

22A3 Mono Amplifier Tube Notes

Bandwidth Audio's 22A3 amplifier was designed to be a feedback-free open loop amplifier providing low THD and wide bandwidth. When playing at loud volumes, a slight amount of feedback can be employed by closing the feedback loop. Like all feedback-free or very mild feedback amplifiers, vacuum tubes types, brands, and construction now play a considerable role in the sound of the amplifier as well as matching between channels.

1. Tube Matching

Since the 22A3 runs in open loop mode without feedback or with a very mild amount of feedback in closed loop mode, tube matching is essential for good stereo imaging.

A. PP vs SE Output Tubes

With most traditional Class-AB and Class-A Push Pull (PP) tube amplifiers, output tubes in matched pairs, quads, sextets, and so on are used to get balanced drive from the push pull output configuration. This ensures low THD and good audio performance within a given channel. PP amplifiers that employ high levels of negative feedback, output tube matching between channels is less critical than inter-channel balance.

With many Class-A single ended amps, tube matching is generally not required since only one tube is used in the output stage. There is no inter-channel balance that needs to be maintained.

However, since many Class-A amplifiers also have little to no negative feedback, like the 22A3, the gain of Left and Right channels (stereo balance) will depend heavily on the performance of the vacuum tubes used. For this reason, matched tubes should be split between the channels for tight stereo balance. Non-matched tubes can cause a very significant imbalance where one channel is louder than the other for a given input signal. This will smear the stereo image and steer the listener's concentration towards the louder channel.

B. 22A3 Output Tubes

Since the 22A3 amplifier is a parallel single ended (PSE) amplifier, it is recommended to run a matched quad of 2A3 tubes per pair of amplifiers such that both the inter-channel balance and stereo balance is maintained for best performance.

However, if needed and 2 matched pairs can be used if they are split between amplifier channels. This will ensure that the

net performance of each output stage is matched between the two amplifier channels.

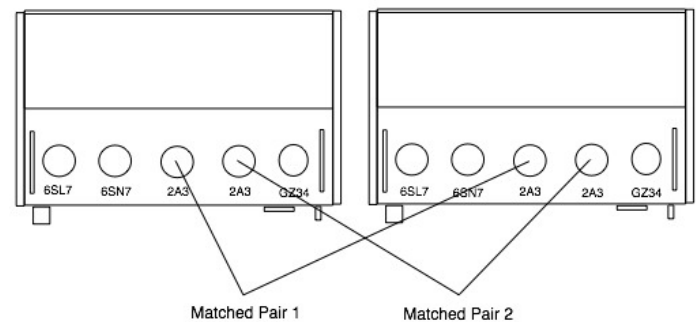


Figure 1: Matched pairs split between channels

C. Preamp Tubes

Like the power tubes, the 22A3 Mono Amplifier requires matching tubes between channels. The 6SL7 and 6SN7 preamp tubes used in each channel should have very close performance with tightly controlled margins. This is key to maintain identical gain of each channel.

Both 6SL7 and 6SN7 tube types are twin triodes that contain two tubes in a single envelope. The 22A3 amplifier uses these twin sections in parallel for both 6SL7 and 6SN7 tubes. It is important to test these tubes with their sections in parallel before matching into pairs.

At Bandwidth Audio, we in-house test 22A3 preamp tubes by curve tracing with their sections in parallel as actually used in circuit. We then find suitable matches to ship with every pair of amplifiers.

2. Tube Rolling

Because of the open loop design, trying different vacuum tube types, known as tube rolling, in the 22A3 Amplifier can have a significant impact on the sound and presentation of music.

A. 45 Output Tubes

Although this amplifier was designed around the 2A3 output tube in parallel single ended operation, 45 tubes can be used if desired. Before 45 tubes are used, the bias should be turned all the way down (to the left) to minimize idle current through the output stage since the 45 has reduced dissipation ratings compared to the 2A3. After replacing the 2A3's with 45's the bias can be adjusted so the target idle current is in the range of 30-36mA.

The available output power with 45 tubes is about 3.5W before clipping compared to 5W with 2A3 tubes. Figure 2 is a plot of output power vs THD for 45 and 2A3 tubes in the 22A3 amplifier. The second sharper rise in distortion indicates maximum output power at clipping.

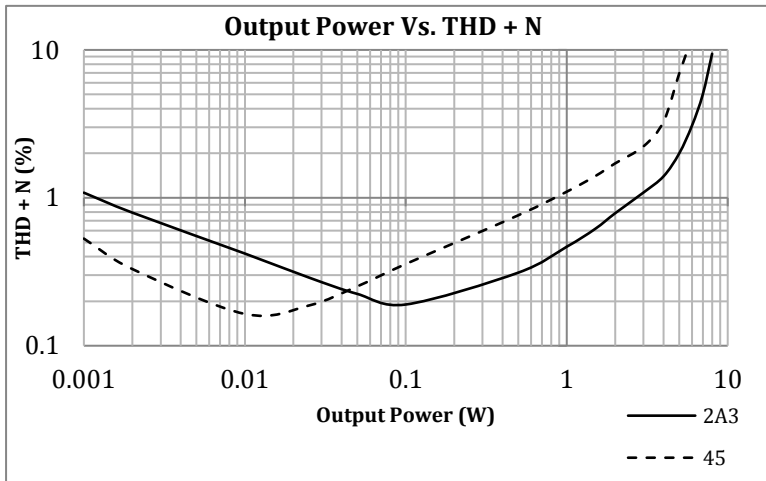


Figure 2: 2A3 vs. 45

The 45 tube type is a predecessor to the 2A3 and one of the earliest audio output tubes. The earliest versions were balloon or globe shaped glass envelope, which were available in the late 1920s. Later the 45 changed to an ST or shouldered glass envelope and are more common. Although the 45 predates the 2A3 and provides less power, the 45 is extremely linearity. Later vacuum tube designs often sacrificed linearity for higher output power.

When using very efficient speakers (recommended at >96dB), the 45 can provide fantastic detail, nuance and depth assuming they are not pushed too hard. With >100dB efficient speakers, the 45 can really enhance music presentation and provide quite high SPL.

Very efficient speakers are required for running 45's for best results. This is not only because of the low output power, but the output impedance of the 22A3 amplifier doubles when running 45s. The 45 tube's plate resistance is roughly double the 2A3. This reduces speaker control, so the back EMF caused by woofer excursion can cause reduced bass definition. If the speakers used are more efficient, less woofer excursion is required for normal listening volumes. This means that the output impedance of the amplifier will have less of an impact in the feel and presentation of bass frequencies.

Due to the paralleled output stage of the 22A3 and its inherently low output impedance, running 45 tubes will provide very good results with more loudspeaker types when compared to a non-paralleled 45 amplifier design.

B. 6SN7 Tubes

In the original release of this article back in 2015, we stated that, *"the new production Tung-Sol 6SN7GTB tubes have been found to give unsatisfactory results."*

After implementing our standardized tube testing practices, we revisited the Tung-Sol 6SN7GTB's in the 22A3. We are happy to report that the Tung-Sol 6SN7GTB do work, very nicely in fact, in our 22A3 amplifier. The results were fantastic, and the sound was clear, strident and focused.

The NOS Sylvania large getter chrome top tubes with black angled plates provide great results. These tubes have lots of detail and nuance with fast attack and very clear highs without any harshness. Maybe less focused than the new Tung-Sol 6SN7GTBs with a bit more color.

Other NOS 6SN7 tubes have also worked well including the Sylvania Tall Boy with bottom getters.

C. 6SL7 Tubes

The 6SL7 stage is the preamp gain stage in the amplifier. Both new production and NOS types do very well in this stage.

The new production Tung-Sol are every bit as good sounding as the NOS types. Big detailed and articulate come to mind with these tubes.

The RCA 6SL7GT grey smoked glass tubes have a very smooth and sweet-sounding presentation. They would work great taming any harshness in a system.

The military spec VT-229 from both Sylvania and RCA are a bit more articulate and detailed compared to the RCA grey glass. They are on par with the new Tung-Sol's with the added benefit of very long life.