Technical Paper:

A Quantitative Analysis of the Distance Dependent Variation in Magnetic Field Strength of 'Across the Counter' Induction Loop Systems.

Purpose:

To determine the maximum usable listening distance (range) from a standard 'across the counter' type induction loop assistive listening system using a variety of loop antenna designs.

Background:

All assistive listening systems have a given range over which they can be effectively used.

- The range of FM (radio) listening systems can typically extend over several hundred feet in every direction (through walls).
- The range of IR (light based) listening systems can also extend over several hundred feet, but cannot travel through walls, so are constrained to the rooms in which they are installed.
- Induction Loop systems are much more complicated:
    - Large 'Perimeter' loop systems (with the loop wire installed around an entire room) can transmit audio up to the width of the loop in all horizontal directions.
    - Large 'Phased' loop systems (also installed within a room) can be designed so that NO audio is transmitted outside of the room at all.
    - Small 'Across-the-Counter' type induction loop systems are somewhat more variable. Depending on the design and installation of the 'loop antenna', these systems can vary widely in their transmission range. Advanced Listening Systems & Technologies Ltd. (ALST) has developed various antenna designs that are implemented depending on the desired balance of security vs. usable audio range.

This paper will compare the range of a commonly used antenna design in the Induction Loop Industry (called Design A in this paper) with two antenna designs developed by Advanced Listening (called Design C and Design D in this paper).

Methodology:

A standard Advanced Listening counter loop amplifier and six turn 16AWG loop antenna was used for the field strength tests. A Univox FSM 2.0 RMS field strength meter (SN:4106) was used for all measurements.

NOTE:A field strength of 0dB is defined as in the IEC 60118-4 induction loop standard as 400mA/m using a 1kHz tone as audio source. It should be noted that the dB level of the field at any point represents the PEAK field strength of an actual spoken audio signal, not the AVERAGE.

All measurements were made in the plane 50cm above the uppermost edge of the loop antenna (regardless of antenna configuration). This approximates the distance between the loop installed at an average bank teller wicket and a person's hearing aid.

Measurements were made in two directions in the plane:

> 'On Axis' measurements were made between the teller wicket (0cm) and walking orthogonally away from the teller wicket (to a distance of 100cm).
>
> 'Off axis' measurements were made between the teller wicket (0cm) and walking parallel towards the next adjacent teller wicket (to a distance of 100cm).
>
> **Note**: Walking to the left or the right has the same field strength decay due to the symmetry of the loop antenna designs.

Results:

Loop Antenna Design A:

As can be seen in **Figure 1**, the on axis field strength of Design A starts at -10dB then peaks at 0dB around 30cm from the front of the wicket. It then very slowly decays and remains in the 'Clearly Intelligible Zone' for greater than one meter.

As can be seen in **Figure 2**, The off axis field strength of Design A starts at -10dB then decays rapidly, leaving the 'Clearly Intelligible Zone' by 40cm. By 60cm, the signal is unintelligible.

Explanation: Antenna Design A is only useful in situations where the loop cannot be placed close to the listener (requiring 30cm to reach 0dB level) and requiring a long on axis effective area. The off axis decay is so abrupt that it is too narrow for most applications, not even filling the width of an average teller wicket.

This is not a design that Advanced Listening uses very often (never in financial institutions). It should be noted though that because this design is very easy to install, it is the one most often used by other loop installers.

Loop Antenna Design B:

As can be seen in **Figure 1**, the on axis field strength of Design B starts at 0dB then slowly decays, nearly linearly, leaving the 'Clearly Intelligible Zone' at a distance of 75cm in front of the wicket. It becomes unintelligible slightly before 100cm.

As can be seen in **Figure 2**, The off axis field strength of Design B starts at 0dB then decays very evenly, leaving the 'Clearly Intelligible Zone' by 60cm. By 72cm, the signal is unintelligible.

Explanation: Antenna Design B is an excellent general-purpose design that allows good, even field strength coverage with very good security. A person attempting to overhear the loop signal would need to be within 100cm behind or 72cm on either side of the wicket (75cm behind or 60cm on either side to get a good signal).

Advanced Listening has used this design in many financial institutions with excellent results. The installed system has also been tested by hearing aid users both at and near the teller wicket. The result is that the loop signal in any position (except while standing right at the wicket) is less than or equal to what a person with normal hearing would hear standing in the same position. Right at the teller wicket, the loop signal is very strong, allowing the hearing aid user to hear very clearly while eliminating the need for the teller to raise his or her voice. This increases the security of the transaction.

Loop Antenna Design C:

As can be seen in **Figure 1,** the on axis field strength of Design C starts at 0dB then rapidly decays, leaving the 'Clearly Intelligible Zone' at a distance of 35cm in front of the wicket. It becomes unintelligible at 45cm.

As can be seen in **Figure 2,** the off axis field strength of Design C is nearly identical to Design B.

Explanation: Antenna Design B Is considered a very secure on axis design, but greatly limits the range in that direction. Rarely does a situation warrant this fast a field strength decay.

Figure 1.

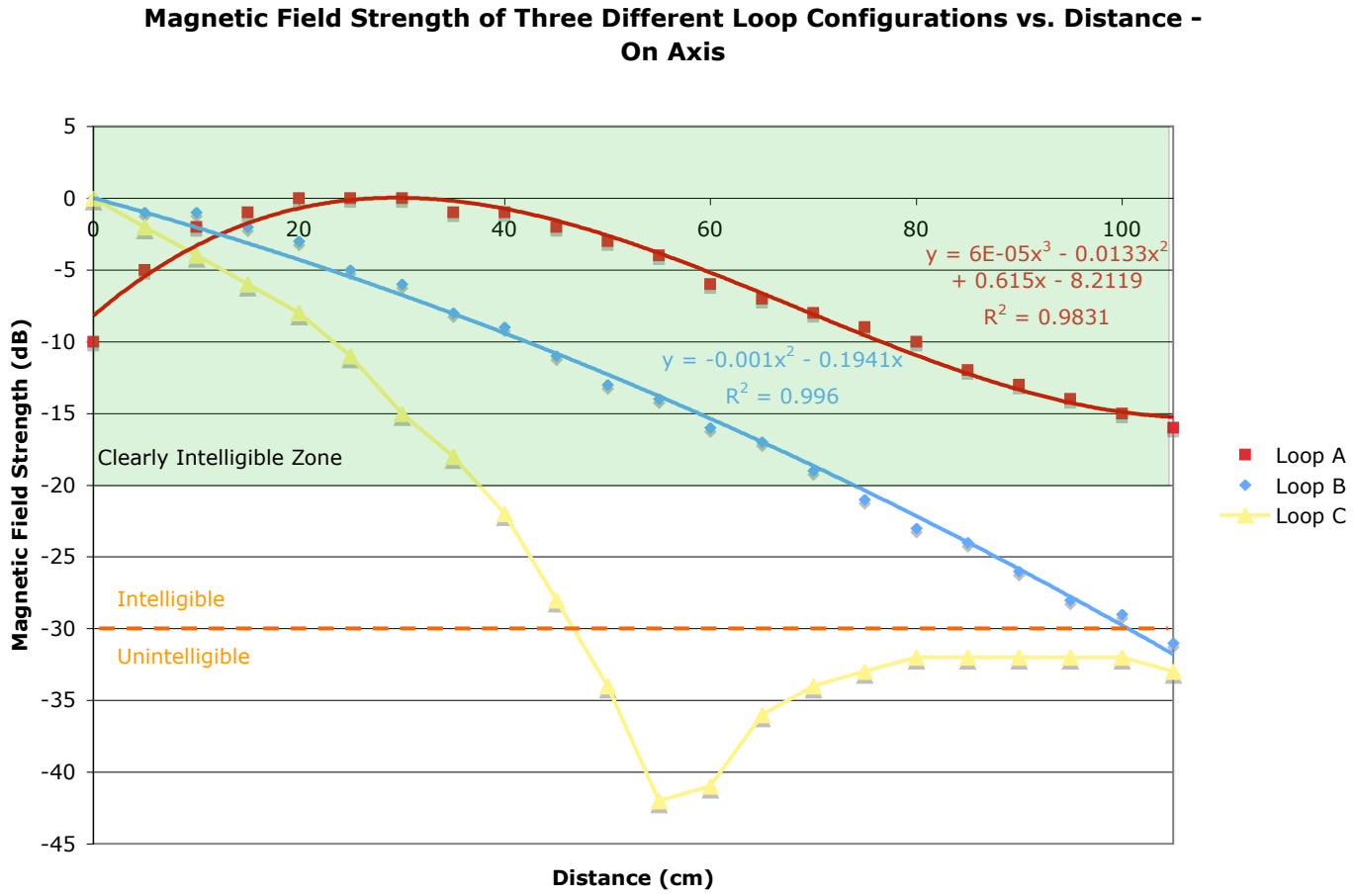

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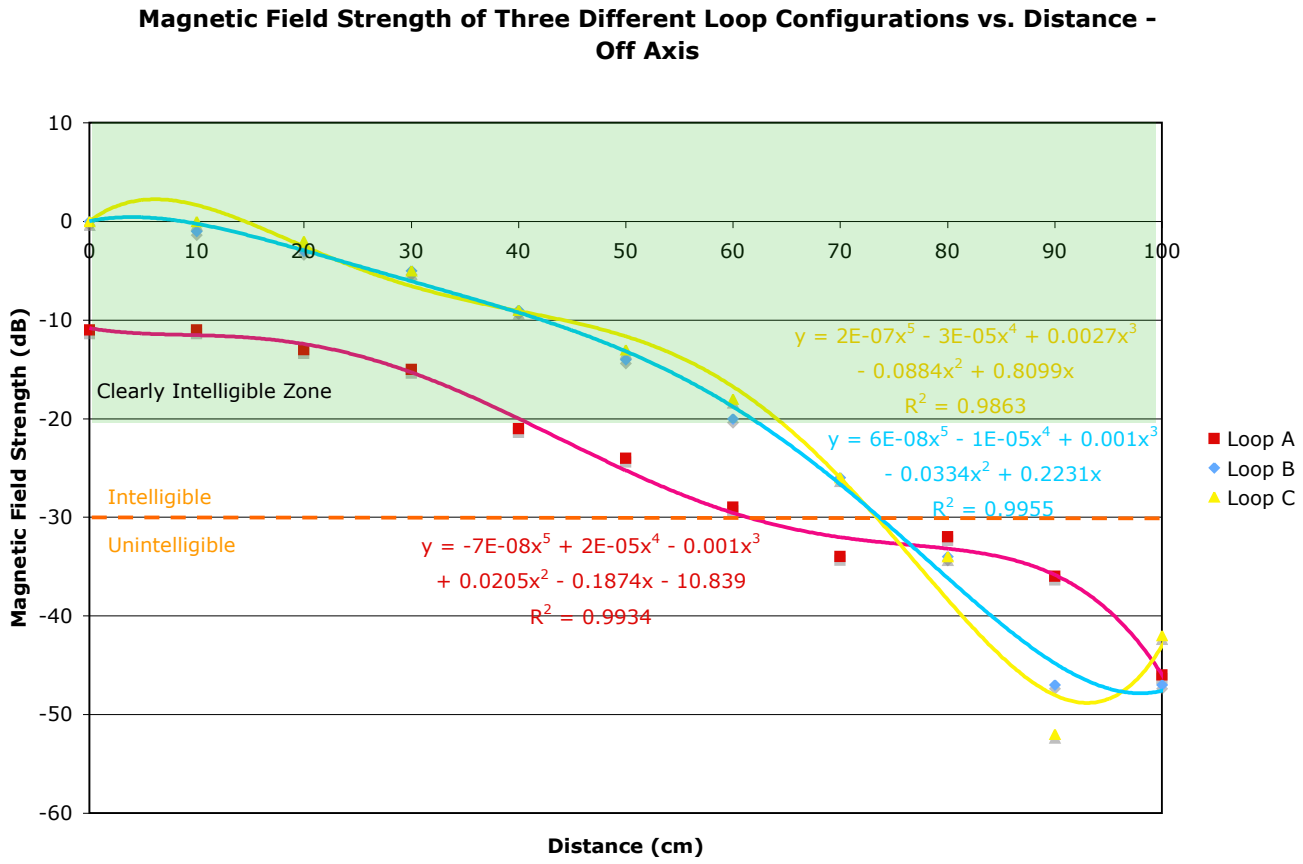
Figure 2.



Conclusion:

In induction loop design, as in many things, one must use the right tool for the job and have the experience and technical expertise to know what tool that is. Induction loops can be the most secure assistive listening technologies available, but they must be designed and implemented to meet the needs of a given situation. This paper outlines only three loop antenna configurations. All of these designs can be modified to meet specific requirements.

Note: This paper is intended for educational purposes only. It is not intended as a guarantee of performance of any Advanced Listening Systems & Technologies product. Differences in wicket dimensions, materials and feasible installation location will affect performance. An onsite evaluation is required to guarantee system.

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