

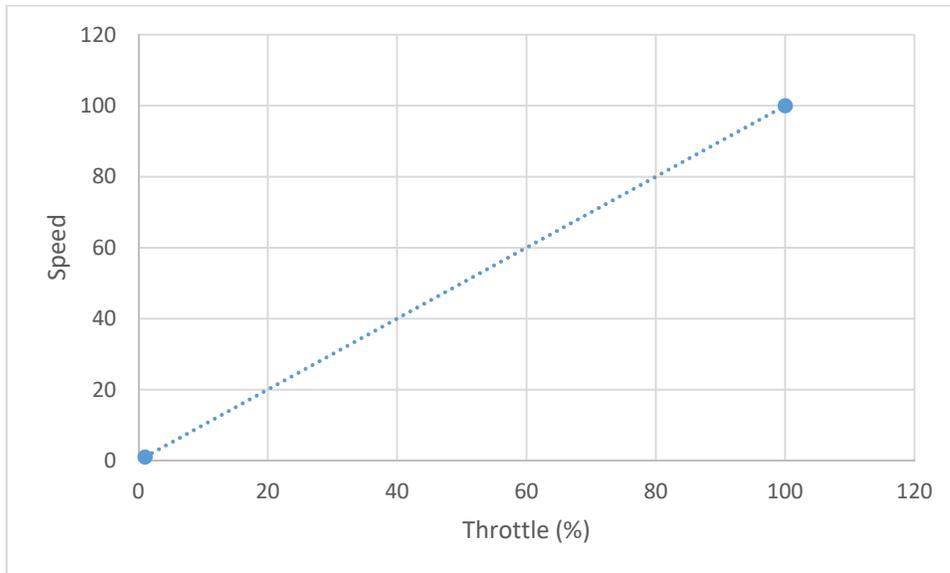
# Speed Matching

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Let's keep this simple. It really does not need to be complicated.

And don't forget, you've got a safety net: CV 8 to 8 and repower. <https://www.youtube.com/watch?v=VE6qKXhtcy8>

If you have two locomotives that both start at the lowest (or same) throttle level and both have the same maximum speeds at maximum throttle level they should be fairly well speed matched. Both would be expected to have speed curves that look something like this:



If we have two locomotives that respond like this they do, in fact, behave a lot alike.

So what are the problems?

There are a few, but, fortunately, they are mostly workable.

Consider that two locomotives have two different sets of wheels (electrical pick-ups), two different drive trains (slop and resistance), and (perhaps) two different masses (more resistance).

With a little work (good layout practices) and the help of DCC we can minimize these problems.

Let's deal with them in order:

First: Electrical pick-up.

1. Keep your wheels clean.
2. Keep your track clean.
3. Have lots of feeder lines (avoiding dead spots on the layout).

Second: Drive train variability.

1. Keep your drive train well lubricated, linear, and tight.
2. Create a speed table that makes your locomotives run in uniform, predictable ways.

Decoder manufacturers sell us decoders that present the locomotive with a speed table that reflects what the manufacture thinks we want. Well, that's not necessarily true and, because of the reasons outlined above, makes speed matching very difficult. So the first thing we need to do is turn off the manufactures speed table. To do that we set CV 29 to a value of 34. (CV 29 is used to control a variety of parameters including: Default Direction, use of 14 or 28/128 speed

–step mode, use of a 3-point or Linear/28-point speed table, and the ability to use an Extended Address.) Setting CV 29 to a value of 34 sets forward as the normal direction, allows for 28/128 speed mode (finer control), use of the 3-point speed table, and use of the extended address. This value sets us up to use a three point speed curve defined by CV2 (Starting voltage), CV 5 (Maximum voltage), and CV6 (Midrange voltage).

Now we can go in and set CV2 (Starting Voltage):

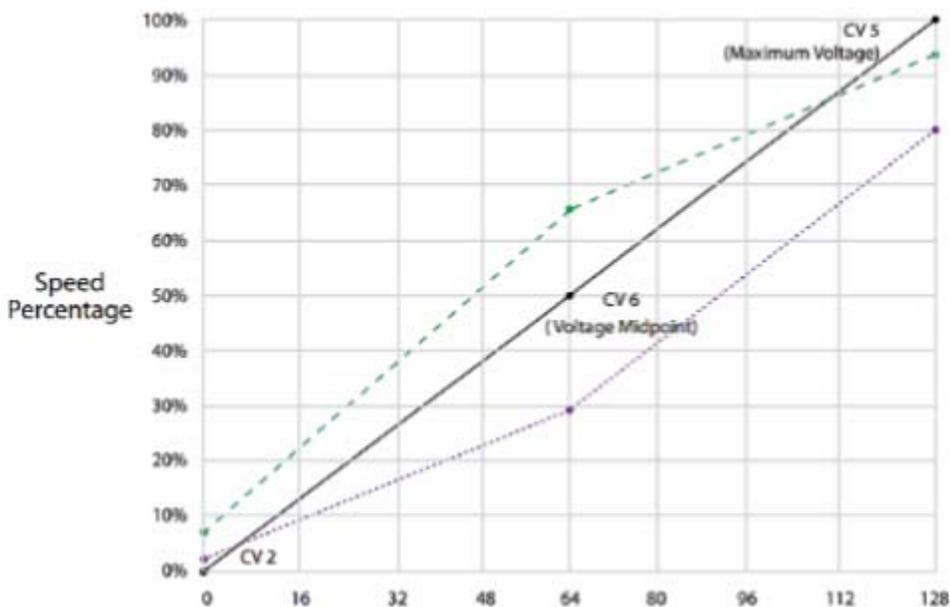
With the locomotive on the track and the cab (throttle) set to speed step 1 start increasing the value of CV2 until the locomotive just moves. I suggest initially working in increments of 20. i.e.: start with 20, if there isn't any movement, go to 40, if there still isn't any movement go to 60, etc.

Next we set CV 5 (Maximum Voltage) to a value that corresponds to the fastest speed we ever want to see that locomotive move at. The possible range is 0 to 255. You probably don't want the maximum voltage being applied to your locomotive (unless you are in to locomotive racing). So try an initial value of about 100. Now move your throttle up to the maximum setting. Too slow? → Increase CV 5, to fast? → Decrease CV5.

The last step is to set CV 6 (Midrange Voltage): Set your throttle to its midpoint (14 on a 28 step scale, 114 on a 128 step scale). Now start adjusting CV 6. I suggest you start with a value midway between the values you have in CV2 and CV 5. So if CV 2 is at 40 and CV 5 is at 180, try an initial value of 110 for CV6.

The process of setting CV5 (Maximum Voltage) to a value of less than 255 may have altered the initial voltage going to the locomotive at speed step 1. So go to speed step 1 and check the locomotives response. If necessary reset CV 2 (Starting Voltage).

In graphic form this is what you have:



(Copied from the Soundtraxx Tsu2 Technical Reference Guide)

You are half way home!

Now take your next locomotive and repeat this process, matching the amount of movement (not the absolute CV value) at the Starting (CV2), Maximum (CV5), and Mid (CV6) points.

Following these steps will give you locomotives that will play fairly well together (think consisting). There will be some differences, but, for similar locomotives the differences should be minimal.

If I must do my programming with a hand-held cab this is what I do; Minimum steps, minimum time, acceptable results. If I have access to a computer and JMRI (Java for Model Railroad Interest) then I'll use DecoderPro for significantly better results.

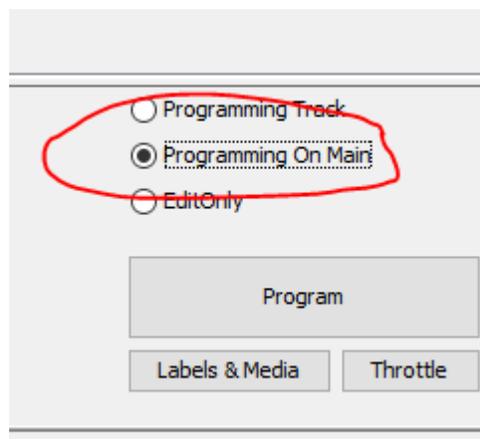
Let me start by saying that we are using JMRI DecoderPro version 4.10+R419243e connected to a NCE Power Pro system with a UN8-BE from RR-cirkit using the Driver supplied by them. This is the detailed description for our current method of Speed Matching locomotives; the goal being a consistency of operation when operating each of the locomotives in the roster and smooth consist operation. A secondary goal of this process is to a realistic maximum speed limit for all locomotives in the roster. I suggest that you select one of your easiest to use, and handle, locomotives to be the Golden Standard. You will be using it during the Speed Matching of all subsequent locomotives.

Much of the information included comes directly from the SoundTraxx **Diesel User's Guide** (Release 1.1) and the JMRI web site, specifically, the Speed Table chapter of the Comprehensive Programmer for DecoderPro ([http://jmri.org/help/en/manual/DecoderPro3/Comp\\_Speed\\_Table.shtml#gotchas](http://jmri.org/help/en/manual/DecoderPro3/Comp_Speed_Table.shtml#gotchas)). For the SoundTraxx information you could also use their **Steam User's Guide**. Both are available on the SoundTraxx website Manual page at <http://www.soundtraxx.com/manuals.php>. Direct quotations from that site are indicated: (SoundTraxx, 2018) or (DP Speed Table).

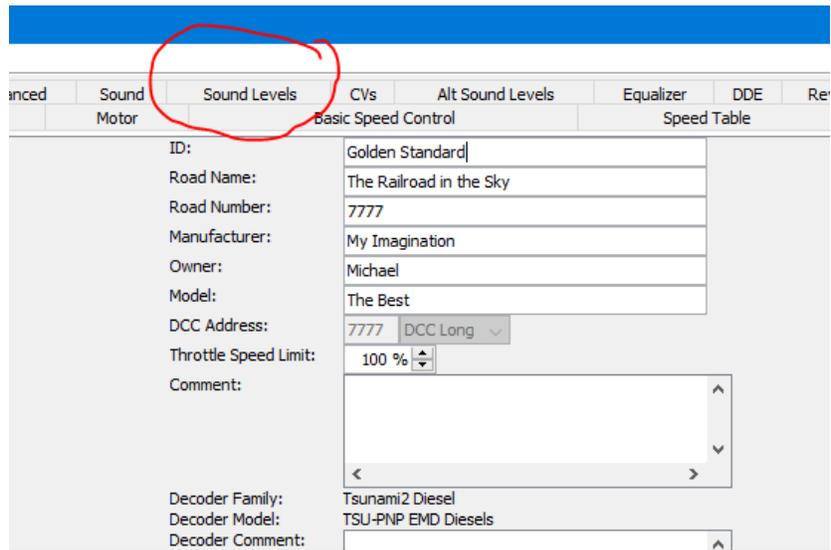
On our test track we have calculated that at 55 SMPH a locomotive should complete a circuit in 22.4 seconds and 10 laps in 3min 44 sec.

(The formula for calculating scale speed at a given distance and time is:  $(D/T) * 3600/5280 * S = \text{smph}$ , where D is the distance traveled in time (seconds).)

1. Start by placing the locomotive that will be your "Golden Standard" on the Track.
2. Open Decoder Pro and set it to use Programming on the Main by selecting the "Programming On Main" button in the lower right corner of the Home Page:



3. From your Roster (on the "All Entries" page) open "Golden Standard": Double click on that locomotive.
4. This will open the Roster Entry tab of the Programming Page for Golden Standard.
5. Since the primary sound coming from a diesel locomotive is the sound of the Prime Mover I recommend starting by decreasing that volume. SoundTraxx sets it to a fairly high default value, which I find a bit distracting. So I set CV 130 to a lower value of 5. To do this open the "Sound Levels" tab:



You should get the following window:



I suggest lowering this to a value of about 25 or less.



Select “Write changes on sheet” and you should hear a drop in the sound volume coming from your locomotive.

- Next we are going to get the locomotive running smoothly throughout its range, starting with slow, smooth movement at speed step 1. I suggest you use a 128 step throttle. The first thing we need to do is get rid of any encumbrances to movement. CV 3 (Baseline Acceleration Rate) slows acceleration to mimic operating under a load. CV 4 (Baseline Deceleration Rate) slows the breaking rate, mimicking the effect of trying to stop a heavy load. CV 66 (Forward Motor Trim) and CV 95 (Reverse Motor Trim) are used to “trim” the forward and reverse drive voltages when the 28-point custom speed table is enabled. Setting motor trim can help compensate for speed differences between forward and reverse directions.” (SoundTraxx, 2018) The neutral, “Disabled” value for these CV’s is 128. So, until later, we’ll turn all of these off by setting CV’s 3 & 4 to a value of 0 and CV’s 66 & 95 to 128. To do that open the CV tab.

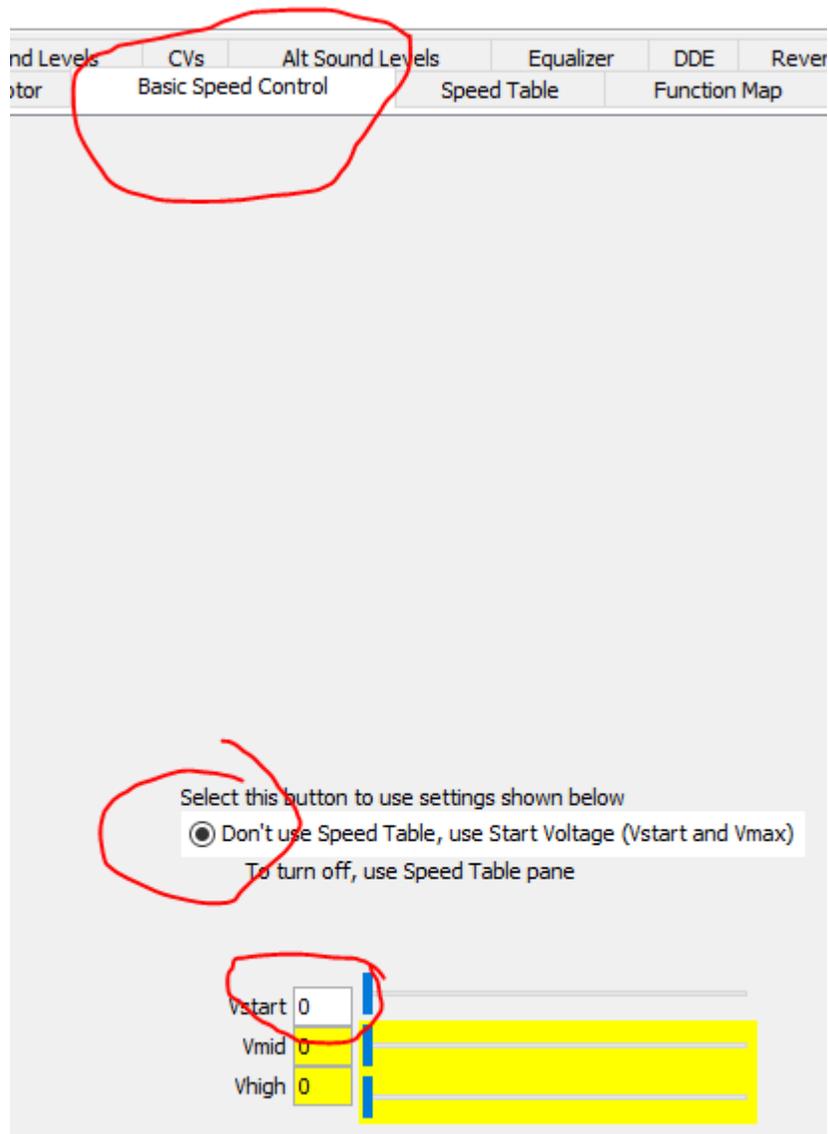
telp

Basic Motor Basic Speed Control Speed Table Function Map Lights  
 nd Sound Levels CVs All Sound Levels Equalizer DDE Reverb ASC

CV	Value (Deci...	State	Read	Write	Compare
1	3	From file	Read	Write	Comp...
2	5	From file	Read	Write	Comp...
3	0	From file	Read	Write	Comp...
4	0	From file	Read	Write	Comp...
5	0	From file	Read	Write	Comp...
6	0	From file	Read	Write	Comp...
7	0	From file	Read	Write	Comp...
8	0	From file	Read	Write	Comp...
10	0	From file	Read	Write	Comp...
11	0	From file	Read	Write	Comp...
12	1	From file	Read	Write	Comp...
13	0	From file	Read	Write	Comp...
14	3	From file	Read	Write	Comp...
15	0	From file	Read	Write	Comp...
16	0	From file	Read	Write	Comp...
17	222	From file	Read	Write	Comp...
18	97	From file	Read	Write	Comp...

If the value for CV's 3 & 4 is not already 0, then enter 0. If the value for CV's 66 & 95 are not 128, then enter 128. When done click the "Write changes on sheet" button.

7. Select the "Basic Speed Control" tab:



8. Make sure that you are not using the “Speed Table” and that CV 2 (Vstart) is 0. Remember to click the “Write changes on sheet” button whenever you make changes. The following description is from page 25 of the Tsunami2 Diesel User’s Guide:

1. Place the unit on the mainline and set the throttle to speed-step 1, and then increase the value of CV 2 until the model responds to your preferred starting voltage.
2. Set the throttle to a medium speed step, and then increase the value of CV 6 until the model responds to your preferred mid-speed voltage.
3. Set the throttle to the maximum speed step, and then increase the value of CV 5 until the model responds according to your preferred high-speed voltage level.

Page 25 also shows a graph of a few of these 3-Point Speed Curves.

9. Using your cab increase the throttle to its maximum (if safe). The range of CV 5 is 0 to 255; 0 corresponding to 0% voltage to the motor and 255 corresponding to 100% voltage to the motor. Start entering values into CV 5 (Vhigh) until your locomotive is traveling at a speed slightly in excess of your maximum sMPH, 55 sMPH in my case. Now set CV 6 (Vmid) to a value halfway between CV 2 and CV 5. Remember to save
10. Next we will set the complete 28-point custom speed table. To do this open the Speed Table tab.

Advanced Sound Sound Levels CVs Alt Sound Levels Equalizer DDE Reverb ASC Legacy  
Basic Motor Basic Speed Control **Speed Table** Function Map Lights

Select this button to use a Speed Table for Speed Control  
 Use Speed Table  
 To turn off, use Basic Speed Control pane

Speed Table Selection 28-Point Custom Speed Table

Speed Table

0	9	18	28	37	47	56	66	75	85	94	103	113	122	132	141	151	160	170	179	188	198	207	217	226	236	245	255
<input type="checkbox"/>																											

Force Straight Match ends Constant ratio curve Log curve Shift left Shift right

Forward Trim 0 Reverse Trim 0

Check that the "Use Speed Table" button is selected and that you are using a "28-Point Custom Speed Table." (A note about this table: "SoundTraxx Tsunami decoders differ from the standard. When the speed table is active (Bit 4 of CV29 is 1), the value in CV2 is not ignored but is effectively (in the decoder) added to CVs 67-94 in the speed table, pushing it upwards." (DP Speed Table)

Now set the throttle of your cab to speed step 1. The locomotive should be moving just as it did in Step 9, above, when we were setting CVs 2, 5, & 6. If you need to go ahead and increase the Step 1 level on the Speed Table until the locomotive just begins to move. Next increase the throttle to step 110 (since we want that to correspond to 55 SMPH). Now start adjusting Step 28 on the Speed Table, until the locomotive is travelling at your desired maximum speed (55 SMPH in our case). Between each iteration click the "Match ends" button and "Write changes on sheet." Once you have a satisfactory setting be sure to "Save."

11. Next we need to match the reversing speeds with the forward speeds. So get the locomotive moving in reverse at your maximum throttle setting (110 in our case). Check the speed. If it is too fast set the Reverse Trim value to a value between 1 and 127. The smaller the value the more it will slow the locomotive. If the locomotive is traveling too slow set the Reverse Trim value between 129 and 255. The larger the value the more it will speed-up the locomotive. Again, once you have a satisfactory match be certain to "Save".
12. Next we start speed matching additional locomotives to our Golden Standard. These steps are taken from JMRI site:
  1. If the engine is new, it should be run in for an hour or two before setting the speed
  2. Warm up both engines and make sure their wheels are clean. 3-5 minutes usually suffices. This will also give you an idea on how close the speeds are for the 2 engines.
  3. Make sure CV19 is set to 0 for both engines. Also, make sure your engine is not set for alternate speed steps. If you want to increase the starting voltage on your engine, do it before proceeding to step 4.
  4. Make sure the engine you want to match is in your decoder pro roster. Crank up decoder pro and use programming on the main. Call up the engine you wish to speed match from your roster.
  - 4b. (My note.) At this point we also need to set CVs 3, 4, 66, & 95 to Zero at this point. Following that we also need to complete steps 7-9 (from above) before we move to the next step. This will prevent any major differences between throttle step 28 of our Golden Standard and the new locomotive. If the locomotive we are now adjusting is going to be consisted such that it will be running in reverse it should probably have CV95 (Reverse Motor Trim) set at this point.
  5. Make up a normal consist with your constant engine as the lead engine. Do not lash the engines together. 8-10 inches between them is a good start.
  - 5b. (My note.) I believe we can simply follow the NCE ProCab instructions for setting up a consist at this point. We just need to do the experiment. Also, as I mentioned in 4b (above), if this locomotive will be consisted to run in reverse the following steps should be done with the locomotive running in reverse.
  6. If you are using a decoder with BEMF, it should be turned off for consisting.
  7. Select the speed table screen for the engine called up in decoder pro.
  8. Select user defined speed table on the screen
  9. Set step 1 of your speed to the starting voltage from the top of the page. Set step 28 to 255
  10. Click on match ends on the speed table. Then write this to the loco.
  11. Run the locos. If you have made a good choice on your base engine, the following engine will probably be faster. Reduce the speed step 28 setting; Match ends and write to the engine. Some systems/decoders will allow you to do this on the fly, other will make you stop the engines. Repeat this procedure until the engines speed match. After you do a few you will be able to match an engine faster than you can read this procedure. We have found that this method gives us great speed control and is actually faster to do than using the Vmid and Vmax settings. It also eliminates fooling with forward and reverse trim if you decoder requires it.

13. Once a locomotive has been matched to the Golden Standard we can proceed with setting CVs 3, 4, 66, & 95. I suggest doing that at this point.
14. Next we need to explore setting the braking rates associated with both the Independent Brake (CV 117) and the Train Brake (CV 118), Hyperdrive 2, Dynamic Digital Exhaust (DDE).

<https://www.youtube.com/watch?v=CrB4MUrrbB4&feature=youtu.be>

[https://www.youtube.com/watch?v=\\_1vtPzNlwM4](https://www.youtube.com/watch?v=_1vtPzNlwM4)

[https://www.youtube.com/watch?v=d9SJ5Rfbh\\_k&t=199s](https://www.youtube.com/watch?v=d9SJ5Rfbh_k&t=199s)