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VOICE COIL
THE PERIODICAL FOR THE LOUDSPEAKER INDUSTRY

The D3004/604010 and the D3004/604000

This month, Scan-Speak sent me two new beryllium diaphragm neodymium motor tweeters, the D3004/604010 (see **Photo 2**) and the D3004/604000 (see **Photo 3**).

These two D3004 beryllium domes basically share the same platform, with the major difference being the D3004/604010 has a lower F_s due to the larger rear cavity. Both tweeters use a Materion 26-mm 99% pure beryllium dome, an underhung two-layer copper wound voice coil with 0.2 mm X_{MAX}, a neodymium ring magnet in conjunction with Scan-Speak's patented symmetrical driver SD-2 motor system (the SD-2 includes copper shorting rings), a non-resonant aluminum rear cavity, a wide coated cloth surround, and a sonically transparent metal protective grill with a 9-mm diameter diffuser built into the structure. The protective grill keeps the dome from being damaged and is a necessary safety precaution when using beryllium. While beryllium is safe in its molded form, if shattered, it's a fairly nasty contaminate that also necessitates careful disposal at the end of its product cycle. For more information on beryllium, visit this link from Materion: http://materion.com/~/media/Files/PDFs/Corporate/MSDS/M10BerylliumSolid.pdf.

I began testing the new Scan-Speak beryllium tweeters, the D3004/604000 and the D3004/604010, by generating

Photo 2: Scan-Speak's D3004/604010

Photo 3: Scan-Speak's D3004/604000

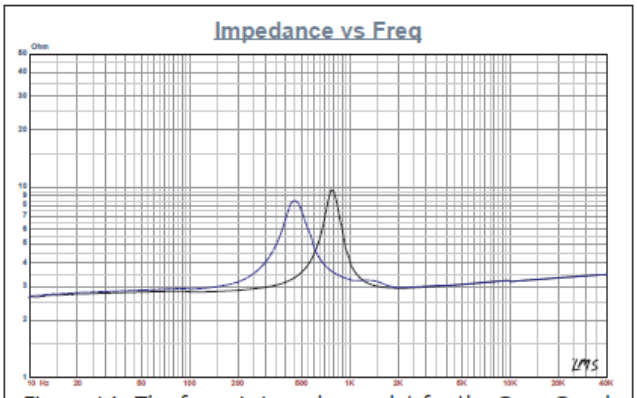

Figure 14: The free-air impedance plot for the Scan-Speak D3004/604000 and the D3004/604010

	D3004/604000	D3004/604010
F_S	750 Hz	450Hz
Q_{MS}	4.02	2.5
Q_{ES}	2.18	0.97
Q_{TS}	1.41	0.7
BI	1.2 Tm	1.7 Tm
C_{MS}	0.19 mm/N	0.43 mm/N
M_{MS}	0.24 g	0.35 g

Table 1: The resonance data for the two tweeters

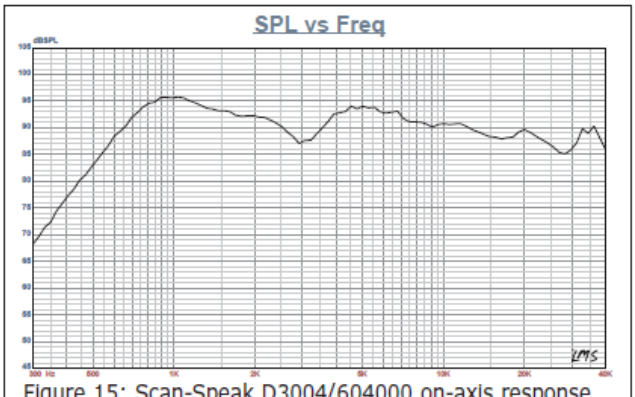

Figure 15: Scan-Speak D3004/604000 on-axis response

a stepped sine wave impedance plot using the LinearX LMS analyzer. **Figure 14** shows the results of the LMS 300-point impedance sine wave sweep for both tweeters. The resonance of the D3004/604010 is 444 Hz, compared to the D3004/604000 at 763 Hz. Minimum impedance for the D3004/604010 is 2.98 Ω at 2.07 kHz, with a 2.79 Ω DCR. The D3004/604000 had a minimum impedance of 2.96 Ω at 1.99 kHz and a 2.87 Ω DCR. **Table 1** shows a more detailed comparison of the resonance of these two tweeters, the factory published Thiele-Small (T-S) parameter data.

I recess mounted each of the tweeters in a small enclosure that had a baffle area of about 10″ × 6″ and measured the on- and off-axis frequency response at 2.83 V/1 m. **Figure 15** and **Figure 16** depict the on-axis response of the D3004/604000 and the D3004/604010, respectively. The D3004/604000's response is about ±3.15 dB from 3 kHz to 24 kHz, out to 40 kHz. The frequency response for the D3004/604010 is ±4 dB from 3 kHz to 26 kHz, also with response out to 40 kHz. **Figure 17** shows the D3004/604000's on- and off-axis from 0° to 45°. **Figure 18** shows the D3004/604010's on- and off-axis from 0° to 45°, with the normalized response curves shown in **Figure 19** and **Figure 20**, respectively.

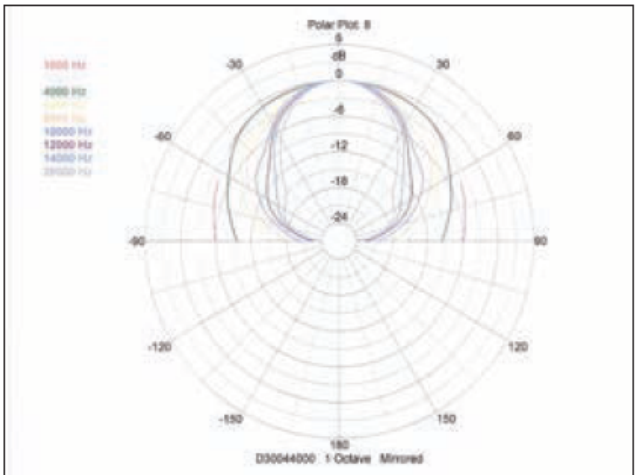

Figure 21: Scan-Speak D3004/604000 0° to 90° polar plot (in 10° increments)

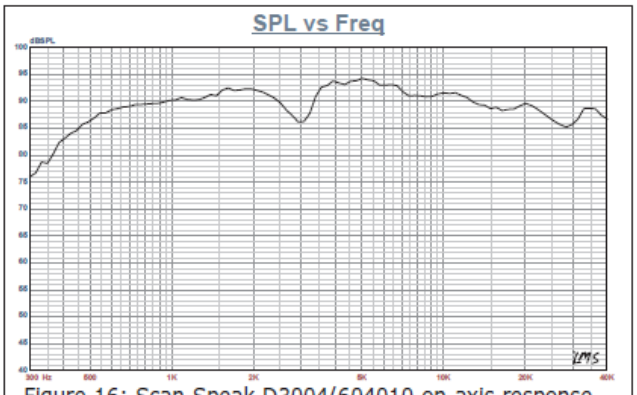

Figure 16: Scan-Speak D3004/604010 on-axis response

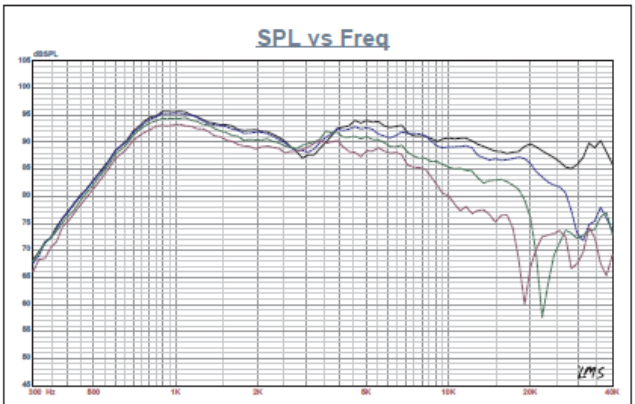

Figure 17: Scan-Speak D3004/604000 on- and off-axis frequency response (0° = solid; 15° = dot; 30° = dash; 45° = dash/dot)

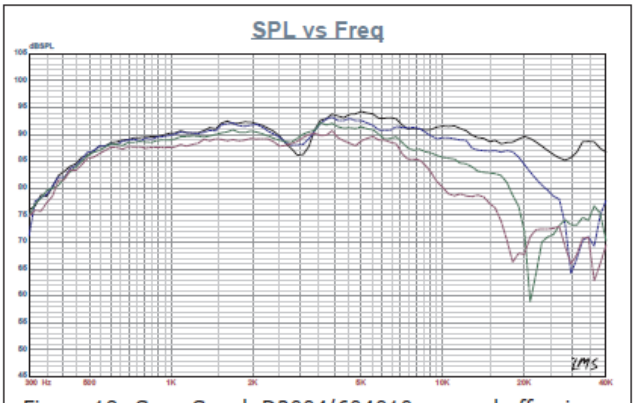

Figure 18: Scan-Speak D3004/604010 on- and off-axis frequency response (0° = solid; 15° = dot; 30° = dash; 45° = dash/dot)

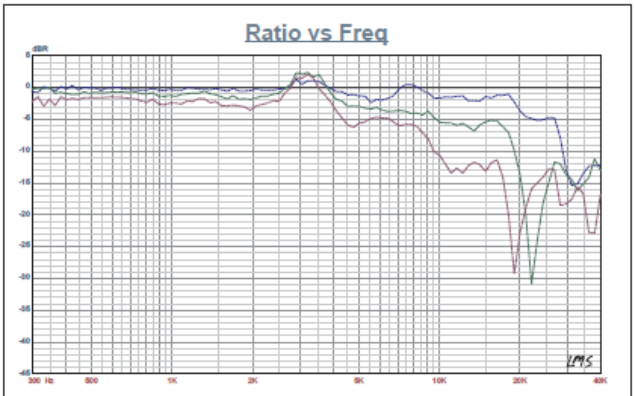

Figure 19: Scan-Speak D3004/604000 normalized on- and off-axis frequency response (0° = solid; 15° = dot; 30° = dash; 45° = dash/dot)

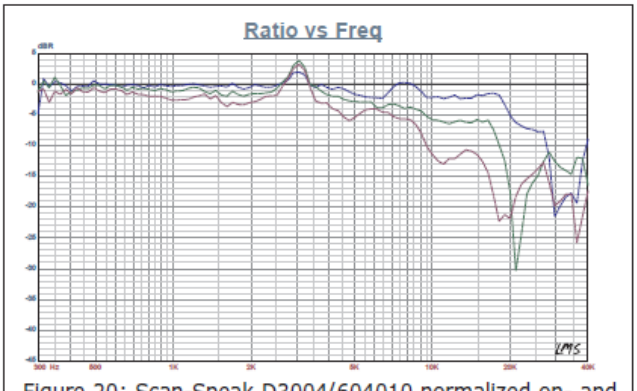

Figure 20: Scan-Speak D3004/604010 normalized on- and off-axis frequency response (0° = solid; 15° = dot; 30° = dash; 45° = dash/dot)

Both curves sets show typical directivity for a 1" dome high-frequency device. For an additional depiction of the directivity of these to beryllium dome tweeters, the polar plot for the D3004/604000 is shown in **Figure 21**. The polar plot for the D3004/604010 is shown in **Figure 22**.

In terms of production consistency, **Figure 23** shows the two-sample SPL comparison for the D3004/604000. **Figure 24** shows the two-sample SPL comparison for the D3004/604010. Both curve sets indicate that the two samples sets were well matched with some minor variation in the 10-to-20-kHz region for the D3004/604000.

Next, I measured the impulse response with both

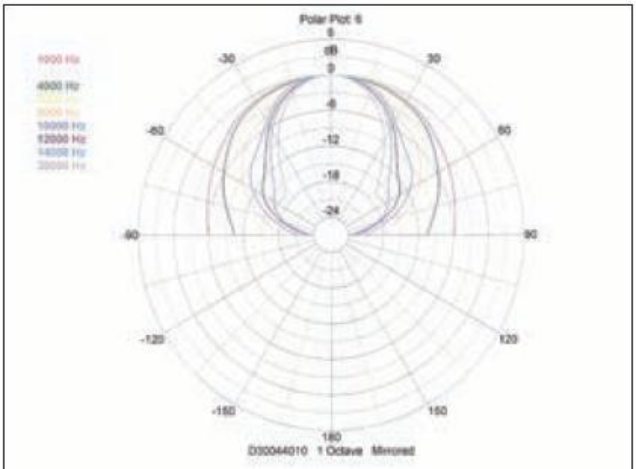

Figure 22: Scan-Speak D3004/604010 0° to 90° polar plot (In 10° increments)

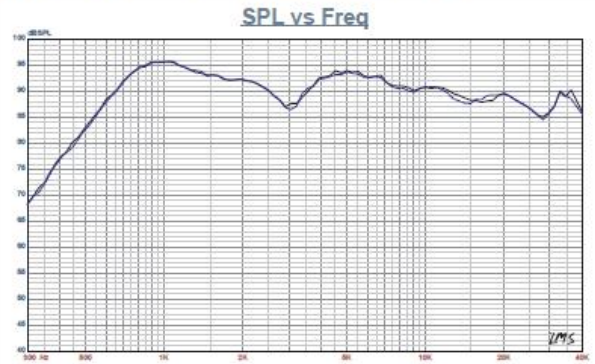

Figure 23: Scan-Speak D3004/604000 two-sample SPL comparison

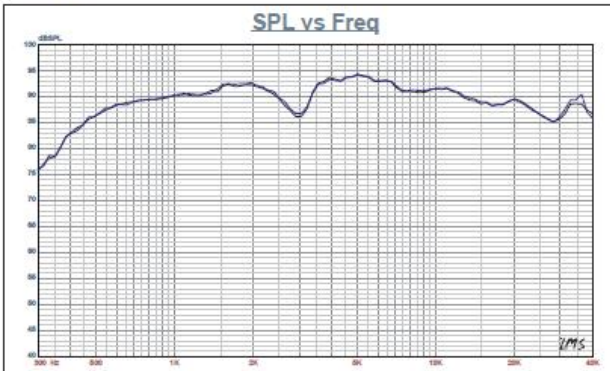

Figure 24: Scan-Speak D3004/604010 two-sample SPL comparison

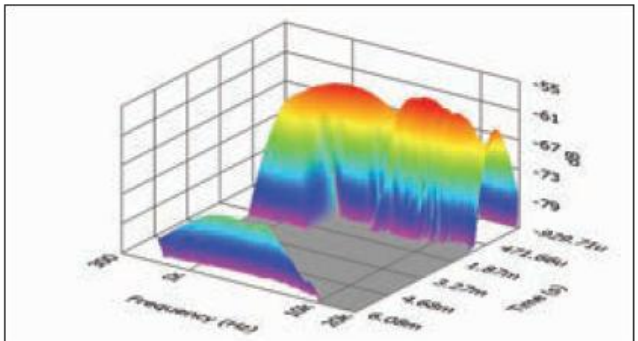

Figure 27: Scan-Speak D3004/604000 SoundCheck STFT surface intensity plot

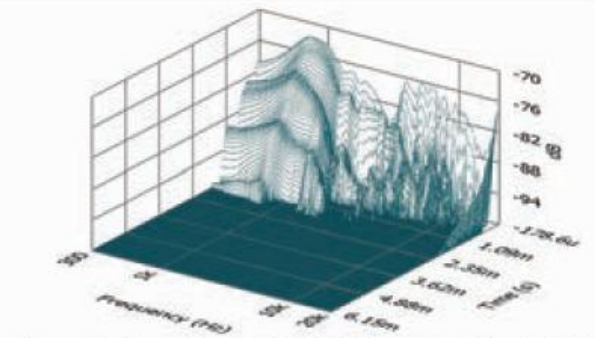

Figure 25: Scan-Speak D3004/604000 SoundCheck CSD waterfall plot

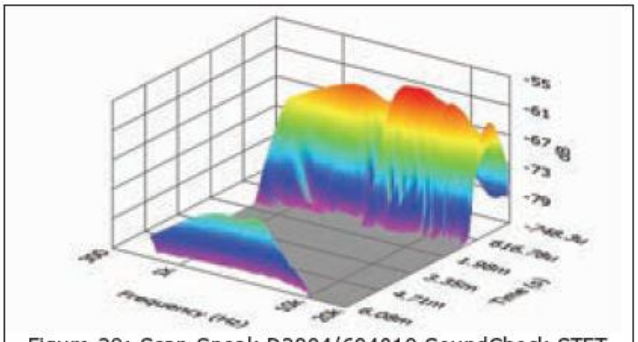

Figure 28: Scan-Speak D3004/604010 SoundCheck STFT surface intensity plot

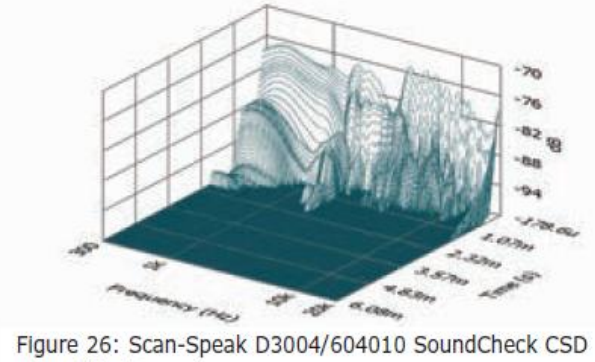

Figure 26: Scan-Speak D3004/604010 SoundCheck CSD waterfall plot

tweeters recess mounted. Importing this data in the Listen SoundMap software produced the D3004/604000's cumulative spectral decay (CSD) plot shown in **Figure 25** and the D3004/604010's CSD plot shown in **Figure 26. Figure 27 and Figure 28** show the Short Time Fourier Transform (STFT) displayed as a surface plot for D3004/604000 and D3004/604010, respectively.

Last, I set the 1 m SPL to 94 dB (3.84 V for the D3004/604000 and 4.07 V for the D3004/604010) and the sweep range to 1 to 20 kHz and measured the second- and third-harmonic distortion at 10 cm. **Figure 29** shows the results for the D3004/604000. **Figure 30** shows the results for the D3004/604010. I provided these measurements to see the relationship between second- and third-harmonic distortion. However, correlation to subjective preference based on total harmonic distortion (THD) is not well established.

I have designed high-end products using Scan-Speak's beryllium domes (the D3004/664000), and it is one of the most musical tweeter timbres I have encountered. For speakers that require a smaller tweeter footprint, these new beryllium tweeters should be an attractive solution. For more information, visit www.scan-speak.dk. ***VC***

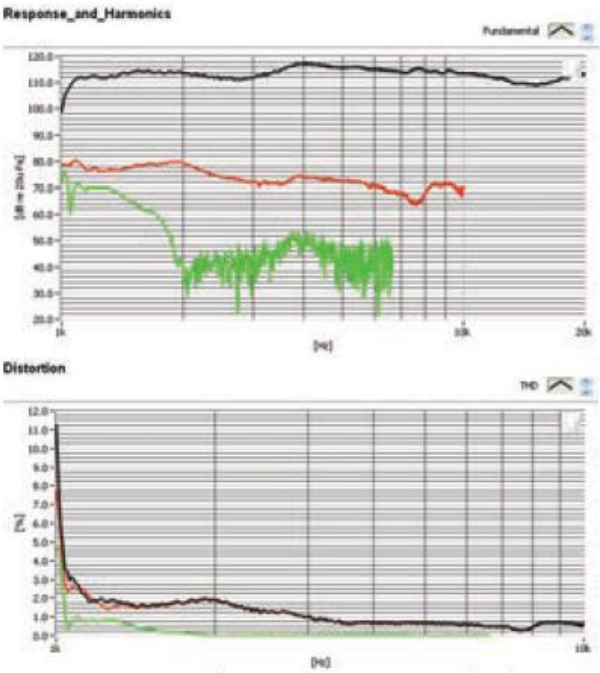

Figure 29: Scan-Speak D3004/604000 SoundCheck distortion plots

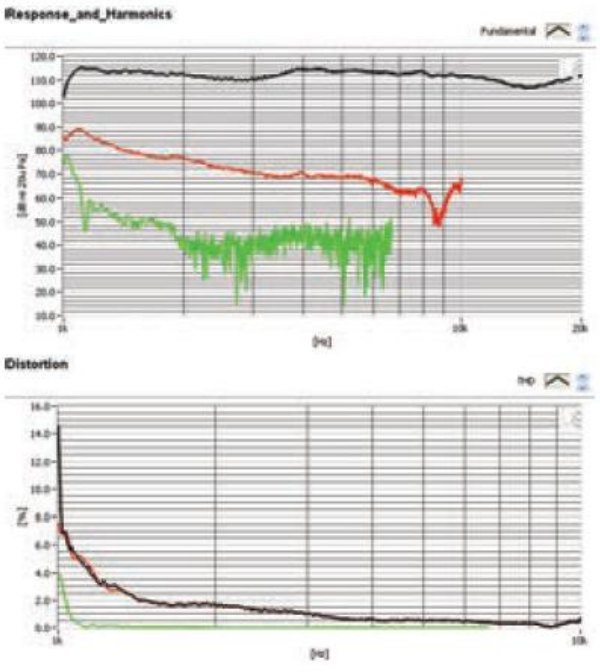

Figure 30: Scan-Speak D3004/604010 SoundCheck distortion plots