle as the "throttle setting," vs. "speed steps" for the corresponding CV and slider. So, for example, speed step 14 would affect throttle setting 64, speed step 7 would affect throttle setting 32, etc.

Initial Locomotive Setup

For each locomotive, create a roster entry for it in Decoder Pro. Then clean the wheels, put the loco on your programming track, and read the settings of all CVs in the decoder by clicking the <Read All Sheets> button. This will ensure that the values you see in Decoder Pro are the true values that are in the decoder. Most decoders have upwards of two hundred CVs, with ESU LokSound decoders reportedly having over 1000, so you do not want to do this step by hand with pen and paper.

After the read is complete, go to the “CVs” tab and scroll down looking for any red-colored CVs that indicate a failed read. Clicking the <Read> button for those CVs will attempt another read, and generally succeeds after a couple attempts. Once all CVs have been read, do a *File*->*Save...* to save the configuration. This complete configuration can be used later if needed to reset the decoder settings to their initial state.

With the locomotive still on the programming track, set and verify the initial value of the following CVs either manually or with Decoder Pro:

- *Start Voltage* (CV2) = 1. This CV is used to adjust the starting voltage at speed step 1, as a fraction of the available voltage. The higher the number, the higher the voltage. This is helpful when the loco needs an extra “kick” to operate smoothly at the lowest speeds. This setting is found on the Decoder Pro “Basic Speed Control” tab.
- *Configuration Register* (CV29) = 50. This is a composite CV that contains a number of bit-level settings. The value of 50 gives a configuration of normal loco direction (i.e., forward on the throttle makes the loco move forward), DCC-only (disables DC mode), speed table enabled, and extended locomotive address mode. In Decoder Pro, these settings are scattered among multiple tabs, so it is easiest to go to CV29 on the “CVs” tab, set it to 50, and click the <Write> button.
- *Speed Table Select* (CV25) = 16. This selects the “User Defined” speed table, once the speed table is enabled via CV29. In Decoder Pro, this setting is activated by selecting “User Defined Speed Table” in the “Speed Table Selection” drop-down menu. Note that this choice is not provided for ESU LokSound decoders, which do not support CV25. In the LokSound case, it appears that “user defined” is always active.
- Define the initial *Speed Table* (CVs 67-94) to be linear. Set slider 1 (CV67) = 4 and slider 28 (CV94) = 200, and click the <Match Ends> button. I choose 4 and 200 to provide a little adjustment room in later steps. Note that if this is an ESU LokSound decoder, neither CV67 nor CV94 are adjustable; you must use CVs 2 and 5. So in this case, set Start Voltage (CV2) to 4, not 1 as previously stated.
- *Forward Trim* (CV66) and *Reverse Trim* (CV95) = 128. For both CVs, this is the “no effect” setting. In Decoder Pro, these are set on the “Speed Table” tab, unless it is an ESU LokSound decoder. In that case, the trim values are not on the “Speed Table” tab and must be set via the “CVs” tab. Note that these CVs are only active when the speed table is activated via CV29.
- CV3 (*Acceleration Rate*) and CV4 (*Braking or Deceleration Rate*) = 0. These are the momentum CVs, and are found on the Decoder Pro “Motor” tab.
- If the locomotive has a QSI decoder, make sure that *Regulated Throttle Control* is enabled. This is done via an indexed CV (set CV 56.4 to '1' – check the manual) or in DecoderPro on the “BEMF” tab via the Throttle Mode drop-down menu.

After setting and verifying the value of these CVs, do another *File*->*Save...* to save the modified configuration, and don't forget to also write the values to the decoder. Once you've configured a few locomotives with the initial settings, you can move on to the speed-matching steps and configure the other locos in the group as you go along. Or if you prefer, you can do this initial setup on all of the locomotives being speed-matched.

Configuring a Reference Locomotive

The basic approach to speed-matching a group of locomotives is to configure a reference locomotive to operate at the speeds you want at various speed steps, then match all of the other locomotives in the group against this reference. As previously explained, this reference locomotive *must* be configured to run at the same speed in both directions at the same speed step.

I've tried a couple of ways to accomplish this, but the approach that worked best was to use the stopwatch tool on my ancient texting phone to time how long it takes the locomotive to cover a specific distance, then calculate the scale mph. I use a distance of 4 feet that I marked off along one side of my loop of track. This is a convenient distance for HO scale, but you might want to use a shorter distance for smaller scales or a longer distance for larger scales. The general mph calculation is:

$$(d / t) * 3600 / 5280 * s = \text{scale mph} \quad [\text{For non-programmers "*" means multiply}]$$

where 'd' is the distance in feet (in my case, 4), 't' is the measured time in seconds, and 's' is the scale (160 for N, 87.1 for HO, 48 for O, etc.). Notice that the 'd', 's', and fraction are constant, so you can simplify the formula by calculating the constant part once, and the calculation becomes:

$$\text{constant} / t = \text{scale mph}$$

In HO scale, for a distance of 4 feet, this constant value is $(4 * 3600 * 87.1) / 5280 = 237.5$, or approximately 240. So a locomotive that takes 4 seconds to travel the 4 feet is traveling at $240 / 4 = 60$ mph, 8 seconds is $240 / 8 = 30$ mph, etc.

From the group of locos being speed-matched, pick one to be the candidate reference. If possible, choose one that does *not* have a Tsunami, primarily due to the mid-speed behavior mentioned below in step 3. The steps for configuring the reference locomotive are as follows:

1. Configure the minimum speed.

Set the locomotive to operate at 128 speed steps, and move the throttle to setting 1, corresponding to speed step 1 (SS1). If the loco does not run smoothly, increase the start voltage via CV2 until it does. Then increase or decrease the speed via CV67 (the SS1 slider in the speed table). Note that if this is an ESU LokSound decoder, neither the SS1 slider nor CV67 are adjustable; you can only use CV2.

I configure my locomotives to run at about 3 mph at SS1, mainly because I have some locos that cannot operate reliably at 1 or 2 mph no matter what I do. At SS1, I make CV2/CV67 adjustments until it takes between 75 seconds (3.2 mph) and 79 seconds (3.0 mph) to travel the 4 feet.

If you cannot get the locomotive to run this slow with *only* the CV2 and CV67 adjustments, set it aside and choose a different locomotive for your potential reference, do the initial setup, and start over. This locomotive can be made to run slower later with other CV corrections when it is matched to the reference loco. But you want a good runner for your reference and this one isn't it.

2. Configure the maximum speed.

With the throttle set to its maximum, adjust the value in CV94, which is the SS28 slider in the speed table, until the maximum speed is where you want it. Remember that if this is an ESU LokSound decoder, the SS28 slider and CV94 are not adjustable, so you can only adjust the maximum speed by changing the maximum voltage value in CV5 (Vhigh). If this is a Tsunami decoder, it's the other way around – CV5 is not supported, so you need to adjust the maximum speed with CV94.

I configure my locomotives to run at a maximum speed of about 60 mph, so I adjust CV94 until it takes between 3.95 seconds (60.8 mph) and 4.1 seconds (58.5 mph) to travel the 4 ft. It is very difficult to be more precise than this when the loco is running so fast. However, I've found that a difference of a couple mph at maximum speed is barely noticeable in an MU, which would never be run this fast anyway.

Once the maximum speed is set, click the <Match Ends> button on the Decoder Pro “Speed Table” tab. At this point, you might also want to save the configuration so that you can restore all CV settings as they currently exist if things get hopelessly messed up in the following steps.

3. Verify the middle speed.

With a minimum speed of 3 mph and a maximum speed of 60 mph, then at SS14 the loco should travel at about $(3+60) / 2 = 31.5$ mph with a linear speed curve. Using the general mph calculation from above, now 't' is the unknown. Rearranging the formula a bit and using the constant, it should take the locomotive $constant / 31.5 = 7.6$ seconds to travel 4 feet in HO. In many cases, it will not. For example, I've found that locomotives with a Soundtraxx Tsunami run way too fast and typically clock in at about 40-45 mph at SS14 when SS28 is at 60 mph. These locomotives can be very difficult to slow down at a given speed step, and are very tedious to configure to run linearly.

If the mid-speed is close, minor CV adjustments around the middle of the speed curve can give the locomotive linear performance even though the “linear” speed curve displayed by Decoder Pro has a slight bend in it.

If the mid-speed is not close, now you have a decision to make. You can set this loco aside, choose another one as your potential reference locomotive, and start from the beginning. That's what I did. The alternative is to stick with this one, which will require significant changes to the speed curve because, if it is not linear at the mid-point, it most likely will be off at other points as well. So you will end up with a curve that has lots of kinks in it. Yes, it may have linear performance for matching other locos, but then you'll be matching those locos to a reference that needed lots of adjustments to get it to run well. My preference was to have a reference locomotive that ran correctly to begin with, so that few corrections were necessary. I actually started over multiple times at this point until I found one I liked -- an Athearn unit with an after-market ESU LokSound Select decoder. It runs beautifully and was almost dead-on at the mid-point speed.

Regardless of whether you need to make minor or major adjustments to the mid-speed, the process is the same, and described in detail in the next section “**Matching a Locomotive to the Reference**”, in the “Configure the Middle Speed” step. But instead of matching to another locomotive, you'll match the reference to the mid-speed you've chosen; in this case, 31.5 mph.

4. Match the reverse direction.

After the speed curve adjustments have been completed and the performance is linear, it's time to move on to the reverse direction. With the loco in reverse, clock the times for your minimum, maximum and mid-speed throttle settings. If they match the forward direction, you are done with this step. If the loco is faster at all three settings, or slower at all three settings, that can be corrected by adjustments to the Reverse Trim value (CV95, in Decoder Pro on the “Speed Table” tab).

The reverse trim allows the entire speed curve to be adjusted up or down. The default is 128, which has no effect. Values 127 downward slows the loco at all speeds, and values 129 upward increases its speed. The farther from 128, the larger the effect. *Do not change the speed table settings*, because that will mess up the forward speeds. Though the reverse trim can often produce matching reverse speeds, on occasion I've seen a slight variation in a loco, such that it matches two of the three speeds, with the third being slightly off. In these cases, I adjust the reverse trim to match the low and mid speeds.

If the reverse speeds are too far off, then this is another case of a locomotive with running characteristics not worthy of a reference locomotive, so I'd set it aside, pick a different loco, and start over.

5. Set Acceleration and Braking Momentum.

After the speed curve adjustments have been completed and the performance is linear, the last step is to adjust momentum settings. The momentum settings simulate the mass of a prototype locomotive. As the momentum rates are increased, the models take longer to reach the set speed and longer to stop once the speed is set to 0. The amount of momentum is purely your preference.

In Decoder Pro, momentum is configured by the Acceleration (CV3) rate and the Braking (CV4) rate, and are found on the “Motor” tab. The settings for most decoder brands are similar but will vary slightly from one locomotive to the next. Note, however, that Decoder Pro documentation says that ESU V4 and Select decoders use a momentum multiplier value that is not the NMRA-standard. The effect is that the momentum values of the V4/Select decoders must be set to roughly 4-times the values in older ESU decoders and most other decoder models, in order to have the same momentum effect.

If using Decoder Pro, do a *File*->*Save...* to save the modified configuration of the reference loco.

Matching a Locomotive to the Reference

Speed matching locomotives is a highly iterative process that can take a lot of time. You see what it took to get a reference locomotive set up to run linearly at the same speed in both directions at the same speed step. Now you get to start working with those other locomotives that you set aside because they had various undesirable running characteristics.

When matching a loco to the reference, *MU them facing the same direction*, but leave them *uncoupled*. At relatively low speeds, I space them a few inches to a foot apart to more easily see changes in the gap between them as speed adjustments are made. But at higher speeds, I space them on opposite sides of the track loop, and make adjustments until they are consistently crossing the piano hinge at the same time.

1. Initial Setup.

We'll refer to the locomotive being matched to the reference loco as locomotive B. Do the initial setup of loco B as described in the **Initial Locomotive Setup** section above. However, there is an alternative using Decoder Pro that can potentially save some time. If loco B is the same manufacturer/decoder combination as either the reference or a previous loco that you've already matched to the reference, you can dump that configuration to loco B using Decoder Pro. In many cases, this can get you pretty close right at the beginning. For example, if loco B is the same manufacturer and decoder as loco X, and you've already matched X to the reference, do the following:

- Create a Decoder Pro roster entry for loco B.
- Select loco X in the roster, click "Programming Track", and click the <Program> button.
- Put loco B on the programming track.
- Click the <Write All Sheets> button. This will store the loco X configuration into the loco B decoder.
- Once the write completes, close the programming window for loco X. If you are prompted to write to the configuration file for loco X, just click <Close> – do not save anything!
- Select loco B in the roster, click "Programming Track", and click the <Program> button.
- Click the <Read All Sheets> button to read the configuration from loco B's decoder.
- Once the read completes, go to the "Basic" tab and set the locomotive address of B to the correct value. Then select *File-->Save...* to save the new configuration for loco B.
- Close the programming window.

2. Initial Speed Check.

Put the reference loco and loco B on the track loop. Select each one and ensure they are set for 128 speed steps. Then MU them. In Decoder Pro, select loco B in the roster, click "Programming On Main", and click the <Program> button.

Do a quick speed check at the minimum, maximum and mid-speeds to see if locomotive B speeds match those of the reference. Keep in mind that initial locomotive setup turned off momentum in loco B. If you configured the reference with momentum, you need to allow time for the reference to ramp up to the throttle setting before making any judgments about loco B's speed.

If loco B is faster at all three speeds, or slower at all three, you might be able to speed match them by just changing the Forward Trim (CV66) value of loco B. If so, move on to step 5. If not, move on to the next step.

3. Configure the Minimum Speed, then the Maximum Speed.

For both speed extremes, the process of matching the speed of loco B to the reference consists of the same steps as configuring the reference loco to a specific speed.

If locomotive B cannot be made to run as slow as the reference at SS1 by adjusting only CVs 2 and 67, you can further reduce its speed by lowering the Forward Trim (CV66) value from its default value of 128. If loco B still does not run slow enough, the only option is to leave Forward Trim at the lower value and further reduce the speed via CV67, or decrease the start voltage via CV2. Note that if the forward trim is changed in this step, any previous maximum-speed match will be affected, so that will need to be redone.

4. Configure the Middle Speed.

Place the locos on opposite sides of the track loop, and adjust the throttle to its middle setting, corresponding to SS14. In the unlikely event that the speed of loco B matches that of the reference loco, buy a lottery ticket and move on to step 5. Otherwise, you'll need to adjust CV80 (or the SS14 slider) up or down until loco B's speed is correct, and then modify all of the other speed steps so that they form a straight line from SS1 to SS14 and from SS14 to SS28.

I've done this manually in the past and can assure you that it is quite tedious. Say loco B is matched with CV67=6, CV80=110, and CV94=204. Take the difference in the values of CVs 80 and 67 (in this case, 104), then divide it by the number of speed steps from 1 to 14 (always 13 for the lower range; 1→2, 2→3, ..., 13→14). The result, 8, is the increment in the value from one CV to the next (e.g., CV68=14, CV69=22, etc.). The same procedure on the upper half of the range from speed steps 14 to 18, always dividing by 14 (the number of speed steps from 14 to 28), gives an increment of 6.71. When it is an uneven number, round to the closest quarter, in this case 6.75. An average increment of 6.75 must be approximated by an increment sequence of 7-7-7-6-7-7-7-6, etc. So CV81=117, CV82=124, ..., CV84=137, etc. If the average increment had come out to be, say, 5.5 after rounding, the sequence would be 6-5-6-5-6-5, etc.

A *much* easier way of doing this is provided by Decoder Pro, through a feature that is really not all that well documented. On the Speed Table tab, under each slider is an unassuming little box that seems to not do much of anything. Hover your mouse over the box and the pop-up help says to click it to "fix the point when adjusting." If you click it, the slider moves just fine, it is not fixed at all. I figured it was a feature that just didn't work and ignored the boxes for the longest time. Boy, was that a mistake.

Here is what those boxes do: By itself, clicking one box does nothing. But click two, and Decoder Pro adjusts all sliders between them to keep a straight line as one of the checked sliders is moved. Click a third box, and Decoder Pro keeps the sliders between clicked boxes 1 and 2 in a straight line, as well as between clicked boxes 2 and 3, which is *exactly* what we just calculated manually. So to configure the middle speed, click the boxes under the sliders for SS1, 14 and 28, then adjust

the SS14 slider up or down until loco B's speed is correct. The straight lines from SS1 to SS14 and SS14 to SS28 are maintained automatically.

5. Check $\frac{1}{4}$ and $\frac{3}{4}$ Speeds

I always do a final check of the MU moving forward at speed steps 7 and 21. These will usually match once the minimum, maximum, and mid-speeds are calibrated, but not always (can you say "Tsunami"?). Any speed discrepancies between the reference and loco B are eliminated by following the same procedure as with the middle speed. If using Decoder Pro, leave the boxes checked under the sliders for speed steps 1, 14 and 28, and in addition, check the boxes under SS7 and SS21. Then, for example, if you move the SS7 slider, the value of SS14 remains unchanged and straight lines are maintained between SS1 and SS7, and SS7 and SS14, with all CV values above SS14 being unaffected. If you are not using Decoder Pro, the manual process for matching SS7 and SS21 is the same as in the previous step.

6. Fine Tune.

At this point, the speeds should be very close. Place the locos a few inches apart, and then check the minimum, maximum and mid-speeds, remembering to allow time for the reference locomotive to accelerate to the throttle setting. At each point, make small adjustments, if required, to CVs 67, 80 and 94 until loco B runs at the same speed as the reference loco. While making adjustments during this step, use the Decoder Pro slider boxes or manually calculate values for CVs between 67-80 and 80-94, as described in step 3. Then verify and adjust the CVs for SS7 and SS21 if required (the $\frac{1}{4}$ and $\frac{3}{4}$ speeds). If adjustments were required at most of those CVs, it's a good idea to split the CV intervals again, to include CVs 70, 76, 83 and 90 (these correspond to the $\frac{1}{8}^{\text{th}}$, $\frac{3}{8}^{\text{th}}$, $\frac{5}{8}^{\text{th}}$ and $\frac{7}{8}^{\text{th}}$ speeds).

7. Match the reverse direction.

Now reverse the MU, and check the minimum, maximum and mid-speeds. If the speeds of loco B and the reference loco match, move on to the next step. If loco B is consistently faster than, or slower than, the reference loco, try to correct the mismatch by adjustments to loco B's Reverse Trim value (CV95, or in Decoder Pro on the "Speed Table" tab).

In some cases, the reverse speed of loco B is considerably faster than the reference throughout the speed curve, and I've been unable to bring SS1 down to the 3 mph reverse direction speed by using the Reverse Trim alone (hint: the decoder brand starts with "T"). After lots of swearing and gnashing of teeth, the only option at this point is to use the speed table SS1 slider/CV67 to slow it down, or reduce the CV2 Start Voltage.

Once you have a match in reverse, those changes will have affected the SS1 forward matching that you've already completed, so you'll need to go back and redo steps 2 and 3 at a minimum. In doing this, remember that CV67 or CV2 (or both) have now been used and are off-limits to further adjustments when redoing the forward direction match. Changes to the Forward Trim (CV66) value of loco B is the only option.

8. Set Acceleration and Braking Momentum.

Line the two locomotives on the piano hinge on opposite sides of the loop, like they are at the starting line for a race. Then increase the throttle setting to its maximum as quickly as possible. When the locos stabilize at the maximum speed, if locomotive B is *ahead* of the reference as they cross the hinge, that means it accelerated faster than the reference. So *increase* the Acceleration Rate of loco B, thereby increasing the momentum effect, which in turn causes the loco to accelerate *slower*. Yes, it is somewhat counter-intuitive. Stop the locomotives, and repeat. Once they accelerate at the same rate, they will cross the hinge at the same time.

Now, with them running at maximum speed, reduce the speed back to zero as fast as possible. If loco B stops before the reference, it is decelerating faster than the reference, so *increase* the Braking Rate. This will increase the momentum effect and cause the loco to take longer to stop. Return the locomotives to the maximum speed, and repeat. They are matched when they come to a stop at the same time.

If using Decoder Pro, do a *File*->*Save...* to save the configuration of locomotive B.

9. Don't Forget to Delete the MU.

Congratulations! The two locomotives are now speed-matched! Delete the MU, and move on to the next loco to be matched with the reference.

So that's the speed matching process I use. There are certainly easier and quicker ways to do this if you only need "close enough" performance with locomotive pairs that always run together. But if you have numerous locomotives that you want to MU in any combination, I hope you give my approach a try.

Publication History

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Photos:



Photo 1



Photo 2



Photo 3