TYPICAL POST-INSTALLAITION AFILS TEST & COMISSIONING PROCEDURE

This procedure is intended to be used in conjunction with an appropriate record form.
A commissioning certificate may be generated for the client provided that the system meets the performance requirements of EN60188-4:2006 (or as revised), as noted below.

1 Test Equipment

PURPOSE – ensure that appropriate equipment for test is available and ready for use.

- **Magnetic Field Strength Measurement:** *Either* Ampetronic FSM *or* Ampetronic CMR3 probe with a portable audio analyser (e.g. NTi Minilyser ML1), *or* equivalent measurement instrument set. Suitable items will have at least dB scale, be calibrated to 0dB=400mAm^{-1} sine 1kHz with true RMS reading, accurate frequency and amplitude response, frequency response measurement (by filters or FFT), and be capable of accurate measurement over at least the range -45dB to +10dB.
- **Signal Source:** *Either* Ampetronic test CD & CD player *or* Signal generator (e.g. NTi Minirator MR1 or MR1-pro) *or* other equivalent signal source. At least pink noise and sinewave signals (1kHz plus 100Hz, 5kHz, and other suitable frequencies to match the measurement equipment in use). Ampetronic combination pink/sine signal is recommended. You may be able to use a solid-state signal store (MP3/WAV player, or even portable PC) if they can be effectively interfaced to the system under test.
  It is preferable to have a recording of speech and possibly music available as well.

  Where an AFILS is connected to a centralised system with recorded audio, it may be possible to store the test signals centrally and route them to only the AFILS under test. It is not advisable to route AFISL test signals to a PA, intercom or audio system globally!
- **Connection cables:** Suitable cable(s) to connect the signal source to the AFILS signal input.
- ***Note:*** *Do not carry a mobile phone on your person when making the measurements. Most probes / meters are affected by very close GSM / 3G mobile and similar transmissions. Put your phone at one side of the area under test or turn it off whilst measuring!*

2 System Equipment and Wiring Integrity

PURPOSE – verify that the installed equipment is as specified, that the loop cable has the expected electrical characteristics, and has not suffered significant damage to the conductors.

- Identify the induction loop drive equipment and record this on the form.
  Verify that the installed equipment is as specified in the loop system final design (or specification). If not as expected, verify that the installed equipment is suitable for the installation.

  Also verify that the equipment is connected correctly. Record any incorrect wiring found and rectify problems before proceeding.
- Measure the resistance of each loop or loop array, the resistance between loops or arrays, and the resistance from each loop to building earth (ground). Record the resistance readings on the form.
  Verify that the resistances are in the expected range for the loop design.

3 Volume (space) of use (in 3 dimensions)

*PURPOSE - define and record the three dimensional **useful magnetic field volume** for the loop system and determine a series of reference measurement points.*

- Define the area of use and all required listening positions.
- Determine the height of use, i.e. the normal height of the hearing aid - typically 1.2m for seated persons, or 1.2m to 1.7m to cover a range of heights from wheelchair users to standing adults.
  The widest range of listening heights expected in most applications could be up to 2.0m for very tall standing adults and down to 1.0m for children or wheelchair users.
- Sketch the ***floor plan*** and ***useful magnetic field volume*** on the record form. Include any areas where overspill of field needs to be examined.
- Select 4 to 6 measurement points (e.g. A to F on the Certificate of Conformity) inside the loop area where the system will be used.
  These should be points that are representative of the whole volume of use. Experience will suggest where best to choose in order to get a good sample of the range of magnetic field strengths.
- Consideration should be given to the use of the room and furniture layout. Some venues may have multiple room set-ups – e.g. movable seating / tables.

4 Background Noise

PURPOSE – check that the level of background magnetic noise is acceptable throughout the intended volume of use.

- Ensure the loop system is switched off, and all other building systems and services (e.g. lights) are operational.

- On the FSM: Select 'Background noise' mode *(this automatically adds A-weight)*.
    - On other meters: select a suitable range with A-weight and RMS fast response
- Locate and note maximum reading levels / positions on the record form ensuring the meter / probe pick-up coil is orientated the same as the hearing aid telecoil (usually vertical).

  If a noisy zone is found a minimum of 30 sec should be taken to establish a maximum reading. Depending on the electrical environment and systems in use the noise may be transient in nature and an extended measurement period may be necessary.

  If you have the facility on your measurement device, identify the freqyuencies at which interference is occurring. This may help to determine the source and whether the interfering signals will prevent communication.
- Evaluate these levels against the following recommendations:
    - Below -42dB (off scale on the FSM) is excellent performance for any installation.
    - Report levels greater than -32dB. Above this level the interference may be a problem for hearing-aid users. The character of the noise needs to be assessed before a loop system can be commissioned or ideally before is even installed.
    - Report and investigate levels greater than -22dB: This is an unacceptable level and remedial action (or careful technical justification) will be required to declare effective coverage in this area.
- Outline and shade any problematic areas on the floor plan sketch of the Certificate of Conformity.
- The ***useful magnetic field volume*** can be reduced if background noise can not be controlled sufficiently in particular areas. If effective AFILS provision in only a reduced part of the field volume is considered to be unacceptable, then an investigation of the noise source, and possible remedial action may be required. You may need to involve the building management and/or other contractors in remedial works where other systems (e.g. electrical works) require amendment.

5 Field Strength (set-up)

PURPOSE – set the field strength to approximately the right operational level

- On the FSM: Select 'Field strength' mode.
    - On other meters: select a suitable range with RMS fast response but **without** A-weight.
- Turn on loop system and set output current to zero (or low) to avoid sudden unexpected signal affecting hearing aid users in the vicinity. Run the combination noise test signal (CD track 1) into the loop system. Ensure any equalisation or filtering on the CD player such as 'Bass boost' is disabled.
    - If the combination noise test signal is not available, see the 'alternative method' below.
- Increase the input gain to achieve compression (6dB / 12dB LED on the loop driver front panel for Ampetronic amplifiers).
- Select a typical listening position, and increase drive current until FSM reads approximately 0dB during the bursts of 1kHz sine wave. The reading is the *maximum* LED illuminated over 60 seconds. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
- Take and note a series of readings at each defined measurement point (A-F), marking the positions and measured levels on the record form ('initial' values).
- Adjust drive current such that in the ***useful magnetic field volume***:
    - Maximum reading is no greater than +3dB
    - 0dB is achieved somewhere
    - Minimum reading is no less than -3dB

- Record the ‘final’ levels on the form at each measurement position.
- Alternative method:
  - This test can also be performed using the ‘Pink noise’ signal (CD track 2). With this signal the peak readings must be between -9dB and -3dB, with at least one point in the volume reading -6dB. *Note: This method is more likely to be affected by any subsequent adjustments of the ‘Tone’ or ‘MLC’ control, and different amplifiers’ AGC / compressor characteristics.*
  - Whilst it is also possible to use continuous 1kHz sine signal, this can only be used for short periods on most induction loop drivers due to the thermal demands of delivering continuous sine signals. *Note: This method may give unexpectedly low readings on some amplifiers due to their AGC / compressor characteristics.*
- Not advised:
  - Artificial / simulated signals such as ITU speech are not recommended as test signals for setting up systems - it is better to use the real thing, and then only as a final check.

6 Frequency Response

PURPOSE – check the frequency response is acceptable and adjust if necessary

- On the FSM: Select ‘Frequency response’ mode (this activates frequency-specific filtering).
  - On other meters: select either a FFT feature, or a frequency-specific filter mode, **without** A-weighting.
- Use pink noise (CD track 2) as an input to the loop system.
- For meters using frequency-specific filtering: At each measurement position (A-F), measure the readings with the frequency filter set to 100Hz, 1kHz and 5kHz (or the nearest equivalents) – record the readings as ‘initial’ values on the record form.
  - The reading is the *peak* reading on the LED display
  - Readings at 100Hz and 5kHz should be within ±3dB of the reading at 1kHz
- For meters using FFT analysis: At each measurement position (A-F), obtain a frequency spectrum and note the value at 100Hz, 1kHz, and 5kHz, and possibly at other points in between. Record the readings as ‘initial’ values on the record form (you may also save the reading if possible, and record the memory reference.
  - Ensure that you wait for the reading to stabilise at each point. You should use long time constants and wait at least 3 times the time constant at each point (e.g. 5 seconds constant – wait 15 seconds minimum).
  - Readings at 100Hz, 5kHz and points between should be within ±3dB of the 1kHz reading.
- If required, adjust the tone or Metal Loss Compensation (MLC) of the amplifier to boost high frequencies and achieve ±3dB across the three frequency bands.
- When all points achieve ±3dB across the three frequency bands, record the three readings at 100Hz, 1kHz and 5kHz at each measurement point and record them as ‘final’ readings on the record form.
- If it is not possible to achieve the required ±3dB across the 3 bands, contact Ampetronic to discuss your application.

Note – Due to the nature of the pink noise signal, and the method of testing, the 100Hz measurement can be erratic. If the reading is unstable, record the *peak* reading. If using FFT, you should inspect the adjacent bands (e.g. 125Hz) which should be similar.

7 Field strength (confirm)

PURPOSE – make a final check, and readjust the field strength if necessary. Not required if there has been no adjustment in step 4.

- On the FSM: Select ‘Field strength’ mode.
  - Other meters: select a suitable range with RMS fast response but **without** A-weight.
- Select Combination signal (CD track 1). If not available, see ‘alternative methods’ below.
- Re-test the system at one or more measurement points. Re-adjust if necessary to ensure the levels match the ‘final’ levels observed in step 3 and record these values on the record form. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.

- Alternative methods:
    - This test can also be performed using the 'Pink noise' signal (CD track 2). With this signal the peak readings must be between -9dB and -3dB, with at least one point in the volume reading -6dB. *Note: This method is more likely to be affected by different amplifiers AGC / compressor characteristics.*
    - 1kHz sine-wave (CD track 3) can also be used for a short duration, however use of this signal for long periods can cause amplifiers to overheat. With this signal the peak readings must be between -3dB and +3dB, with at least one point in the volume reading 0dB.
- Not advised:
    - Artificial / simulated signals such as ITU speech are not recommended as test signals for setting up systems - it is better to use the real thing, and then only as a final check.

8 Overspill

PURPOSE – check that no magnetic spill exists that could interfere with a neighbouring loop system, above, below or to the side of this system, or cause a potential breach of confidentiality. This step is only required if there are neighbouring systems (within 4 x loop width distance) or there are confidentiality requirements.

*If **Overspill** analysis is not required - Go to next step: **System use**.*

- Determine areas in which the spill of the system needs to controlled – either for compatible operation with another system, or for confidentiality. Define points for measurement outside the room and mark them on the system sketch on the Record Form (e.g. points G-K).

  Note: Detailed architects drawings may be required in order to define the measuring positions for spill.

- Survey background noise in these positions with all loop systems turned off. This needs to be done to ensure that the spill measurements are not influenced by other factors.
- Switch on loop system, and using the combination signal (CD track 1) take a reading at each of the overspill measurement points (G-K). Ensure areas in which spill needs to be controlled read less than -40dB during the burst of the sine-wave signal. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
- Alternative method:

    - This test can also be performed in the frequency response mode (set to 1kHz), using the combination signal. The measurements should be taken outside the loop in the area where spill needs to be controlled - during the sine bursts.

      This method does provide better rejection of the background noise signal due to the sharp filtering in this mode, but unfortunately the levels shown by the meter do not tally with either scale.
      In this mode the central green 0dB (-20dB) reference LED will illuminate with a -15dB signal re: 400mA/m; i.e. to take a measurement deduct 15dB from the white scale (Field strength mode) reading.
    - When using an audio analyser (such as the NTI Minilyzer with Ampetronic CMR3 probe), you may use the FFT mode (with a short time constant) to identify the 1kHz sine burst clearly despite the presence of background noise at other frequencies. Such instruments may also allow more detailed investigation of system behaviour.

9 System use

PURPOSE – check that the system is delivering a useable, undistorted comfortable sound when received through a hearing aid or listening device.

- Set up the loop system inputs as they will be used, with actual input devices and actual programme signal from the venue e.g. audio feed from PA, or microphone. System problems such as hum or HF oscillation warrant a full investigation, which is beyond the scope of this test method.
- Ensure the programme signal activates the compression on the loop driver. If not, adjust input gain until compression is achieved.

- Use the FSM in 'Field strength' mode to check the room for levels, and signal quality. Ensure the pick up coil is orientated the same as the hearing aid telecoil – usually vertical.
    - Other meters: select a suitable range with RMS fast response but without A-weight.

- Record levels at each measurement point. The reading is the *maximum* LED illuminated over a 60 second period. Readings should be between -9dB and 0dB throughout the volume depending on programme material, and field pattern. It should not be necessary to make any adjustment to the system for this test.
- Ideally, hearing aid users should be present to listen to the system. Care must be taken to ensure that the hearing aids are set correctly for telecoil use. Alternatively a loop listener can be used (such as the headphone output of the FSM, or the Ampetronic ILR3). The system should be observed for signal strength, intelligibility, distortion and overall quality.

  It can be useful to mark the loop receiver headphone volume control in a position where a comfortable listening level is achieved with a given set of headphones. This provides a reasonably objective reference when quickly evaluating systems and background noise characteristics.

10 Additional Information

BASIC COMMISSIONING PROCEDURE using AMPETRONIC FSM

AFILS Commissioning Procedure for Ampetronic FSM to IEC 60118-4:2006

Step		Audio input	FSM settings	Adjustments	Performance requirements
1	Volume of use	SYSTEM OFF	METER OFF	n/a	Determine volume of use Sketch Layout
2	Background Noise	SYSTEM OFF		Sources of magnetic noise	< 22dB essential < 32dB acceptable
3	Field Strength (1)	*Track 1:* COMBINATION *		Loop current	-3 to +3dB peaks
4	Frequency Response	*Track 2:* PINK NOISE	5kHz 1kHz 100Hz	MLC / tone control	-3 to +3dB peaks compared to 1kHz
5	Field Strength (2)	*Track 1:* COMBINATION *		Loop current	-3 to +3dB peaks
6	Overspill (if required)	*Track 1:* COMBINATION		n/a	< 42dB (OFF SCALE)
7	System use	ACTUAL SIGNALS		Input gain	-9 to 0dB peaks Subjective -> OK

* Other signals may be used with revised performance requirements: PINK NOISE -9 to -3dB, 1kHz SINE -3 to +3dB

AMPETRONIC TEST CD TRACK LISTING

Track 1: COMBINATION (30 mins) Pink noise with 1s bursts of 1kHz Sine

Track 2: PINK NOISE (30 mins) Bandlimited as per IEC60118-4

Track 3: 1kHz SINE (1 min)