Speed Matching and Consisting in DCC

A Couple of Things to Note About This Clinic

1. This clinic covers very basic information about DCC and is intended for model railroaders that are new to the hobby or new to DCC.

2. I use a Digitrax DCC system and any references to the use of throttles or other aspects of DCC are based on the characteristics of the Digitrax system.

Multiple-Unit Consists are made possible in DCC Through the Use of 2 Processes:

Speed Matching & Consisting

- **Speed matching** is the process of adjusting a locomotive's motor output voltage so that the locomotive runs at the same speed as the other locomotives in the consist across the entire range of throttle settings.

- **Consisting** is the process of linking the locomotives together via their addresses so that they respond to throttle commands as one unit.

Speed Matching Basics

- There are 2 ways to adjust the decoder motor voltage output for speed:

  - **Basic Speed Control** uses CV 2 (Vstart), CV 5 (Vmax) and CV 6 (Vmid).
    Beware! Some brands of older decoders do not use CVs 5 and/or 6.

  - **Speed Table Control** uses CVs 67 thru 94. Allows finer adjustments to speed settings.
    Note: You must change CV 29, bit 4 to '1' (add the decimal value 16 to CV29) to enable the use of speed tables.

Things to note about Speed Matching:

- You may not need to make many (or any) adjustments, depending on the type and age of the locomotives & decoder. Two locomotives from the same manufacturer, the same production run and using the same decoder *MAY* be reasonably matched right out of the box. ***(However, they may not run at the speeds you want them to!)***

- A locomotive may run noticeably different when operated in different directions. Use the Forward (CV66) & Reverse Trim (CV95) settings to make corrections – *but*, Fwd & Rev Trim are **only** enabled when using the speed table*.
  (*No longer entirely true. Newer ESU Loksound decoders enable Fwd & Rev Trim CVs for Basic Speed Control!)

- Momentum settings will impact ease of speed matching, so set CVs 3 & 4 to 0 before starting the speed matching process.

The Speed Matching Process

- There are 2 ways to match speeds:

  - **The Hard Way.** Select one locomotive as your “standard”. Run it and another locomotive side-by-side on straight double track or in line on single track and make the necessary adjustments to the 2nd locomotive. *(This method is called ‘trial & error’ and can be time-consuming!)*

  - **The Easy Way.** Design a speed curve to your liking and set your locomotive’s speed according to that curve. However, this method does require the purchase of a scale speedometer.

The Easy Way of Speed Matching

Step 1. Design a speed curve that works for you. I use the following target speeds for my Speed Curve:

Throttle Setting 1: Start speed = 3 smph
Throttle Setting 50: Midpoint speed = 33 smph
Throttle Setting 99: Max speed = 63 smph

Step 2. Place the locomotive on the programming track. Set CVs 3 & 4 to 0.

Step 3. On the programming track, read the existing speed control CVs (Basic or Speed Table, whichever you're using) into the DecoderPro locomotive file. This will give you a starting point of reference.

Step 4. **Set the Start Speed.** Place the locomotive on the track and run the locomotive at throttle setting '1' thru the speedometer. Using Ops Mode programming, change CV 2 to run faster/slower according to your desired starting speed. Also, make sure to run it forward & backward through the speedometer and note if there is any difference in the forward & reverse speeds.

Easy Speed Matching (continued)

Step 5. Set the Max Speed. Repeat Step 4, using throttle setting ‘99’ and making changes to CV5 according to your desired top speed.

Step 6. Set the Middle Speed. Repeat Step 4 again, using throttle setting ‘50’ and making changes to CV 6 according to your desired mid speed.

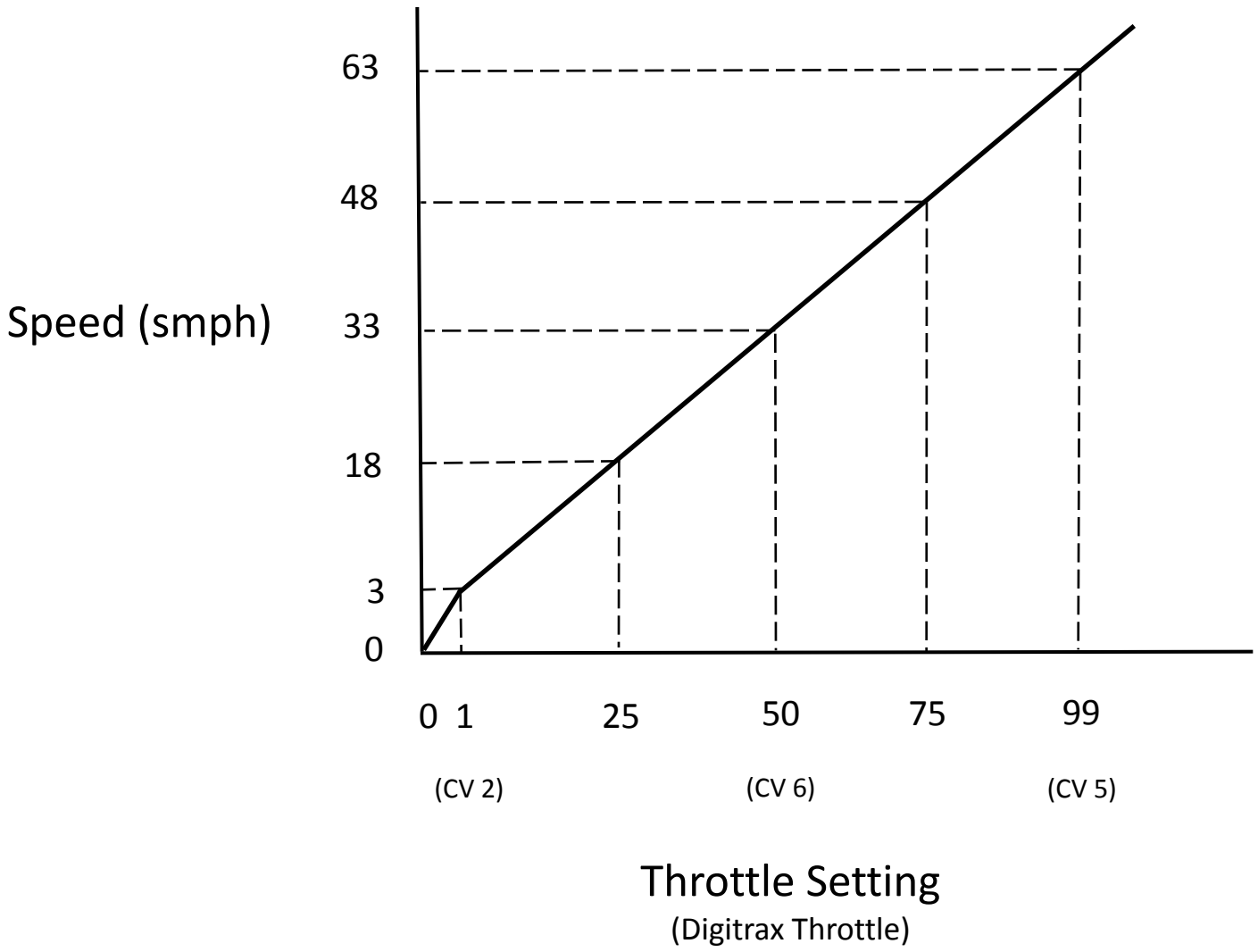
Step 7. Run the locomotive forward & backward thru the speedometer one last time to verify speed settings. I check the speeds at throttle settings 1, 25, 50, 75, and 99 to verify the speed curve.

Helpful Hint: Record these 5 speed readings in a spreadsheet.

If the locomotive runs at the speeds you want, you’re done!

Step 8. Change CVs 3 & 4 back to your desired values.

My Pre-determined (Target) Speed Curve



Easy Speed Matching (continued)

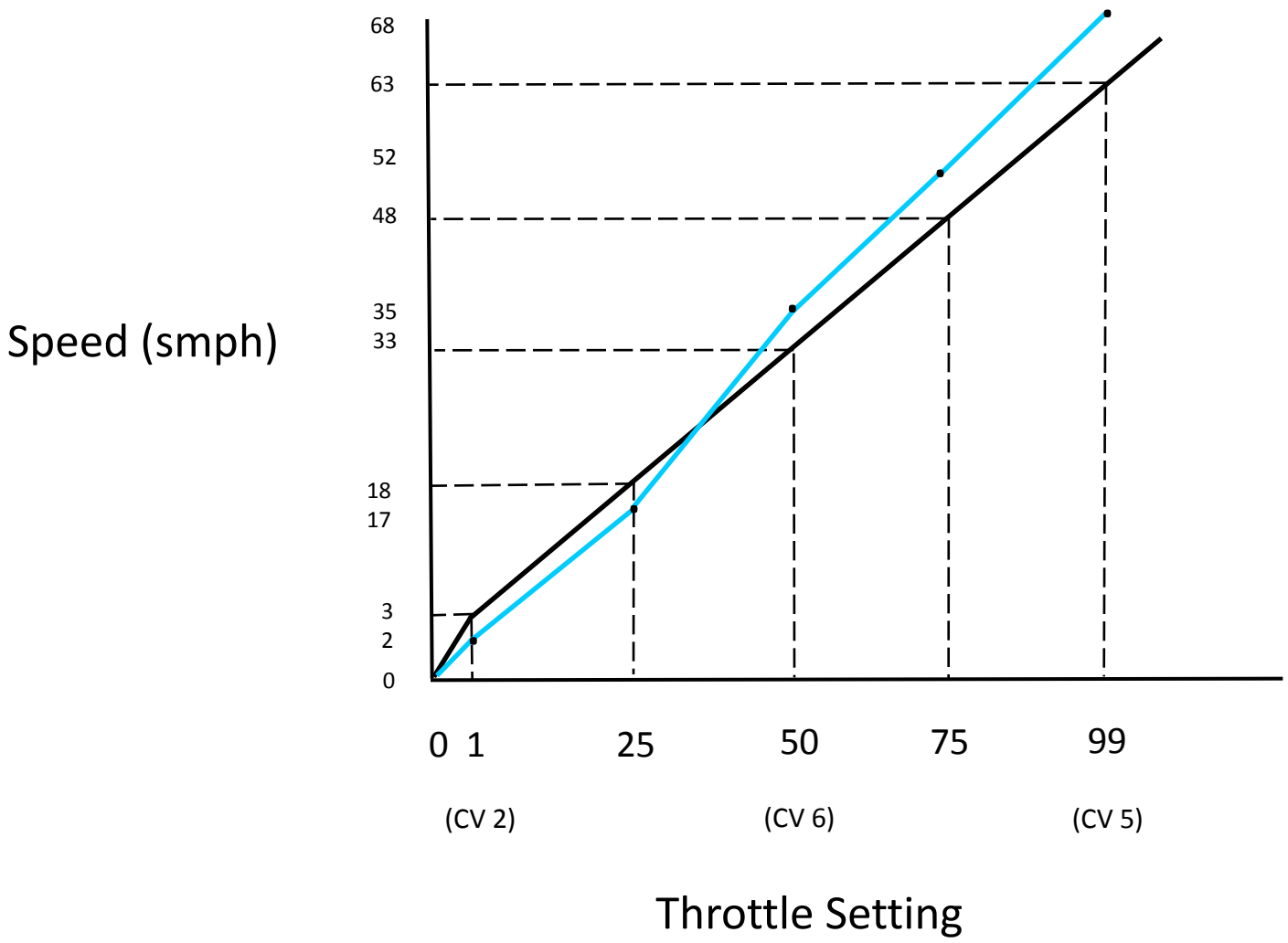
Note:

It will help you if you proceed in consistent steps and keep notes as you make changes to CVs.
This will help you keep track of what works and what doesn't.

When programming a locomotive,
I keep notes of the CV values being entered vs. the resulting speeds
in an Excel Spreadsheet --

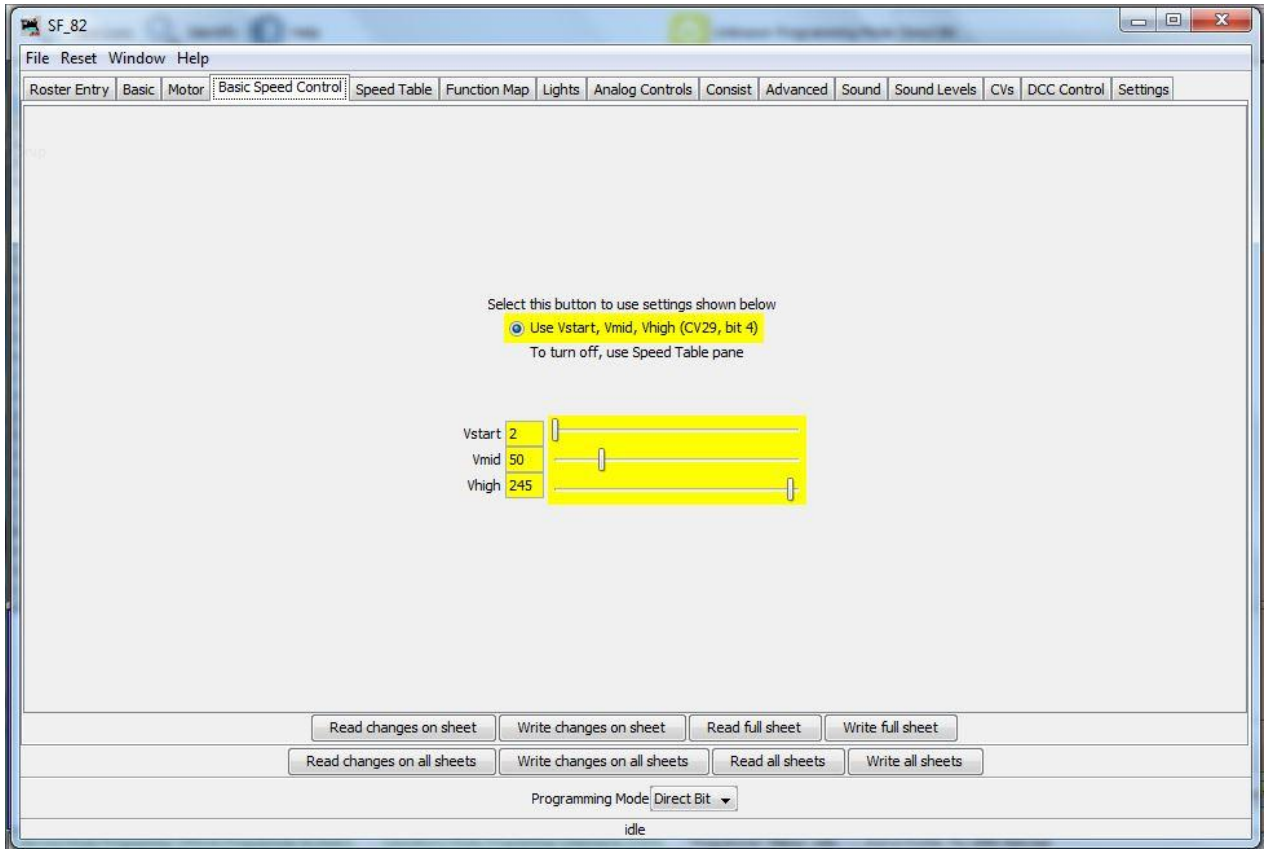
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Engine #	NS 5334	SOU 1136	SOU 177	CSX 2771	CSX 2456	SEA 2680	UP 759	EL 814	BNSF 7676	SCL 617	CSX 5379	CSX 7661	CSX 3250	SP 8116	NP 765	SF 152	BN 7068	Amtrak 391	Amtrak 334	Amtrak 161	Amtrak 91	CP 9379	CSX 8745	
2	CV 2, Min	19	14	52	15	39	15	35	60	14	26	7	33	8	10	15	10	10	10	8	10	10	7		
3	CV 6, Mid	98	110	115	99	100	95	128	128	83	107	62	110	78	21	110	80	80	85	68	85	85	65		
4	CV 5, Max	174	225	204	175	176	173	230	220	168	204	135	212	164	45	235	167	175	210	170	190	190	140		
5	CV 3																								
6	CV 4																								
7	1	3	3	3	3	3	3	4	4	4	3	3	4	3	3	3	4	3	3	3	3	3	3	3	
8	25	17	18	18	17	18	16	18	18	18	16	17	18	18	18	18	18	17	17	14	16	16	16	18	
9	50	32	33	30	33	33	33	35	33	34	33	34	33	35	34	35	35	34	33	31	33	33	32	33	
10	75	51	49	46	51	50	51	48	48	49	48	48	48	49	48	54	50	48	52	49	48	48	48	48	
11	99	62	62	59	62	63	62	62	60	60	62	62	62	62	62	62	62	62	59	62	62	62	62	63	

Speed Curve for a Locomotive



DecoderPro

Once you have set your locomotive to a speed curve,
it is a good idea to record those values into your DecoderPro locomotive file.



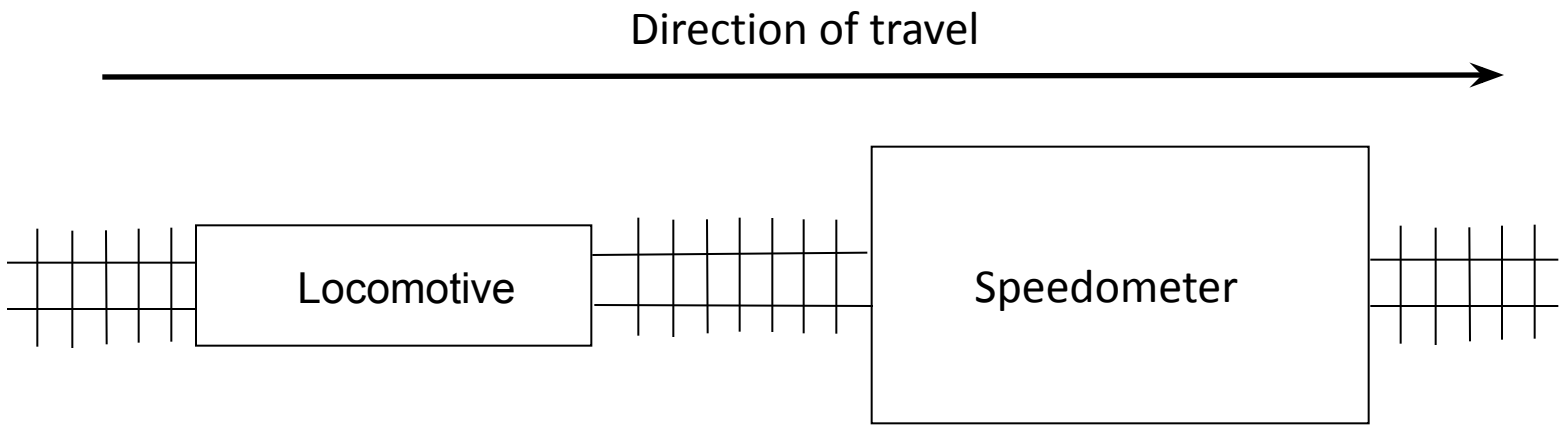
Using the Speed Table

Some decoders, like the older Tsunami, do not use CVs 5 & 6. You'll have to set up a speed curve using the Speed table.

Click on the 'Use Speed Table' button and then select 'User Defined Speed Table' or 'Linear Speed Curve' from the drop-down box.

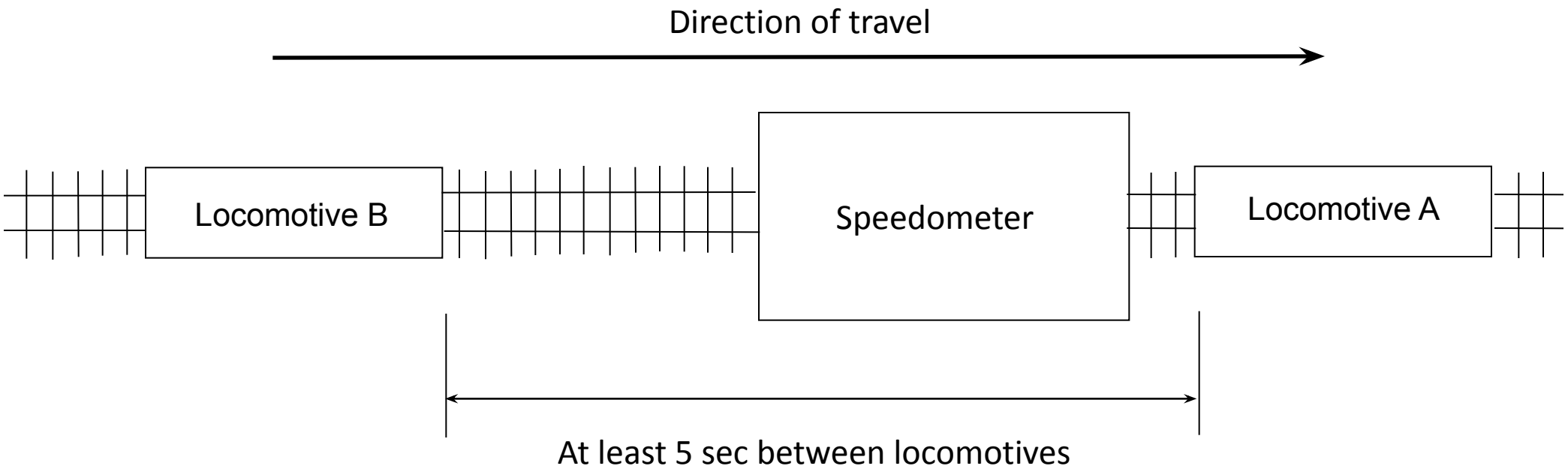
One Advantage to Buying a Speedometer -

Speed Matching just one locomotive is very easy.



Another Advantage to Buying a Speedometer -

You can easily compare 2 Locomotives prior to programming to see how well they are matched!



Consisting

There are 3 ways to consist locomotives:

- **Basic or Address Consisting** is the simplest form of multiple unit control. The decoder in each locomotive is set to the same address (2 or 4 digit).

- **Universal or Standard Consisting** uses the command station to keep track of each locomotive in the consist.

- **Advanced Consisting** uses CV 19 in each locomotive's decoder to set the address of the consist. *Any value other than zero entered into CV 19 "overrides" the 2 or 4 digit addresses in CV 1/CVs 17+18*, so that the locomotive only responds to the address entered into CV 19.

Consisting (Corrected)

- **Basic or Address Consisting** is the simplest form of multiple unit control. The decoder in each locomotive is set to the same address (2 or 4 digit).

- ~~**Advanced**~~ **(Intermediate or Basic+) Consisting** uses CV 19 in each locomotive's decoder to set the address of the consist. *Any value other than zero entered into CV 19 "overrides" the 2 or 4 digit addresses in CV 1/CVs 17+18*, so that the locomotive only responds to the address entered into CV 19.

- **Universal or ~~Standard~~ (Advanced?) Consisting** uses the command station to keep track of each locomotive in the consist.

Basic/Address Consisting

Advantages:

- Simple

- Only one address slot is used for the consist

- Consist is easily transferred to another layout

Disadvantages:

- Locomotives must face same direction, unless CV 29 is changed in the one that will run in reverse.

- Sound, lighting, and other function effects are triggered on all locomotives simultaneously

- The consisted locomotives must have their addresses reprogrammed when the consist is broken up

Advanced (Intermediate) Consisting

Advantages:

- Sound, lighting, and other effects can be programmed for each individual locomotive within the consist when it is created -- use CVs 21 & 22.

- Only one address slot is used for the consist.

- Consist is easily transferred to another layout.

Disadvantages:

- Must use a 2 digit address in CV 19 (like CV1, it is limited to a value of 1 to 127)

- Changing the consist set-up or sound & lighting effects requires multiple steps

- Some older decoders do not support CV 19

- When you break up the consist, if you don't change all CV 19s back to 0, you may forget what address runs a particular locomotive.

Universal/Command Station Consisting

Advantages:

- Direction of locomotives can be set individually & are easily changed

- Sound & lighting effects can be triggered individually

- Easy to add/remove locomotives to/from the consist

Disadvantages:

- One address slot is used per locomotive in the consist

- There is a slight time lag as commands are sent to each locomotive (usually not noticeable unless there are a large number of locomotives on the layout)

- Consist cannot be transferred to another layout because consist information is stored in the CS (usually not a problem)

When Should You Use Each Method of Consisting?

Basic/Address: Hardly Ever. (Only when the number of available slots in the CS is of concern.)

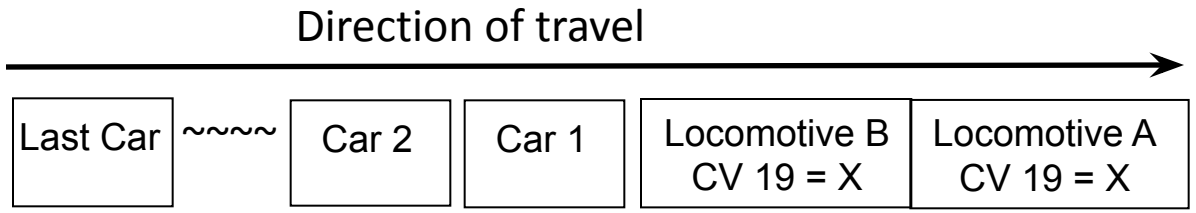
Advanced: Use when locomotives are coupled together in a 'semi-permanent' fashion; for example, an A-B-A set of F7s

Universal/Command Station: Most of the time

- Most flexible and easiest to manage.
- Making changes to a consist are very easy.
- The one real disadvantage (portability between layouts) is usually not a problem.

Combined Consisting

It is possible to use Universal and Advanced Consisting together to make it easy to add a mid- or end-of-train helper set:



Use Advanced Consisting on the Lead Locomotives:
Couple A & B together using address ‘X’

Helper Locomotives

Locomotive D CV 19 = Y	Locomotive C CV 19 = Y

Use Advanced Consisting to
Couple C & D together using address ‘Y’

Then, use Universal Consisting to MU X & Y together.
When done, break the X & Y consist.

References

1. “Speed Matching for DCC Consists” by Larry Puckett, Sep 2016 issue of MR

2. “Tips for Consisting DCC Locomotives: Basic, Universal, & Advanced” by Larry Puckett, Jul 2016 issue of MR

Accutrak Speedometer:

- SBS4DCC.com, https://sbs4dcc.com/products/model-railroad-technologies-accutrack-ii-train-speedometer.html, $74.95

- DCCTrain.com, https://dcctrain.com/products/accutrack-ii-speedometer, $289.00

Trainspeed Speedometer: TCS, https://www.tcsdcc.com/speedometers, $117.95