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Federal Communications Commission  
Office of Engineering and Technology  
Laboratory Division

**GUIDANCE FOR PERFORMING T-COIL TESTS FOR AIR INTERFACES  
SUPPORTING VOICE OVER IP (e.g., LTE AND Wi-Fi) TO SUPPORT CMRS BASED  
TELEPHONE SERVICES**

## **1. Introduction**

In 2015 the Federal Communications Commission expanded the scope of the hearing aid-compatibility (HAC) rules to include new features.<sup>1</sup> The revised rules became effective January 1, 2018. The expanded rules include two-way voice services over air interfaces utilizing Voice over Internet Protocol (VoIP), or any other protocol that provides real time two-way voice communication either through interconnected or non-interconnected public networks.<sup>2</sup> In addition, since January 1, 2018, the expanded rules eliminated the previous exclusions permitted for testing VoLTE and Wi-Fi calling air interfaces due to unavailable test equipment and unknown network engineering information.<sup>3</sup>

The requirements for T-Coil signal tests are defined in Clause 7 of ANSI C63.19-2011 and C63.19-2019. This KDB publication provides clarification and guidance for air interfaces that support VoIP<sup>4</sup> not explicitly identified in Table 7.1 of ANSI C63.19-2011 and Table 6.1—Normal speech input level for ANSI C63.19-2019<sup>5</sup>.

Manufacturers must test all voice applications and services installed within the handset to be counted as HAC rated. This includes applications installed by a manufacturer at the direction of a service provider.

## **2. T-Coil compliance tests for VoIP**

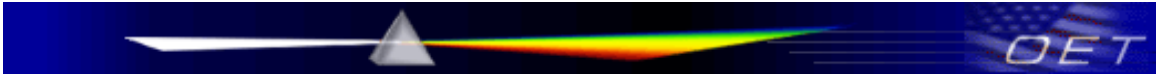
ANSI C63.19 HAC T-Coil testing is a measurement of the intended magnetic field strength of the audio signal generated by a telephone handset and detected by hearing aids that are equipped with T-Coil magnetic pick-up coils. The handset generates a magnetic field of the received audio from the far-end telephone conversation and magnetically couples directly into the hearing aid, bypassing the hearing aid's acoustic microphone. T-Coil compliance testing includes three measurement parameters: (1) the magnetic field strength; (2) the frequency response; and (3) the

<sup>1</sup> Fourth Report and Order (FCC 15-155, released November 20, 2015, WT Docket No. 15-285).

<sup>2</sup> Voice services are as defined in section 20.19(a). The expanded rules currently exclude testing for air interfaces operating over licensed Public Safety, private enterprise, and non-terrestrial Mobile Satellite Service (MSS) networks.

<sup>3</sup> Third Report and Order (DA 12-550, April 9, 2012, WT Docket No. 07-250).

<sup>4</sup> See filename C63.19-2011\_interpretation\_T\_coil\_audio\_levels\_for\_LTE\_July\_2012.pdf, [http://c63.org/documents/misc/posting/new\\_interpretations.htm](http://c63.org/documents/misc/posting/new_interpretations.htm).



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signal quality as a signal to noise ratio between the wanted magnetic fields of the received audio and stray unwanted magnetic fields. These measurements are typically made using a base station simulator,<sup>6</sup> using defined network reference test signals over the handset's supported air interfaces with the appropriate codecs.<sup>7</sup> The applied 1000 Hz test signal- either a sine wave at 1025 Hz or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as defined in ANSI C63.19 that correlates to normal speech is critical in establishing the signal intensity, required reference to normalize the frequency response, and the reference as the signal (ABM1) for the signal to noise (ABM2) ratio (all sub-clause references are in ANSI C63.19). This level establishes the baseline for T-Coil measurements.

### 3. Instrumentation for T-Coil testing for VoIP

Base station simulators or adjunct network simulators must support all the applicable air interfaces. The manufacturer is responsible to identify and/or provide the necessary means for:

- a) Establishing or simulating an audio connection to/from the handset under test between matching compatible codecs over a digital data stream (without transcoding), and
- b) Injecting the necessary ANSI C63.19 test tones at the calibrated nominal speech level applied at a digital or analog calibrated reference point.

The applied reference input level applied at the calibrated reference point for legacy protocols fixed to specific air-interfaces are defined in 7.4.2.1 Table 7.1 of ANSI C63.19-2011, ANSI C63.19-2011 VoLTE interpretation of July 2012 with -16 dBm0 or table 6.1—Normal speech input level of ANSI C63.19-2019.

For protocols not listed in Table 7.1 of ANSI C63.19-2011, the ANSI C63.19-2011 VoLTE interpretation, or table 6.1—Normal speech input level of ANSI C63.19-2019 note 2, the average speech level of -20 dBm0.<sup>8</sup> should be used.

ANSI C63.19-2019 use table 6.1 to establish the Normal speech input level and NOTE 2 of table 6.1 identifies the group of VoIP voice services that use -16 dBm0 as the normal speech input level. The group includes a variety of voice services, including Voice-over-LTE (VoLTE), Voice-over-IP-multimedia-subsystem (VoIMS), Voice-over-Wi-Fi (VoWiFi) and similar services. The interpretation of by this publication is that Note 2 defines the VOIP service that use -16 dBm0. Other services not defined by note 2 shall use -20dBm0 or the level defined in an attestation by the manufacture.

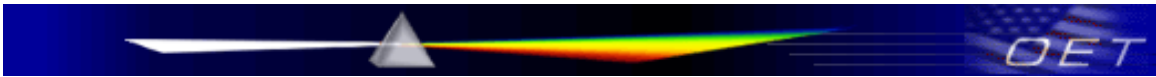
Reporting results involves a two-step process: (1) **Codec Investigation** to determine the worst-case codec for each voice service, and (2) **Air Interface Investigation**. Using the worst-case codec for a voice service, a range of channels and bands shall be tested.<sup>9</sup>

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<sup>6</sup> See: 7.1 through 7.3.2 of ANSI C63.19-2011.

<sup>7</sup> Testing T-Coil requires establishing the connection and testing the variations of voice coder, air interface, band, and bit rate, as defined for that service. The rating is based on the worst-case measurement results associated with an air interface, voice coder, and band and bit rate.

<sup>8</sup> The -20 dBm0 establishes an average reference level as established in IEEE Std 269- 2010 referring a maximum at -10 dBm0, average at -20 dBm0, and minimum at -35 dBm0.



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- a) **Codec Investigation:** For a voice service/air interface, investigate the variations of codec configurations (WB, NB bit rate) and document the parameters (ABM1, ABM2, S+N/N, frequency response) for that voice service. It is only necessary to document this for one channel/band. However, the tester should spot check other combinations to ensure that the channel/band used represents the worst-case codec.<sup>10</sup>
- b) **Air Interface Investigation:** Use the worst-case codec test and document a limited set of bands/channels/bandwidth. Observe the effect of changing the band and bandwidth to ensure that there are no unexpected variations. Using the knowledge of the observed variations, it is necessary to report only a set band/channel/bandwidth for each orientation for a voice service/air interface. Consult with the manufacturer for any abnormal results.<sup>11</sup>

Example of test documentation:

Codec Investigation-air interface					
Codec State	Rate 1		Rate N	Orientation	Band/channel
ABM1 (dBA/m)				*	*
ABM2 (dBA/m)					
S+N/N (dB)					
Frequency response	Pass	Pass	Pass		

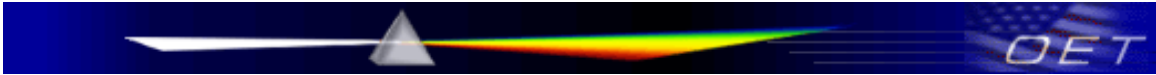
\* It is only necessary to document each orientation, band, or channel investigated—use your judgment.

Air Interface Investigation									
Mode:	Orientat ion	Channel as noted	Bandwidth if applicable	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response Variation dB	Signal Quality dB	T-Rating ANSI C63.19- 2011
Voice service /air interface/ band	Axial								
	Radial								

<sup>9</sup> The objective of the two-step process is to ensure that the results reported for each voice service represent a rating for the worst-case combination of code, channel, and band.

<sup>10</sup> Many test reports have shown very little or no significant variations, and also demonstrate wide margins from the rating threshold, indicating that the variations in band/channel/bandwidth have little effect on the signal quality and even less effect on the rating.

<sup>11</sup> Many test reports show variations that may affect the rating for axial orientation, and for some air interfaces especially GSM. However, within an air interface, and between air-interfaces transporting IP, small variations may not significantly affect the signal quality and T-rating.



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### **Change Notice**

**10/31/2013:** 285076 D02 T-Coil testing for CMRS IP v01 has been changed to 285076 D02 T-Coil testing for CMRS IP v01r01. Revisions reflect changes to the Permit Bur Ask requirements for 4.2 applicants testing T-Coil for CMRS Voice over IP transport.

**04/26/2016:** 285076 D02 T-Coil testing for CMRS IP v02 replaces 285076 D02 T-Coil testing for CMRS IP v01r01. Revision to remove the exemption for T-Coil testing for VoLTE and clarification of the exemption for Wi-Fi calling.

**09/12/2017:** 285076 D02 T-Coil testing for CMRS IP v03 replaces 285076 D02 T-Coil testing for CMRS IP v02. This change represents a major revision to address the Fourth Report and Order (FCC 15-155) rule for expansion of voice service and eliminate the exclusion permitted by the Third Report and Order (DA 12-550, April 9, 2012) for testing VoLTE and Wi-Fi calling.

**02/23/2022:** 285076 D02 T-Coil testing for CMRS IP v03 has been changed to 285076 D02 T-Coil testing for CMRS IP v04 to address ANSI C63.19-2019.