Should I use a correction factor with my pistonphone or calibrator when calibrating my ear simulator?

Every ear simulator/coupler has a different design and calibration method. There are some ear simulators that can even be calibrated in different ways, by adding calibration adapters between the calibrator and the device. Therefore, it is of paramount importance to first read the calibration section of the product´s manual to check for the calibration procedure and calibration correction factors, if any. For example, in couplers like the 2cc (GRAS RA0038, RA0113 and 43AB) the calibration with pistonphone or sound calibrator is performed on the microphone itself, WITHOUT the coupler. In this case, the calibration is performed like a standard microphone set calibration. The same happens for IEC 60318-1 coupler (GRAS RA0039 and 43AA):

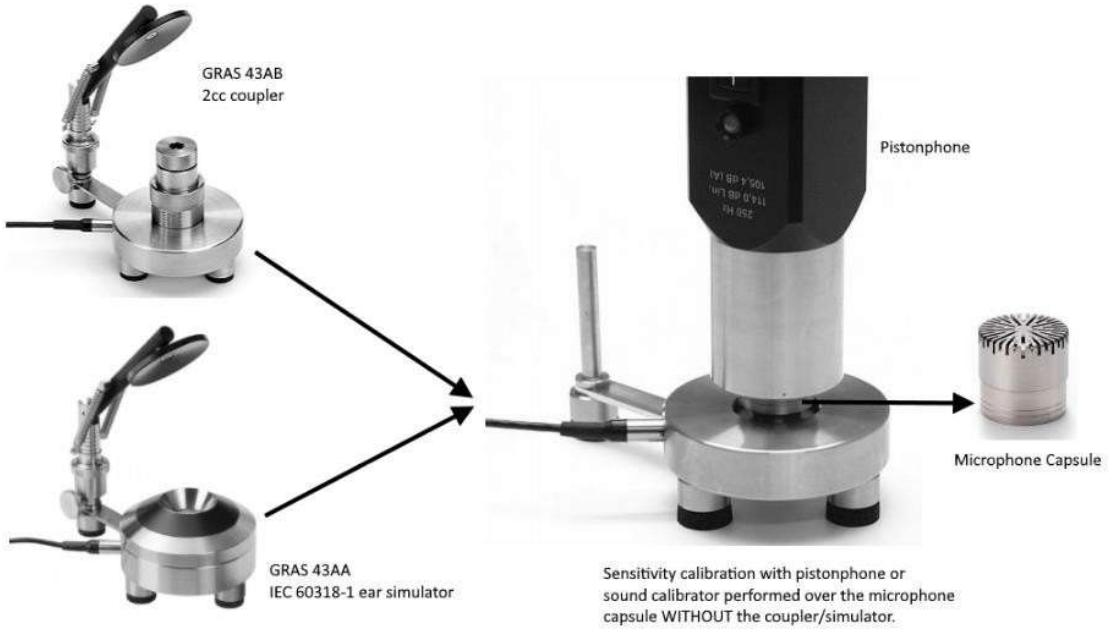

Figure 1. 2cc and IEC60318-1 test fixtures are calibrated without the ear simulator/coupler, but performing a direct microphone calibration. In this particular case, the GRAS 42AA/AP pistonphone has to be set up without its retention collar (See manual).

On the other, in a 711 style ear simulator (like GRAS RA0045, RA0401/2 and RA0403/4), the microphone is built into the device and can´t be removed for calibration with pistonphone or sound calibrator. Under this circumstances we will be forced to perform the calibration with the coupler. When using a pistonphone, this will mean that an extra air volume will be added to the one on the calibration coupler and we will need to correct for it. On a sound calibrator, it will mean that the microphone capsule inside the 711 style ear simulator will be outside the calibration cavity where the feed-back and control circuit is controlling the calibration sound level. The microphone inside the ear simulator is also separated from the calibrator by a cylinder, where standing waves can affect the calibration when using reference frequencies of 1000 Hz or higher. A 711 syle ear simulator doesn’t have a flat frequency response at these frequencies either. This means that depending on the calibration device used and reference frequencies, we will need to apply calibration correction factors due to all the reasons mentioned above.

Figure 2. 711 style ear simulators (like the one include in GRAS 43AC) have a buil-in non-removable microphone that has to be calibrated together with the coupler which will create the need of using correction factors when calibrating with a pistonphone or sound calibrator.

GRAS KEMAR head and torso simulator has many configurations where 711 style ear simulators are used. On the table below it is possible to see that, depending on the calibration setup and frequency used, we will have to use different correction factors for the calibration:

KEMAR with Standard Ear Simulator (RA0045-series and RA040X-series)		
In-situ calibration, without dismantling		
	Accessories	Correction factor
42AP and 42AA	GR0917, GR0924, RA0237, RA0238	-0.62 dB
Calibration done outside the head after clicking out the ear simulator		
42AP and 42AA	GR0408	-1.03 dB
42AG @250 Hz, 114 dB	GR0408	-0.09 dB
42AG @250 Hz, 94 dB	GR0408	-0.09 dB
42AG @1KHz, 114 dB	GR0408	-0.2 dB
42AG @1KHz, 94 dB	GR0408	-0.2 dB
KEMAR with Low-Noise Ear Simulator 43BB-1		
42AP and 42AA	RA0090, GR0408	-0.7 dB
42AG @250 Hz, 94 dB	GR0408	-0.09 dB
42AG @1KHz, 94 dB	GR0408	-0.2 dB

Figure 3. Correction factors for KEMAR with 711 syle ear simulators (RA0045 and RA040X series). The values change depending on the calibration device (42AA/AP pistonphone or 42AG sound calibrator), the reference frequency (250 or 1000 Hz) and the way of mounting the ear simulator to the calibration device (with/without adapters).