Installing and Calibrating Loop Amplifiers to EN81-70 so that Test Certificates can be Produced for Audio Frequency Induction Loop Systems (AFILS) in Accordance with BS EN 60118-4

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Abstract. Service providers have to make "reasonable adjustments" to the physical barriers to gain access in all buildings. The summary of main provisions for disabled access includes: f) Emergency telephone and inductive coupler for hearing aid users. Inductive loop amplifiers need to be installed and calibrated correctly so that test certificates can be produced for Audio Frequency Induction Loop Systems (AFILS) in accordance with BS EN 60118-4. If they are not powerful enough or incorrectly set up they produce distorted sounds. Often, installed systems are simply a loop behind the Car Operating Panel (COP) with limited range, so they cannot be heard by a deaf person at the other side of the car or collapsed on the floor. This leaves users with impaired hearing at a dangerous disadvantage as they cannot hear normal and telephone lift messages. This paper provides guidance on how existing loop amplifier specifications and installations can be improved.

1 INTRODUCTION

Passengers with impaired hearing are often not able to properly 'hear' both the emergency telephone messages and the lift speech messages including emergency messages. Approximately 1 in 6 of the UK population (that is 10 million people!) have hearing loss and would benefit from additional assistive devices to recognize spoken messages.

Those passengers wearing hearing aids will have a 'Telecoil' (T-coil) fitted in the aid (Figure 1), which, if switched on, can pick up audio inductive signals and amplify them in the aid to the passengers hearing requirements. Hearing aids amplify the volume and also compensate for the loss of specific frequencies. The passenger knows to switch their 'Telecoil' ON when they see the hearing loop fitted sign. (Figure 2)

Figure 1 'Telecoil' in hearing aid

Figure 2 Signage

The signal from the loop, if set up correctly, should improve on the signal picked up by the hearing aid itself. It should not distort or clip the signal or it will not improve the signal and will often make it worse.

An AFILS driver or induction loop system has a linear current amplifier of at least 2.2 amps rms with a 1kHz signal and a voltage output of at least 4.5V peak. The input is connected to the speech sources (telephone and lift messages). A low impedance loop coil is connected to the output, and mounted on the perimeter of the area where the field is required, to generate an audio field in the lift car. A passenger standing in this field picks up the audio signals. The equipment and design should be sufficient so there is no clipping or distortion of the signal and have metal compensation.

A 'Telecoil' in the hearing aid is a small magnet and coil which vibrates and picks up these audio signals. The signals are amplified by the hearing aid to the needs of the wearer, to compensate for both volume and frequency loss.

The orientation of the loop field is important and should be at 90 degrees to the plane of the 'Telecoil' for the best results. Ideally the loop should be mounted horizontally, above or below the passenger, or the 'Telecoil' will not be in a good field and the audio signal will be very weak. (Figure 3)

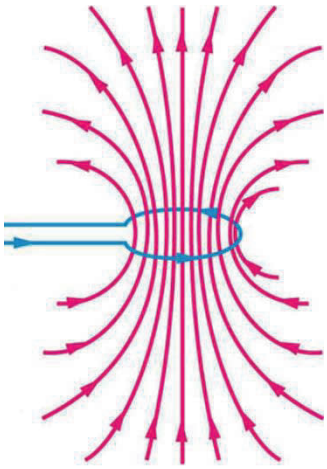
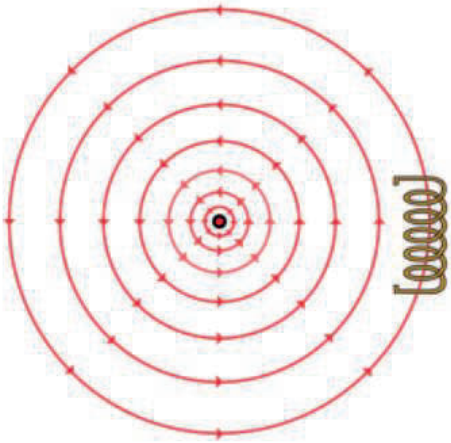


Figure 3 Loop Magnetic field



Hearing Aid 'Telecoil' in the magnetic field

2 INSTALLING LOOP AMPLIFIER CONSIDERATIONS

There are a number of ways loops have been installed in lift cars. The best way is to have a loop in the ceiling or on top of the car as it gives a field in the whole car. Some manufacturers put a small coil behind the COP. This will have limited range and power and will only be picked up by the passenger who is near the COP and not collapsed on the floor or at the back of the car.

The installer should ask if the induction loop amplifier is to have the field coil on top of the car to fill the whole car, or if the coil is to be mounted behind the COP to have a small field just in-front of the COP only. The loop system should ideally have suitable input facilities to accept signals from both the telephone system and the car speech system to give the passenger with impaired hearing all the audio messages. This includes emergency speech messages such as fire recall and door closing etc. Otherwise the passenger will be at a disadvantage in these situations. (Figure 4) (Figure 5)

The lift car is a metal box which will absorb the signal if the loop is mounted near the walls. This "Faraday cage" effect hinders loop installations, so we require the loop amplifier to be located and to have sufficient power and metal compensation for the loop to be mounted outside the lift car metal box yet to allow the audio field signals to pass through. For best effect the loop is mounted on the roof, about 150mm in from the car top edge. It should be above the passenger and no higher than 1.8 metres from their ears. The loop wire containment conduit on top of the car should be of non-metallic construction to avoid short circuit earth paths.

The loop electronics should be in an earthed metal box and mounted where it is not vulnerable to mechanical damage and the controls can be accessed through the cover. It must be close to the loop.

The connections should be of a type suitable for the application. For example, if the input is a telephone system it should have the correct isolation and impedance match. If taken from the speaker feed, it should be a twisted pair.

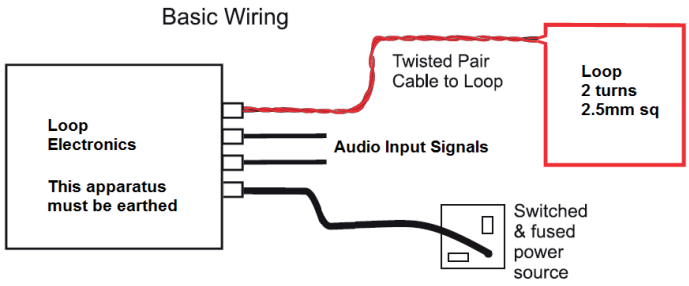


Figure 4 Basic Wiring

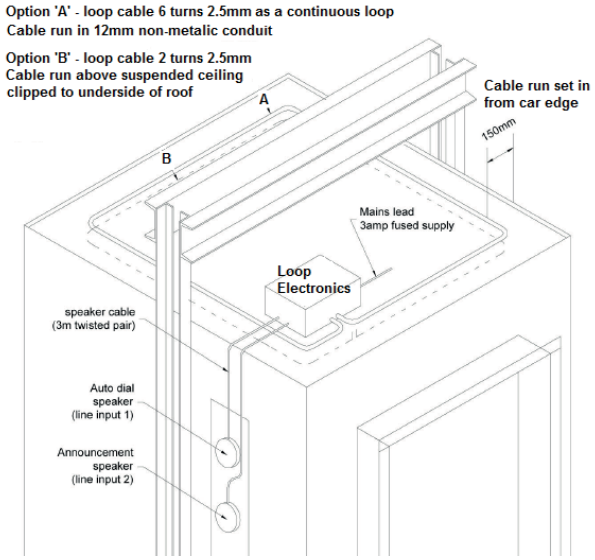


Figure 5 Car top loop fitting

3 CALIBRATING LOOP AMPLIFIERS

Manufacturer's loop amplifier instructions include setting up and adjusting the input and output signals and strengths of the loop electronics.

The signals from the audio sources should be set to the input threshold requirements of the loop amplifier. If too weak the amplified background noise will come through. If too strong the signal will be clipped and distorted. This should be resolved at source of installation.

The current through the loop should be set to give a field strength of 400mA/m sine wave at 1kHz. If it is too high the hearing aid will be overloaded. If it is too low the signal to noise ratio is reduced.

Standard IEC6010118-4 (BS EN 60118-4) is prepared by the International Electrotechnical Commission (IEC). It provides a standard for system performance, and specifies the use of the T-sign logo. It provides an expectation of quality.

Induction Loop Testers (Figure 6) are sophisticated field strength meters with digital displays and menu selection and good quality headphones. They are designed to simplify the setup of an induction loop system to the latest version of BS EN 60118-4 and to check the performance. The tests are very comprehensive so that test certificates (Figure 8) can be produced for AFILS in accordance with BS EN 60118.

Designed to test Magnetic field strength in audio-frequency induction loops for hearing aid purposes, the kit includes an induction loop tester with intuitive display and simple to follow test menus, a calibrated signal generator with pre-loaded test tones and a set of headphones.

As well as checking the magnetic field strength of an induction loop system, it also measures amplified background noise, frequency response, metal compensation loss and also allows you to listen to the loop signal.

Figure 6 Field strength meters

Acceptable coverage should be the whole area where passengers of different heights could be standing or sitting in a wheelchair (or even collapsed on the floor). If total coverage is not possible (e.g. with loops in the COP) then the hearing aid user needs to know where the loop is. Hearing loss is a hidden disability and audio loop fields are not visible.

Amplified background noise should be -32dB or lower (A-weighted). Noise should not affect intelligibility.

Metal degrades magnetic fields. A 2.5-amp current test in the centre of the loop should give 0db loss with respect to a signal with no metal loss. E.g. if the signal is -6dB in the centre of the loop, the metal loss equals 6dB.

The field strength should be tested at 400mA/m sine wave at 1kHz over the whole required volume. If the signal is too high the hearing aid will be overloaded. If it is too low the signal to noise ratio is reduced. The signal strength should not deviate more than ±3 dB over the listening area, i.e. the signal should be consistent from floor to head height and over the whole floor area.

The frequency response should be within ±3dB from 100Hz to 5kHz with reference to the signal at 1kHz. Factors such as effective drive current and metal structures will affect this.

Listener headphone receivers will not do these tests and cannot be relied on for signal quality.

Signage is essential so the user does not have to ask. Signs must be clearly visible. (Figure 7)

Figure 7 Signage

Test Certificate for AFILS in accordance with BS EN 60118-4

This test certificate is used to log the results detailed in the Fosmeter Pro (FPRO) Instruction (Doc. No. DCM0004006).

Tested to BS EN 60118-4 at any point within the useable volume.

1	Background Noise Acceptable: <-42 to <-22 dB L	Is background noise acceptable? Yes ❑ No ❑ If No _____ dB L
	System Noise Acceptable: <-42 to <-22 dB L	Is system noise acceptable? Yes ❑ No ❑ If No _____ dB L
2	Magnetic Field Strength using a pulsed 1 kHz signal Acceptable: 400 mA/m (0 dB L)	Is field strength acceptable? Yes ❑ No ❑ If No _____ dB L
3	Frequency Response Acceptable: signal @ 1 kHz +/-3 dB L, 100 Hz to 5 kHz	Is frequency response acceptable? Yes ❑ No ❑ If No _____ dB L

Was a metal compensation test performed? Yes ❑ No ❑

Was an overspill test performed? Yes ❑ No ❑

Was a subjective audio test performed? Yes ❑ No ❑

Please note, a plan showing the loop location is required by BS EN 60118-4. Attach a plan to this document (this can be a building drawing or a simple sketch).

Customer: _____ Site/Location: _____

Install Company: _____ Installer: _____

Equipment Used: _____ Serial Nos.: _____

Installer Comments:

The system has been tested in accordance with BS EN 60118-4.

Signed: _____ Date: _____

Figure 8 Typical test certificate produced on installation

4 STANDARDS SUMMARY

As part of the performance standard the system must meet standards for:

- Low amplified background noise
- The correct field strength
- Even field strength
- Flat frequency response

Just as critical are:

- Input audio quality to separate signal from noise
- Acceptable coverage
- Clear signage, no user request necessary
- Training, monitoring and maintenance.

Site testing should be an integral part of achieving standard compliant loop systems. Contractors need to plan and manage and train their employees and provide the information necessary to comply.

5 MAINTANANCE OF LOOP AMPLIFIERS

Ignorance is the most cause of loop failure and incorrect installation. Staff must be trained to test the system and help customers. Loop systems must be regularly monitored. This includes staff access to the monitoring equipment and regular maintenance and testing by trained staff.

Site testing should be an integral part of routine maintenance procedures.

1) Regularly (monthly) check the signal. This can be done using an audio listener headphone receiver. This should be held VERTICALLY to be the same orientation as the “Telecoil” in the hearing aid. (Figure 9)
2) Annually the system should be checked for quality of sound using the full field strength meter calibration again. (Figure 6)

Figure 9 Audio headphone induction loop receiver

6 CONCLUSION AND ALTERNATIVE TECHNOLOGIES

This paper has looked at current technology and given guidance at how to apply it well. When installing loop amplifiers, it is really important that they are set up and calibrated so the passenger can understand the audio signal clearly anywhere in the lift car.

The draft revision of EN 81-70 recently out for public comment is based on induction loops in all lift cars (the current standard has this subject to negotiation – i.e. provided when agreed / specified); however, this has been very heavily commented.

There are other solutions which have not been reviewed in detail as the technology is more recent and not yet so widely available. However, consideration has been given to other technologies including speech to text recognition on mobile devices using Bluetooth or similar. This would be restrictive for passengers with hearing loss as this technology is not as universally available as is a "Telecoil" in hearing aids. Another solution could be to have a speech to text screen in the car taking its inputs directly from the telephone and lift speech systems.

7 LITERATURE REFERENCES

The author is grateful for the input and literature from the following loop system manufacturers

Ampetronic

C.E. Electronics

Contacta

Deaf Alerter

SigNET AC

REFERENCES

Standards IEC6010118-4; BS EN 60118-4; EN81-70

BIOGRAPHICAL DETAILS

John Trett is the Managing Director of C.E. Electronics Ltd in the UK. They make and supply many electronic 'signage' devices for lifts to give passengers information, including indicators, TFT screens, speech units and induction loops. John has an electrical engineering degree BSc (Eng) from Nottingham University and other electronic and lift qualifications. He was trained by Otis. John became severely deaf from a virus 3 years ago so needs induction loops to be set up correctly to understand what is going on. He has a personal interest in promoting good installations.