Can I Use a 25V Transformer on a 70V Speaker System ?

by: Joe Ging, E.E.

The Simple Answer: **Lowell Manufacturing does not recommend using a speaker matching transformer that is not rated for the output voltage of the amplifier that is being used.**

The justification for that technical position is given in the white paper that follows. "Constant Voltage Speaker Systems" have been a source of confusion for people for a long time. It's ironic that a system that was specifically designed to make life simpler for designers and installers, still causes so much confusion. In a separate white paper, we have discussed why the constant voltage system was created, the advantages of the system, and some basic system design rule-of-thumb guidelines. We begin this discussion under the assumption that the basics of "Constant Voltage Speaker Systems" are understood by the reader. To understand the calculations that will be discussed in this paper, it would be helpful to review that separate paper called "What is a 25V, 70V, or 100V Speaker System" which can be found at the link below:
https://www.lowellmfg.com/wp-content/uploads/What-is-a-25V-70V-or-100V-Speaker-System.pdf

Note: For the remainder of this paper, we will put the discussion of 100V speaker systems on the back burner. Some Lowell speaker systems have ratings for 25V, 70V, and 100V operation. The "100V" settings are included because those speaker products are marketed outside of the United States. In the USA, 70.7V is the highest voltage speaker system where Class 2 wiring can be used without conduit. Conduit makes a sound system installation very expensive, so for all practical purposes, 100V speaker systems are used overseas and are typically not installed in the United States. So for the remainder of this paper, we are going to concentrate only on 25V and 70V speaker systems. The formulas for the calculations discussed are given below:

Constant Voltage System Calculations

Calculations for constant voltage speaker systems are based on **Ohm's Law** as shown below:

V = Voltage Z = Impedance I = Current P = Power

$V = IZ$ $I = V/Z$ $Z = V/I$ $P = VI$ $P = V^2/Z$ $P = I^2Z$

Derivation for 70.7V Systems

$P = V^2/Z = (70.7V)^2/Z = 5000/Z$

$Z = 5000/P$

Derivation for 25V Systems

$P = V^2/Z = (25V)^2/Z = 625/Z$

$Z = 625/P$

For 70 Volt Systems	$P = \frac{5000}{Z}$	$Z = \frac{5000}{P}$
For 25 Volt Systems	$P = \frac{625}{Z}$	$Z = \frac{625}{P}$

The discussion about speaker matching transformers simply comes down to "Impedance". You can't take an 8-ohm speaker and hang it on a 25V or 70V speaker line. The matching transformer adjusts the impedance that the amplifiers sees so that the speaker/transformer combination will only draw a certain amount of power when the amplifier is at its full 25V or 70.7V output. There's nothing magic that makes a certain transformer a 25V transformer and another one a 70V transformer. It all has to do with the impedance of the power taps (which is determined by the number of windings in the transformer). When the transformer was designed, it was determined for instance, that if this particular transformer is used on a 70V speaker system, the 1W tap should have the proper impedance so that if the amplifier is driving at a full 70.7 volts, the transformer will draw 1W and deliver that one watt to the loudspeaker (assuming we ignore power losses such as "insertion loss" because no transformer transfers power with no loss). This is why it is possible for a transformer to be "dual voltage" like the Lowell TLM-572 because all that is required is for the power taps to be set up to draw the proper amount of power depending on if it is used on a 25V speaker system, or a 70V speaker system.

So it would make sense then that you could take a 25V transformer and hang it on a 70V speaker line, or take a 70V transformer and hang it on a 25V speaker line. In either case, they will draw power and will send that power to the speaker and they will work (for a while). This is where we can run into problems. The power values marked on a 25V or 70V transformer, are calculated assuming that you are using the 25V or 70V speaker system that is called out on the transformer. If you use a transformer on a system other than for what the markings on the transformer are calculated, the markings are meaningless and you can get into big trouble.

A few calculations will demonstrate what can happen. Take for example a 25V transformer with a 1 watt tap. What is the impedance of that 1 watt tap?

For a 25V system (from page 1) Z = 625 / P = 625 / 1W. Z = 625 ohms.

The designer of the transformer set it up that way so you could easily tell that transformer would draw 1 watt on a 25V system.

Now what if we attach that transformer to a 70V system with the amplifier driving at a full 70.7V?

$$P_{\text{(on a 70V system)}} = 5000 \;/\; Z \;=\; 5000 \;/\; 625 \text{ ohms} \;=\; 8 \text{ watts.}$$

So that 25V transformer attached to a 70V line tapped on the 1W tap, will actually draw 8 watts. Is that a problem? Well that depends. If that 25V transformer was rated for a maximum of 8 watts or greater, that would be fine. But what if you are using a Lowell TLM-572 transformer. That transformer has a power rating of only 5 watts. You will over power the transformer and eventually it will overheat and burn up.

Wouldn't it be nice to have a formula that can convert the power rating on a 25V line to the power rating on a 70V line? Well it turns out, that is not hard to do. Note that the subscript P70 or P25, simply means "Used on a 70V system or on a 25V system".

$Z = 5000 / P_{70}$ **$Z = 625 / P_{25}$** **Since we are using the same tap on either system:**

$Z = Z$ **so** **$5000 / P_{70} = 625 / P_{25}$** **or** **$P_{70} = 8\ P_{25}$** and **$P_{70} = 1/8\ P_{25}$**

In Other Words:

For a 25V Transformer	**$P_{(\text{on 70V System})} = 8x\ P_{(\text{marked for 25V System})}$**
For a 70V Transformer	**$P_{(\text{on 25V System})} = 1/8x\ P_{(\text{marked for 70V System})}$**

These formulas make using a 70V transformer on a 25V system, or using a 25V transformer on a 70V system very simple. It all has to do with a factor of 8. A 25V tap used on a 70 volt system, will draw 8X the marked power value. A 70V tap used on a 25V system, will draw 1/8th of the marked power value.

So now that we're so smart and you can figure out with very little math what a transformer will draw when it is used on the "WRONG" system, why would Lowell Manufacturing recommend that you never do this???

You would be doing your customer a serious disservice, and that is something Lowell Manufacturing would never recommend.

Constant voltage speaker transformers are designed so they can be adjusted. What if you tap a 5W 25V transformer on a 1/2W tap and you use it on a 70V system. You know that transformer tap will really draw 1/2W X 8 = 4 watts, which is safe for the transformer. But what if that speaker isn't quite loud enough, so the next technician comes along and changes the tap to 1W. They think that can't be a problem because the transformer taps go all the way up to 4 watts. But what they don't know is that 1W tap will actually draw 8W which will overpower and possibly burn up the transformer.

Using the wrong transformer (even if you know what you are doing) is just asking for problems down the road when the system needs to be adjusted or serviced. You are installing devices that are "Not marked Properly" and sooner or later, that could damage your customer's equipment and could cost them a lot of money. And that is why:

Lowell Manufacturing does not recommend using a speaker matching transformer that is not rated for the output voltage of the amplifier that is being used.