PUBLIC ADDRESS SYSTEMS ON HORSE RACING COURSES IN GREAT BRITAIN

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1.0 INTRODUCTION

Eighteen years ago, Peter Barnett presented a paper at Reproduced Sound 2 on the design of a high quality audio installation at a Hong Kong racecourse. Eighteen years later, UK racecourses are still reluctant to make that level of investment in their public address systems. With a couple of notable exceptions at Sandown and Newbury, most courses' public address systems rely on traditional 'commercial' type loudspeaker installations. This paper aims to show that this need not necessarily be a bad thing, when the requirements for the system are taken into account and the system is properly designed.

2.0 THE TECHNICAL SIDE OF HORSE RACING

There are 59 horse racing courses in Great Britain or 60 if you count the two courses at Newmarket, where there are two finishing straights from the same course. All race meetings on these courses are run under the rules of racing, policed and upheld by the Jockey Club. There are Jockey Club stewards present at all race meetings to ensure the safe and fair running of races. Despite articles recently published in the press, to a large extent they are successful in keeping the sport free from fowl play and corruption.

Technical facilities are provided to assist the stewards in keeping the sport as fair as possible. These include the starting stalls for all flat races, (races not run over jumps) the photo finish operation, and what has become known as "Camera Patrol". This comprises a sophisticated, fully digital outside broadcast unit and four or five cameras placed at strategic parts of the course to capture the racing from all angles. Each of these cameras is individually recorded and displayed on separate monitors in the steward's room, in order that the stewards can see any antisocial antics the jockeys get up to during a race from different angles, therefore making as fair a judgment as possible about the running of the race. The pictures from the OB truck are also sent to BT tower via a private fibre optic network for worldwide distribution, and used to show the racing on televisions located in all rooms, bars, restaurants and suites on the racecourse.

3.0 PUBLIC ADDRESS

3.1 Overview

Public address systems on racecourses serve a number of purposes. There is the obvious need for a system to aid evacuation. It is also an important information service. Apart from the race commentary, telling punters what is happening when a racing pack may be out of sight, important information about the betting odds for the placed horses in each race are given. Judges decisions, photo finish results and stewards notices regarding the running of each race are also announced. All this information is essential for the punting public to help them make their judgements on which horses to back and when to claim their winnings

This was not always the case. Public address systems did not make an appearance on UK race courses until 1952, when the first race commentary was given at Goodwood Racecourse. The Jockey Club, now as then, also dictate what information is allowed to be given over the public address system, although these days they are fairly relaxed whereas once upon a time only the commentary and Judges announcements were allowed.

3.2 Public Address System Setup

Loudspeakers are permanently installed on the racecourse, and cabled back to the curiously titled "Broadcast Office". This usually too small room is located in the weighing room building, where the jockeys are weighed and checked under the watchful eye of the Clerk Of Scales, who is responsible for the running of all races on the day. On the morning of the race meeting, a technician will turn up, and connect the amplification and processing equipment to these loudspeaker circuits, and operate the system. All equipment other than the loudspeakers is, in most cases, carried by the technicians and installed on a day by day basis. Some of the larger courses do have the control and amplification systems permanently installed, in which case the technician merely installs the front end, i.e. microphones, mixer and other paraphernalia. Figures 1 and 2 show the audio equipment used from two eras. Interestingly, the equipment shown in figure 1 was still in use until six years ago!

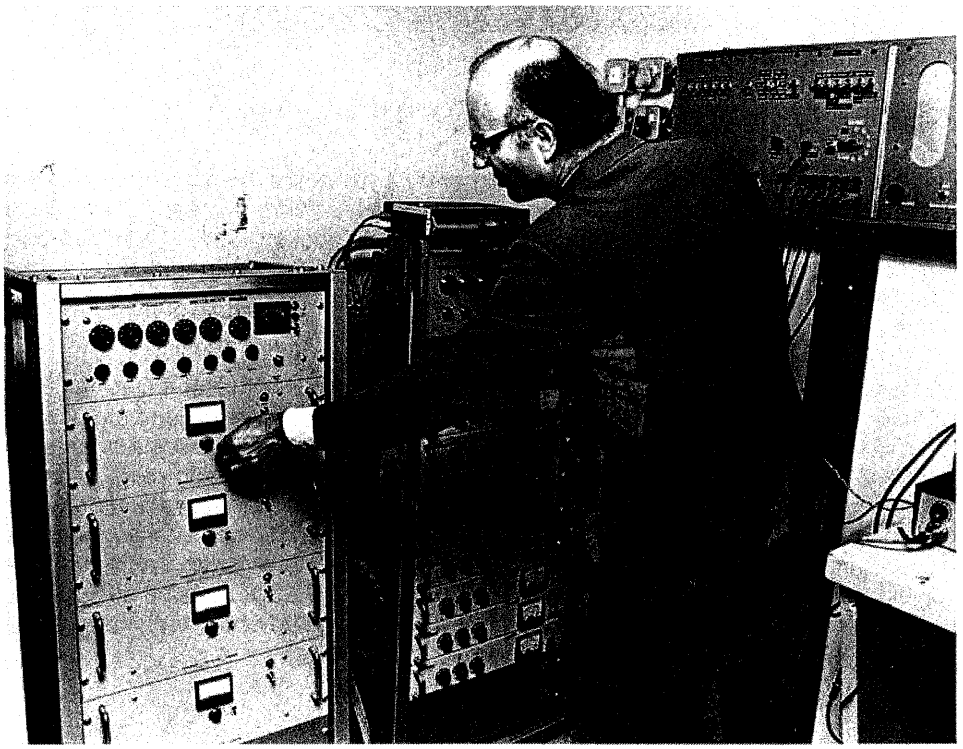


Figure 1. Broadcast office setup, early 1970's. Vortexion mixers, Vortexion and Millbank amplifiers.

Audio feeds come in to the broadcast office at line level from the commentator, via the commentators switch box, and from microphones supplied to the judge, race day announcer and the winners' enclosure. In some cases pre-recorded announcements and fanfares are played back from minidisc. All audio that passes through the system is also recorded to minidisc, in case of later confusion or enquiries by the stewards.

Use of high quality microphones and good quality front end equipment ensures the best possible quality signal is fed to the loudspeakers. Traditionally, rather poor equipment was used in the belief that this was of no consequence with the limited bandwidth and quality of the loudspeakers being used. In fact, the better the front end quality and the lower the distortion reaching the loudspeakers, the more chance they have of producing intelligible and comfortable sound.

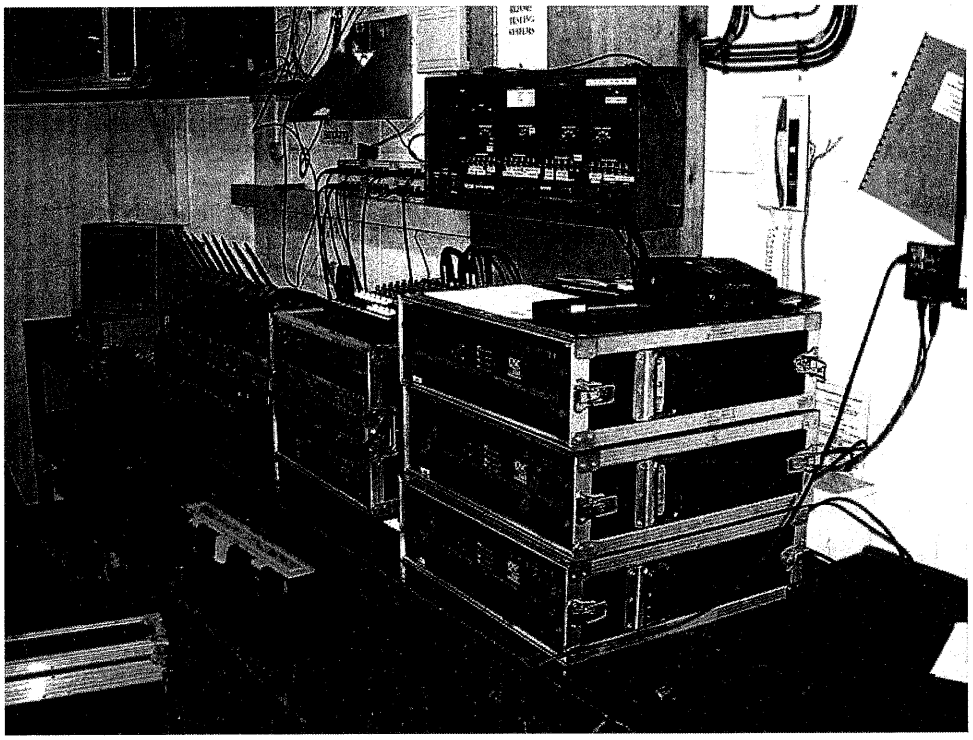


Figure 2. Broadcast office setup, 2004.

Compressors are used to try and control the dynamic range of overenthusiastic commentators and presenters. It is not unusual to be applying 24dB of compression on a commentator, reducing a 30dB increase in level between the start of the race and the final furlong, down to a 6dB difference. Output level limiters and band pass filtering are used in multi channel DSP's to protect amplifiers and loudspeakers from damage due to being overdriven and maximise the available SPL from the installation.

Due to the large number of loudspeakers and the long cable runs on a racecourse, the loudspeaker circuits are obviously run at high impedance and driven at 100 Volt level to minimise losses.

On most racecourses, the same programme material is sent to all external areas. On some courses however, the parade ring and winners enclosure have separate feeds. The parade ring is an oval walkway where the horses parade before a race, to allow the punters to view the animals before they run. For special events happening in the parade ring and for presentations to the winners, there is sometimes a separate system around the ring fed with its own separate mix from that feeding the rest of the course.

Internally, all corridors, toilets lifts and general circulation areas are fed the same sound as is fed to the main external PA system. In the bars and restaurants, locally installed amplifiers or multi zone systems relay the sound from the racecourse's television programme through high density ceiling loudspeaker installations. This means the sound on the television sets does not have to be turned up, which is undesirable as it results in distorted sound from the televisions blaring out in an area local to the televisions, and people further away from the screens being unable to hear.

In the event of an emergency, the sound to all areas of the racecourse can be overridden from the broadcast office, such that all areas and televisions carry security or emergency messages. All audio equipment is powered from the mains, with either battery, UPS or generator backup for use in the event of a power outage.

3.3 PA for open areas

Designing audio systems on tight budgets for use in the open areas of racecourses is made a great deal simpler by only having to deal with speech band reproduction, as music is rarely used, and not having a great many of those problem causing surfaces to worry about!

The main aim with speech reproduction is also intelligibility rather than hifi quality, as the system is used to impart information, rather than entertain. However, a traditional "railway station" approach is clearly unacceptable, and intelligible coverage is a must over all areas. Therefore the loudspeaker installation must be designed properly for optimum coverage of public areas, with as little as possible overspill into areas where delicate thoroughbred racehorses are likely to jump at the PA system suddenly sparking into life! Clearly, the old "horns on poles" approach is not going to achieve this.

Although few details remain of the public address system installed at Goodwood for that first occasion in 1952, figure three shows a photograph from the period. Note the exponential horns on top of the number board to the right.

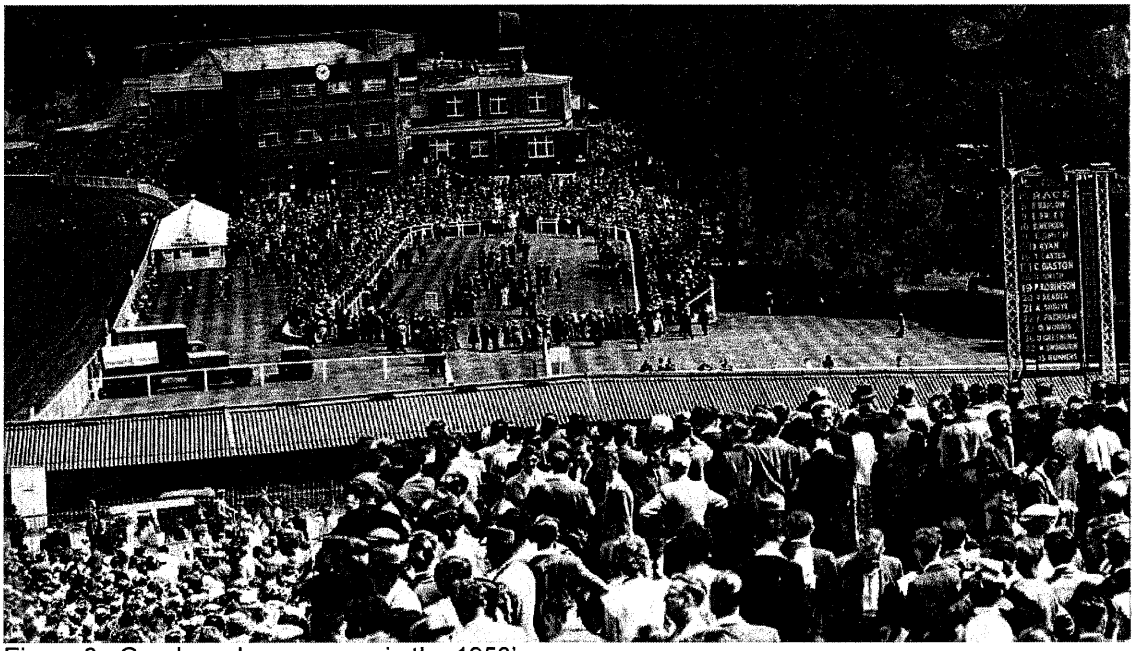


Figure 3. Goodwood racecourse in the 1950's

As the bandwidth we are trying to cover is only that shown in figure 4, these devices are not quite the anachronism they at first appear to be. Figure 7 shows a response and polar plot for a similar type of loudspeaker.

As can be seen by comparing the two figures, there is a remarkable similarity.

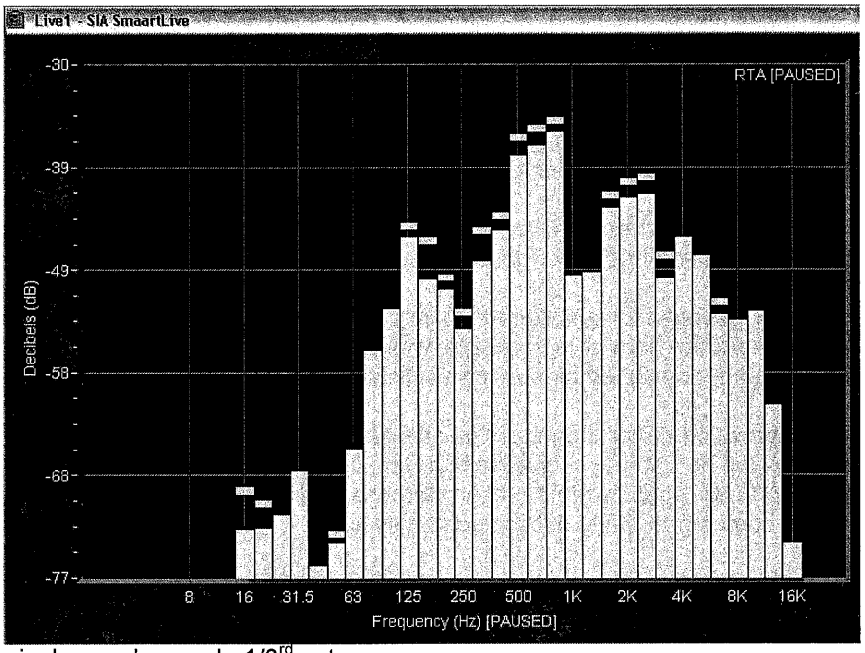


Figure 4. Typical speech sample 1/3rd octave

The large straight exponential horn and others of the same type are an ideal method of relaying speech information over a large distance to a large number of people. They require very little audio power input for a prodigious output over their operating bandwidth. Although of a restricted frequency range, they cover the speech band easily with great intelligibility. They have a narrow coverage angle and therefore project the sound energy forwards very efficiently. They are, however not very good at near field coverage for exactly the same reason. So the installation in figure 5 is a little ill advised!

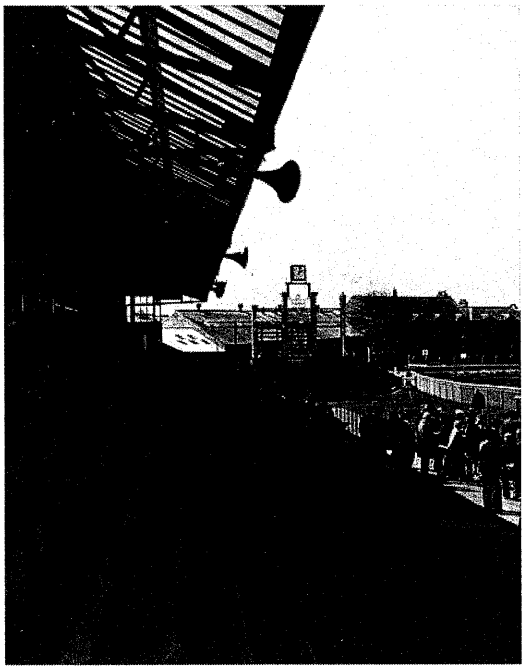


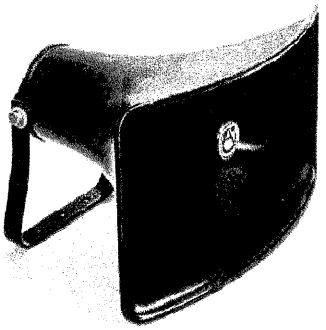
Figure 5. Ill-advised use of large exponential horns at Edinburgh (now Musselburgh) racecourse.

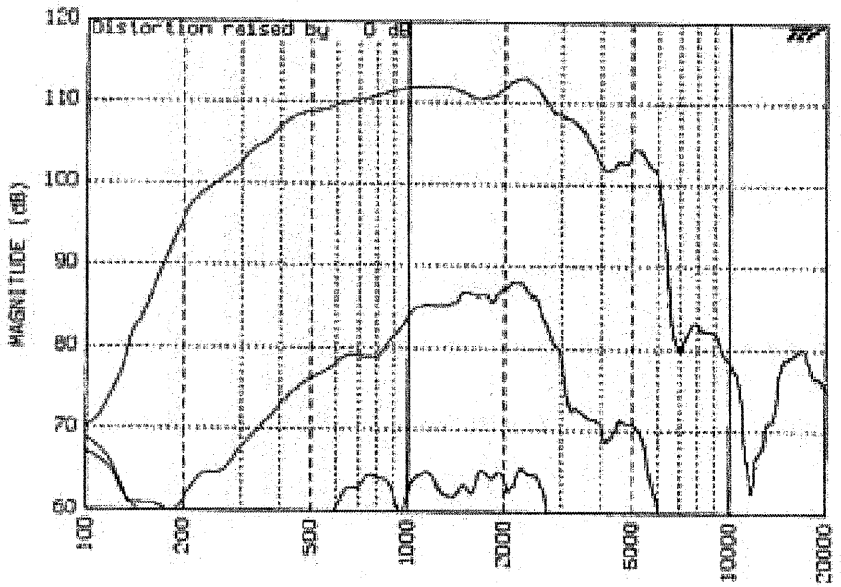
However, when these units are used as intended, their high efficiency means that low power amplifiers could be used effectively, certainly a major consideration when amplifier power was scarce and expensive. When devices such as these are used as part of high impedance distributed loudspeaker line, such as the UK standard 100 volt distribution system, this also has the advantage of presenting a small load to the feeding cable installation, allowing for long cable runs in cable of manageable proportions with minimal loss.

Of course, architects hate these things, and therefore for long throw applications a more aesthetically pleasing solution has to be found these days, and usually custom painted white!

Figure 6 shows the response of an alternative interpretation of the straight exponential horn, a properly designed re-entrant horn of high quality, with an air column length of 46" fitted with a good quality compression driver designed for speech applications.

With a decent compression driver, horns of this size also have a reasonable response down to the 250Hz region, allowing for some subjective warmth in the speech, making these devices not unpleasant to listen to for speech reproduction purposes. They certainly do not have the peaky, screechy sound so common to many public address systems.





Frequency Response (1W/1M)

Figure 6. Frequency response and distortion for proprietary 46" air column length re-entrant horn

As with all loudspeaker designs, care has to be taken with deployment of these re-entrant horns, if they are to be used to best advantage. The polar plots for the same re-entrant horn are shown in Figure 7. The unit is marketed as a "wide angle" horn. Although the polar plots demonstrate clearly that this is not the case, it is a useful device where a narrow dispersion angle and therefore good projection is required.

Despite the involvement of marketing departments, at least manufacturers are now making this type of data available for 'commercial sound' loudspeakers. In fact, the manufacturer of this particular device also includes EASE data on their website. This is becoming more and more common in the commercial sound sector. It may be a little later than this data became available for 'professional' sound products, but we now seem to be getting there. It wasn't very long ago it would have been ears and guess work to optimise system coverage, with no predictive material available. Even if the curves have been through the marketing department's patented "curve flattening" machine, it all helps.

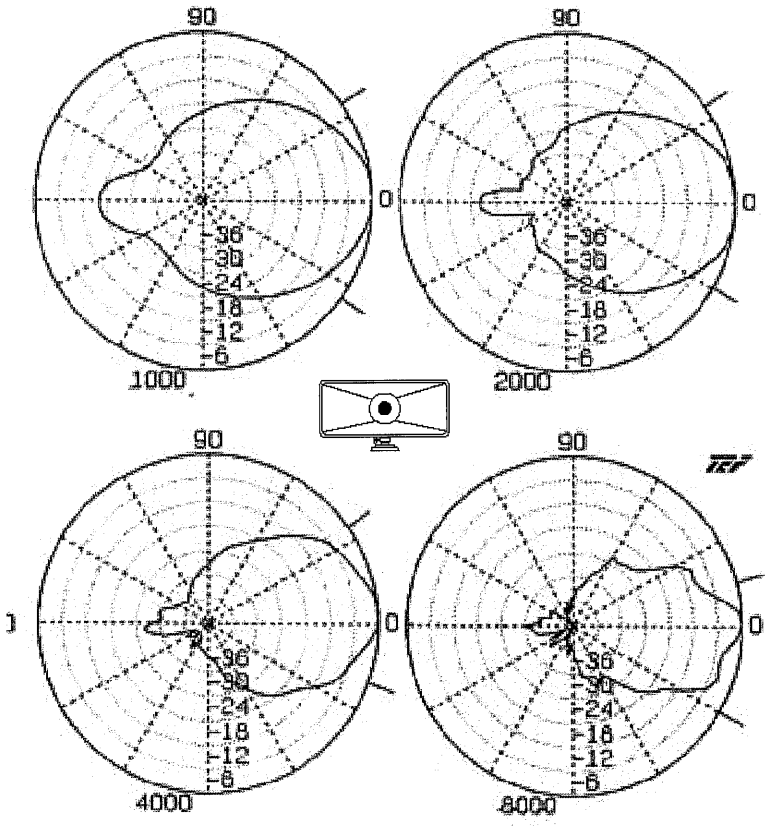


Figure 7. Polar response for high quality re-entrant horn.

So we have a more compact, architecturally acceptable device (when painted white!) for projecting speech over a distance, which when used with a 60 watt compression driver and correctly band pass filtered has a 1 metre maximum output of 128dB, or 94dB at 50m distance in ideal conditions. The trade off against the straight horn is an increase in distortion. Such a practical selection of device has not always applied on racecourses, however.

The revolting item shown in figure 8 is a small, 15watt re-entrant horn. For some reason these were very popular at one time on racecourses, used for everything from an internal loudspeaker in a

highly reverberant betting hall to an external long throw loudspeaker, two of which would be expected to cover an area of 50m by 50m. Tapped at 5 watts each, of course!

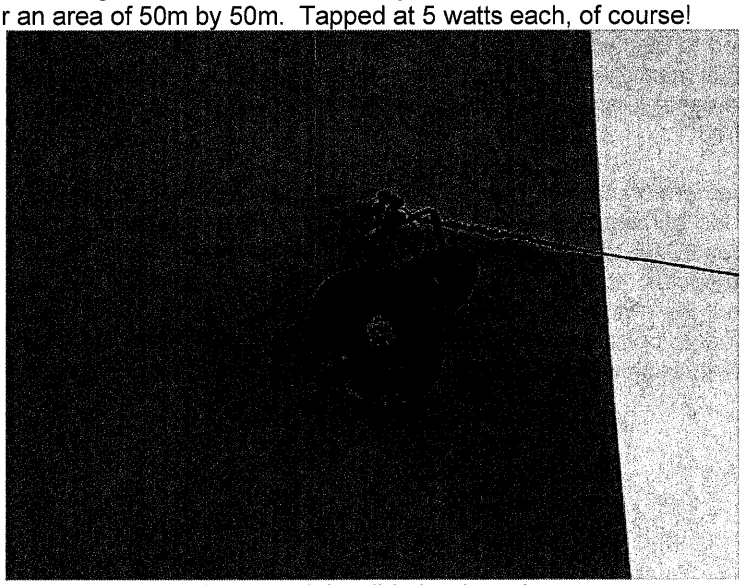


Figure 8. A horrible loudspeaker

3.4 PA under cover

Figure 9. Ayr Racecourse steppings PA cover

Racecourse grandstands have areas known as the "steppings", where the punters stand with their binoculars and watch the race, or these days, the big video screens. The listener is in much closer proximity to the loudspeakers in these areas, and therefore a subjectively softer, wider dispersion device is obviously required. These areas are often over hung by balconies or canopies, and are therefore semi-enclosed. Compression driven horns do not work well in this environment, as they sound subjectively harsh, and are usually of too narrow dispersion.

It used to be done as shown in figure 9. The loudspeaker cabinets shown hanging are housing paper coned 6" by 3" elliptical loudspeakers, tapped at 3 watts per pair of drivers in a V cabinet. This is actually a better example of the breed, usually only one of those cabinets would have been used for that size area. These are not the worst examples to be found on a racecourse. There are still in existence on some courses, heavily varnished wooden cabinets, containing KEF B200 bass drivers. A superb bass unit, but not much use over the speech band, with a response tailing off sharply at 3.5 kHz and a broadband sensitivity of 85dB/W/M. These would be tapped at 2 or 5 Watts, giving a maximum SPL of 92.5dB at 1m, or 72.5dB at 10m. Not very helpful, but used originally due to their weather resistant 'Bextrene' cones and rubber surrounds. There are examples of these loudspeakers being tapped at the heady level of 10 watts, when they would be used to cover (or not) distances of up to 50 metres!

With the shorter throw requirement, less efficient loudspeakers with a broader bandwidth can be used. For source to listener distances up to 15 metres, a preferred type of device is that which goes under the name of "Music Horn". These devices are generally small, cone driven horns or two way units, with a cone driver firing into a reflex horn, and a forward firing HF unit housed in the low frequency driver chamber. Not ideal for perfect time alignment, but for these purposes they work well. A sample response and polar diagram of the two-way type are shown in figure 8. Again, subject to the magic curve flattener, but you get the idea. With a little EQ, these can sound quite pleasant, and even make a reasonable hash of music reproduction. An example is shown in figure 10, with its response plots shown in figure 11.

When source to listener distances drop below 5 metres, small, single driver loudspeaker enclosures are used. These typically use a four inch weatherised cone loudspeaker, with response tailored for speech. Whilst not of particularly high audio quality, they do achieve good intelligibility when used correctly and within their limitations.

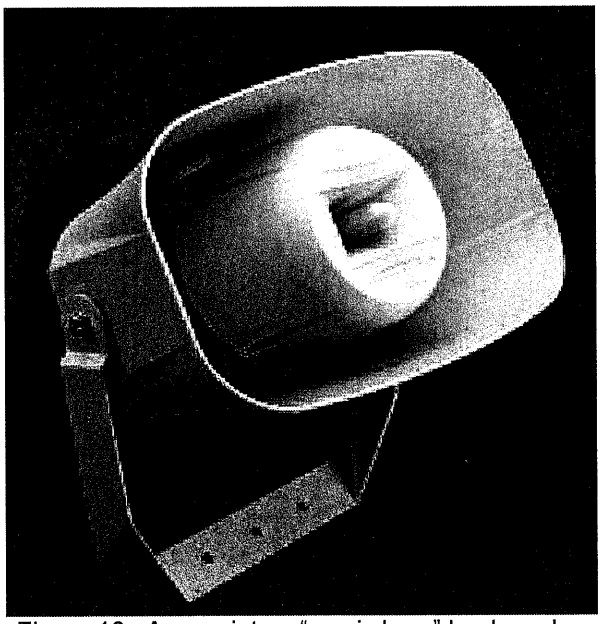


Figure 10. A proprietary "music horn" loudspeaker

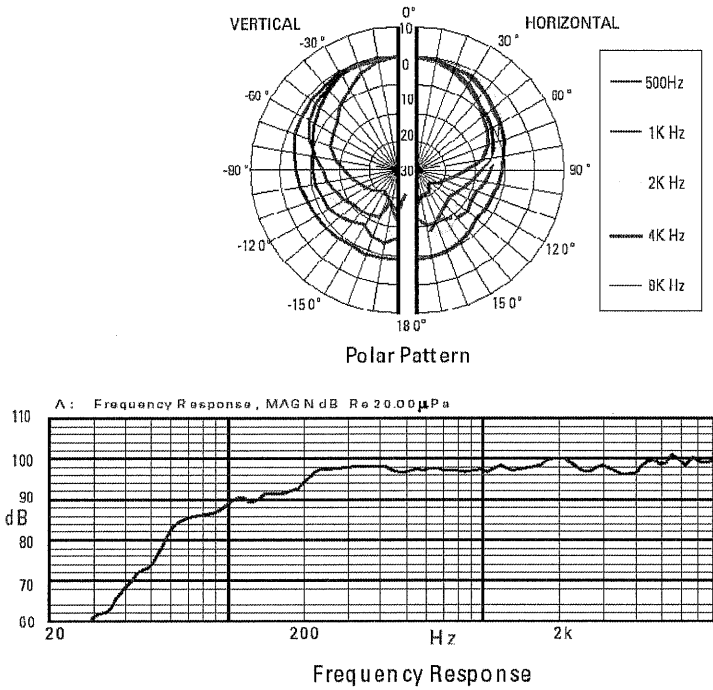


Figure 11. Response of proprietary "Music Horn" loudspeaker.

3.5 Case Study – Newbury Racecourse

Newbury is one of the UK's premier racecourses. Over the last five years, a rather aging and dilapidated loudspeaker installation has been replaced. This started with a new grandstand, shown in figure 12, built in 2000/2001. The first problem to cover the area in front of the stand was a distance of some 60 metres between the stand and the course, potentially full of punters. In this instance, we were able to install three full range, horn loaded loudspeakers of asymmetric pattern. At the bottom of the vertical pattern, the horizontal dispersion is 70 degrees, and at the top of the pattern this narrows to 40 degrees. This pattern is ideal in this particular arrangement, as you have a broader pattern in the nearer field, covering a wider area, and greater projection from the narrower angle for the far field.

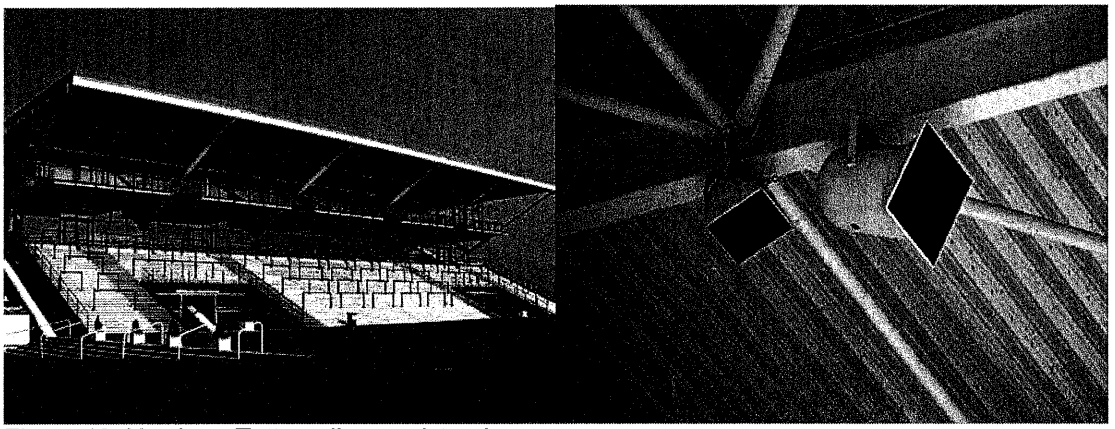


Figure 12. Newbury Tattersalls grandstand

Smaller two-way horn loaded devices were used to cover the stepped area out to the first five meters of the tarmac area, with 'music horn' units used as under balcony fill. This combination has resulted in extremely even coverage of the area, from 70 Hz to 10 kHz +/- 4db. The STI figures are given below, taken off axis of the loudspeakers, to give a worst case scenario.

Under Balcony	.65
Mid Steppings	.66
Front Steppings	.66
10m from stand	.66
20m from stand	.70
30m from stand	.59

The subjective quality of this system is obviously high, and is well suited for the occasional music reproduction which is called for on the front of this stand.

Once this installation was completed, it became very obvious that the only place on the racecourse where you could clearly hear the commentary and announcements was in front of this stand. And so, with a considerably smaller budget than was given for this one stand, the loudspeaker installation was replaced on the rest of the course.

The Hampshire Stand, shown in figure 13, was tackled with intelligibility the number one priority.

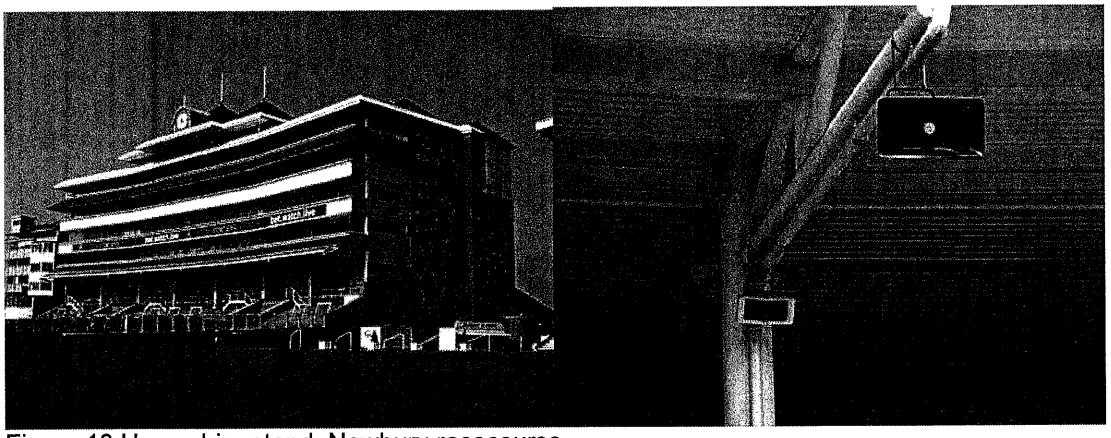


Figure 13 Hampshire stand, Newbury racecourse

Here at the front of the stand we see use of both the re-entrant horn discussed earlier, coupled with a 50 Watt compression driver and a single 4" cone driven 30 Watt 'music horn'. The loudspeaker you can see behind the pillar is a 6 Watt single driver device as mentioned earlier. The 'music horn' is used to cover the near field, the re-entrant the 45 metre distance to the running rail. The STI values achieved with this combination are as follows, again showing the worst cases.

Rear steppings (6 Watt devices)	.60
Front Steppings (30 Watt devices)	.59
Forward Horns @ 10m	.70
Forward horns @ 20m	.72
Forward Horns @ 30m	.73

As one would expect, the subjective audio quality is not as high on this stand, although the intelligibility is in fact higher, subjectively as well as measured.

3.6 PA Inside

There are often large, open bars and betting halls in racecourse buildings. Architects currently seem to favour large, flat surfaces such as tiled floors, rendered walls and plasterboard ceilings in these areas, which are no help when trying to install a loudspeaker system that will give intelligible speech reproduction, especially when the bars are full of people chatting, placing bets, scraping metal chairs across hard floors, etc. The first course of action when a drawing for a room such as this is seen is to ask the architect to refer to an acoustician before any further progress is made, pointing out to the consultant that the room needs to be suitable for amplified speech with at least a modicum of intelligibility.

Once the architect has ignored the consultant's advice because it's jeopardising his RIBA award for the building, it is usual to resort to a high density ceiling loudspeaker installation, in order to minimise the source to listener distance. There's not a lot else to be done in these situations. To be fair, the architect is usually persuaded to apply at least some treatment to the room, where it will not make to much aesthetic impact. Although figure 14 shows a room where all pleas for leniency were ignored! The treatment that seems to improve the acoustic environment in areas such as this the most is a decent carpet, as this not only stops the early reflections bouncing off the floor, but also stops the sound of clanking and scraping furniture.

Figure 14. Not a nice room for pleasant sound!

Apart from these nightmarish scenarios, other rooms are usually fairly favourable environments in which to install an effective audio system. Often in the constant search for extra revenue, the more comfortable areas of the grandstands such as restaurants, members' bars and private boxes are now multifunctional rooms. The open bars as described above are often used as exhibition spaces, the more comfortable areas are used for meetings, conferences and functions. These are therefore of a rather softer acoustic, and easier to deal with. Typically, STI levels of .58 and above are achieved in these rooms, with a response +/- 3dB from 125Hz to 8kHz.

In the larger new stands on major racecourses, centralized multi zoned systems tend now to be installed, allowing audio sources to be connected in each room and relayed through the installed loudspeaker system. These system are usually DSP based, and allow room EQ, and dynamics processing to be applied to each area, and give the ability to have control panels in each area to select audio sources and volume level. This may be old news to most of the professional audio

community, but has come as bit of a shock to the racecourses, which are more used to a 100 watt mixer amplifier stashed behind the bar and covered in beer (or champagne, depending on whether you are in a members or punters bar).

4.0 CONCLUSION

Although it was rather overdue, public address facilities on the UK's horseracing courses are being dragged slowly into the 21st century, by applying the same design techniques that have been used in this country for many years on high end audio installations, but never really applied in the so called 'commercial sound' market. Significant increases in quality and intelligibility are achieved without large budgets, to improve the overall experience for the race going public and the racecourse owners.

5.0 ACKNOWLEDGEMENTS

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