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ACOUSTICS BULLETIN

Institute of Acoustics

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Acoustics Bulletin Volume 48 No 3 May/June 2022

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Institute affairs

Features

Technical

Regular

Technical articles review procedure

All technical contributions are reviewed by an expert identified by publications committee. This review picks up key points that may need clarifying before publication, and is not an in-depth peer review.

The IOA is holding the International Conference on Underwater Acoustics 2022, 20-23 June 2022 in Southampton, UK. The conference will have a series of oral sessions covering a broad spectrum of international underwater acoustic research. Philippe Blondel will be talking about remote sensing, and YT Lin will be talking about underwater propagation. **icua2022.org**

The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society. The Institute of Acoustics is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels.

The Institute has over 3000 members working in a diverse range of research, educational, governmental and industrial organisations. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustic, engineering dynamics, noise and vibration, hearing, speech, physical acoustics, underwater acoustics, together with a variety of environmental aspects. The Institute is a Registered Charity no. 267026

Institute of Acoustics

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Dear Member

Education

One of the many functions of the Institute is its education provision. Our Diploma in Acoustics and Noise Control is the post-graduate qualification. It is ideal for those who are seeking a career in acoustics but whose first degree contained little or no acoustic content. It has to be remembered that attending a few lectures on the acoustics of a recording studio does not mean that the graduate is competent in environmental noise assessment and can successfully apply the requirements of standards such as BS4142. The Diploma provides that essential bridge and is a basis for becoming an acoustic consultant. Furthermore, it is a qualification widely recognised by acoustic consultancies.

Certificate of Competency Courses

The IOA also offers various Certificate of Competency (CoC) courses, including Building Acoustics Measurement, Environmental Noise Measurement, Workplace Noise Risk Assessment, and Management of Occupational Exposure to Hand Arm Vibration. We also offer a Certificate of Proficiency in Anti-Social Behaviour etc (Scotland) Act 2004 – Noise Measurements. Usually one week in duration, these courses provide attendees with skills in the particular topic. The course can be regarded as a form of entry-level qualification and a stepping-stone towards a career in acoustics. However, it is important to recognise the limitations of these CoC courses. Holding a certificate in Environmental Noise Measurement does not mean the person is competent in environmental noise assessment. Furthermore, having obtained a CoC certificate 10 or 20 years ago does not mean the person is competent today, unless they have been regularly undertaking the particular activity in the intervening period. This is because Regulations and/or Standards may have changed since the CoC course was undertaken. Consequently, it is important that we all ensure that we are genuinely competent to carry out a particular measurement or assessment.

The Institute is very grateful to our Education Committee and Education Manager who look after this area of activity. We are also grateful to Helen and Caitlin in our head office for their work in this area. Sadly, we must say farewell to Caitlin who is moving to pastures new. Thank you, Caitlin, and best wishes for the future.

New Certificate of Competency courses

Later this year, we are hoping to offer two new CoC courses. These will cover Technical Report Writing and Preparation, and an Advanced CoC in Report Evaluation. As those of you will know who have attended the 'Art of Being a Consultant' meetings, including the excellent event held in Manchester in March this year, I am a strong advocate of good report writing and how the skill of good writing is as important for an acoustician as being able to undertake, for example, good quality sound measurements.

Royal Charter

With the help of a small working group comprising Russell Richardson, Fiona Rogerson, Reena Mahtani and Chris Turner, the Institute has formally sent a 'Letter of Intent' to the Privy Council seeking leave to pursue securing Royal Charter status. This is the first step in a process to becoming a Chartered Institute. Please see Russell's article on page 62 for further information.

Institute Annual General Meeting

The next IOA AGM will be held in Glasgow on Wednesday 24th August 2022 just after the closing ceremony of Inter-Noise 2022. That will be the time for me to step down as President and hand over to Alistair Somerville, our current President-Elect. I will become Immediate Past President taking over from Barry Gibbs.

I am delighted to announce that Professor David Waddington has accepted Council's invitation to become our next President-Elect. David will formally start in his new role at the AGM. Formal notice of the AGM will be sent to members in due course.

In the meantime, best wishes

President

Engineering Division

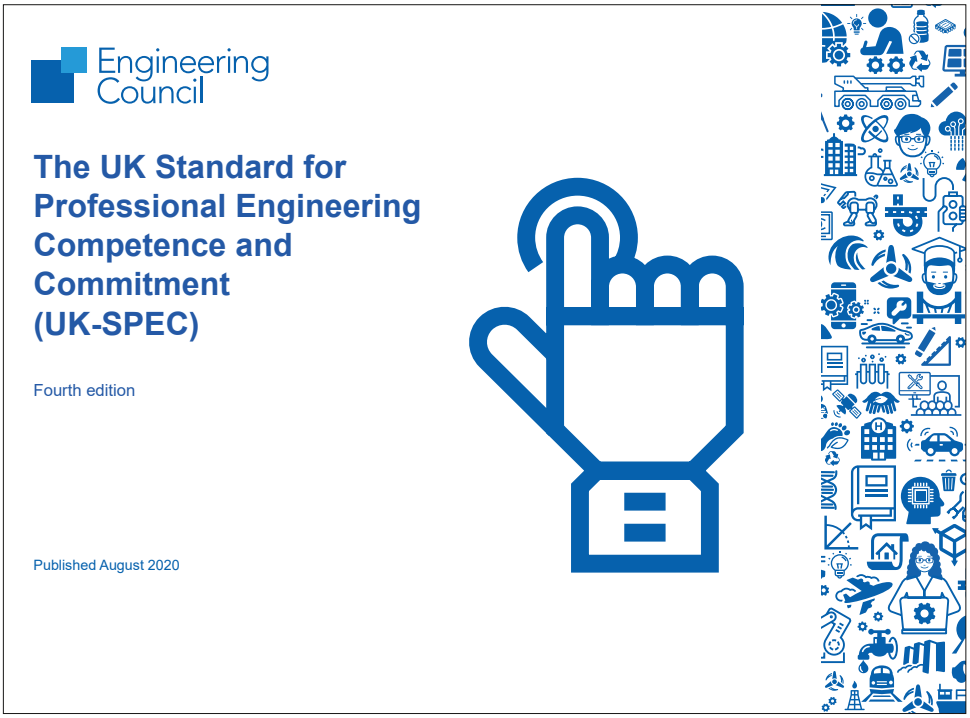
By Blane Judd BEng FCGI CEng FIET FCIBSE, Engineering Manager

The IOA Engineering Division will support you through the process to help you become one of almost 229,000 registrants that hold international professional recognition.

The most recent set of interviews took place on 6 April 2022. We only had two candidates for this session, which is partly due to a slowdown in the numbers who are completing their documentation, probably due to a return to a level of normality in the workplace. Candidates are provided with guidance material when they first apply, and we are always ready to comment on the content of their professional review report prior to them submitting the final draft.

The Engineering Council UK (ECUK) SPEC version 4 is the standard that we are using for all interviews and can be accessed from their website here: **https://www.engc.org.uk/ukspec**

Emma Lilliman is keeping response times down to a minimum while hybrid working between home and the office, and this mix is working well. Neil Ferguson continues to help us with academic equivalence support for those candidates who do not have recognised qualifications. You can check for yourself if your qualifications meet the required specification by visiting the Engineering Council website **http://www.engc.org.uk/courses**. But please don't panic if your specific qualification is not listed, as we can still help you through the process using individual assessment (see later in the article).



Interviews

We still have a few candidates working towards interview dates later in the year. As yet, our Engineering Council Liaison Officer, Malcom Carr-West, from the Institute of Agricultural Engineers, has not participated in interviews, but this is something we are working on.

We hold several interview events through the year, depending on the number of candidates we have coming forward for registration. If you are interested in taking the next step to becoming a professionally registered engineer, email us at **acousticsengineering@ioa.org.uk** sending a copy of your CV and copies of certificates and transcripts of your qualifications. It is important that we have all your further and higher education certificates, not just your highest attainment.

Confusion arises sometimes among applicants who have a Master's degree because they are still asked to follow the individual assessment route. This is because that while certain degrees have been assessed as meeting the requirement for UK SPEC version 4 academic attainment, some have not. It does not mean the qualification is not acceptable, but rather that the qualification does not appear on the ECUK database as recognised.

This could be because the university has not applied for recognition, or that it does not have enough students taking the course to mean it is assessed. In either case, applicants will be asked to follow the individual assessment route and we will seek an academic equivalence statement to satisfy ECUK. P8

Events for 2022/3

IOA events 2022

Organised by the Underwater Acoustics Group
ICUA 2022
20-23 June 2022
Grand Harbour Hotel, Southampton
https://icua2022.org/
(See more information on page 27)

Joint event with the University of Salford and UKAN+
Virtual Acoustic Prototyping: methods for predicting noise and vibration in complex structures
17-19 August 2022
University of Salford Research Centre
https://bit.ly/VirtualAcousticProto

Inter-Noise 2022
20-24 August 2022
SECC, Glasgow
https://internoise2022.org/

Organised by the Electroacoustics Group
Reproduced Sound 2022 (Auralisation and Personalisation – Beyond Reality)
15-17 November 2022
The Bristol Hotel, Bristol
https://reproducedsound.co.uk/

IOA events 2023

Organised by the Underwater Acoustics Group
5th International Conference on Synthetic Aperture Sonar and Synthetic Aperture Radar
6-8 September 2023
Villa Marigola, Italy
https://www.ioa.org.uk/civicrm/event/info?reset=1&id=718

11th International Conference on Auditorium Acoustics
28-30 September 2023
SNFCC, Athens Greece
https://www.ioa.org.uk/civicrm/event/info?reset=1&id=717

Other events 2022

Instrumentation, Analysis and Testing Exhibition
17 May 2022
Silverstone Race Circuit
https://e-i-s.org.uk/instrumentation-analysis-testing-exhibition-2022/

The EAA symposium on the acoustics of ancient theatres
6-8 July 2022
Palazzo della Gran Guardia, Verona, Italy
https://www.euracoustics.org/events/acoustics-ancient-theatres/
This event is organised by The Acoustical Society of Italy and the European Acoustics Association, with the collaboration of the Hellenic Institute of Acoustics.

IMA Maths in Music Conference
13-15 July 2022
Royal College of Music London
https://ima.org.uk/18115/ima-maths-in-music-conference/

12th Ibero-American Acoustics Congress
28 August-31 September 2022
Florianopolis, Brazil
https://www.fia2022.com.br/ingles/index.php

Other events 2023

NOVEM 2021 (Noise and Vibration: Emerging Methods)
Now 10-12 January 2023
Auckland, New Zealand
www.novem2021.ac.nz

Acoustics 2023
International Convention Centre Sydney (ICC Sydney)
4-8 December 2023
https://acoustics23sydney.org/

For up-to-date information visit www.ioa.org.uk

Without this, when we come to the point of registering, the Engineering Council may reject the application, so it is to avoid that occurrence that we use this process.

There are two routes to registration:

The **recognised qualification** route, if you have achieved the required learning outcomes through recognised qualifications in acoustics. Qualifications which provide the required level of knowledge and understanding are for IEng and accredited Bachelor's degree and for CEng an accredited integrated Master's degree or a combination of accredited Bachelor's and Master's degrees (see table below).

The **individual assessment** route, for applicants who do not have the recognised qualifications and who will have an individual assessment of their qualifications and any other relevant learning such as: formal academic programmes, in-employment training and experiential learning self-directed learning. In many instances, it is likely to be a combination of some or all these options.

Remember we are here to help you get through the process and advice and support is offered to every candidate personally.

For **individual assessment**, the Institute accepts several courses from certain academic centres in relevant subjects, such as audio technology, as being equivalent to accredited courses for the purposes of EC registration, without the need for further assessment.

The Institute recognises the IOA Diploma course and the several Master's courses linked to it as providing evidence if you are looking to gain CEng registration. You could also offer a PhD qualification, depending upon the content of the associated taught element. We can also offer support for registration via a 'technical report' route, if you do not have the relevant qualifications to help you demonstrate you are working as a professional engineer in acoustics. If you need to follow the technical route, we will discuss this with you before you embark on that process.

Election process

The election process is overseen by the Institute's Engineering Division Committee, which is made up of volunteers from the membership, to whom we are extremely grateful. They represent the ever-growing number of members holding EC registration. They provide the essential peer review process that affirms that you are at the appropriate level for recognition as an Engineering Council Registered Professional Engineer.

Incorporated Engineer (IEng) One of the following:	Chartered Engineer (CEng) One of the following:
An accredited bachelor's or honours degree in engineering or technology	An accredited bachelor's degree with honours in engineering or technology, plus either an appropriate master's degree or engineering doctorate accredited by a licensee, or appropriate further learning to master's level*
An accredited Higher National Certificate (HNC) or Higher National Diploma (HND) in engineering or technology started before September 1999	An accredited integrated MEng degree
An HNC or HND started after September 1999 (but before September 2010 in the case of the HNC) or a foundation degree in engineering or technology, plus appropriate further learning to degree level	An accredited bachelor's degree with honours in engineering or technology started before September 1999
A National Vocational Qualification (NVQ) or Scottish Vocational Qualification (SVQ) at level 4 that has been approved by a licensee, plus appropriate further learning to degree level*	Equivalent qualifications or apprenticeships accredited or approved by a licensee, or at an equivalent level in a relevant national or international qualifications framework†
Equivalent qualifications or apprenticeships accredited or approved by a Licensee, or at an equivalent level in a relevant national or international qualifications framework†	

* See: www.engc.org.uk/ukspec4th for qualification levels and HE reference points.

† For example, UNESCO's International Standard Classification of Education (ISCED) framework.

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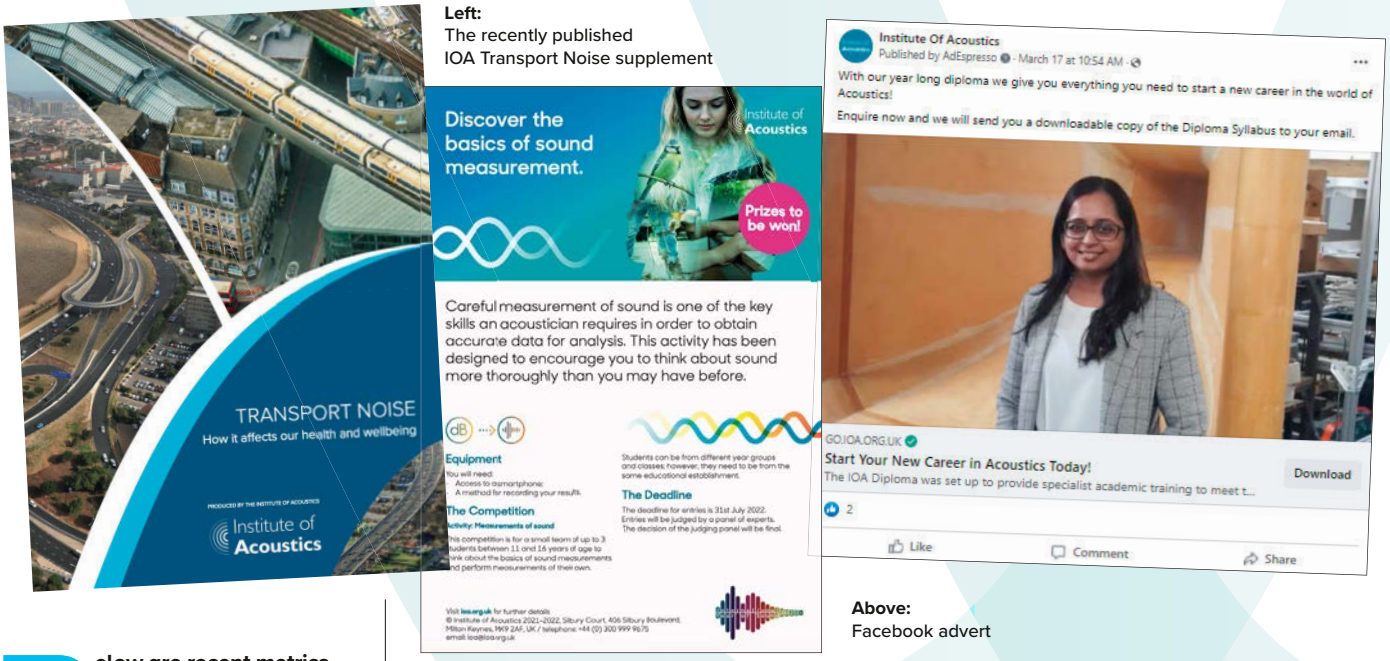
IOA website and social media marketing stats update

Alex Shaida, IOA's Head of Marketing, reports that IOA's marketing metrics over the past few years provides us with useful insights into digital activities, and recent analytics tell us how the IOA is expanding its reach.



Left:
The recently published IOA Transport Noise supplement

Above:
Facebook advert

Above:
Competitions 2022 flyer

Below:
Website metrics

Below are recent metrics based on the IOA's overall website activity (these are noted for January and February this year compared to a year earlier).

The numbers show us there has been a rise in the number of visitors to the Institute's website year-on-year. This can be partially attributed to an increase in digital marketing spend. Even though pages per session are down year-on-year in this snapshot of website activity (2.69 pages in January '22 compared to 3.66 in January '21), overall website usage is significantly higher.

The bounce rate (the percentage of users leaving the website after visiting their landing page) appears somewhat higher, which indicates traffic that was driven to the website was mainly looking for a single topic of interest and not necessarily perusing various topics. This isn't at all surprising, as new users (visitors) may be coming to the website looking for information on a specific event, a news item, or often due to interest in our training offerings, and they're not interested in other areas of the website at this point.

Where our paid traffic originates

The IOA invests in a combination of paid for advertising using Google AdWords, Facebook and LinkedIn ad platforms, and the Google AdWords campaigns is by far the largest driver. There are usually upwards of nine or 10 campaigns that run at any time. These cover different subject areas of the IOA website. See below a list of paid for clicks generated during the January to early March period 2022 as an indication of the different types of traffic being provided by the AdWords campaigns. P12

Digital reach	Users	New Users	Sessions	No. Sessions	Pageview	Page per Session	Average session	Bounce rate	New visitor	Returning visitor
Website traffic for January 2022	16,221	14604	23,520	1.45	63,243	2.69	01:45	62.83%	82.00%	18.00%
compare to										
Website traffic for January 2021	7,739	6400	13,575	1.75	49,662	3.66	2.4	44.08%	71.50%	28.50%
Website traffic for February 2022	17,639	16,013	24,645	1.4	56,737	2.3	01:23	68.90%	83.50%	16.50%
compare to										
Website traffic for February 2021	7,348	5806	13,463	1.83	45,131	3.35	2.32	46.53%	68.70%	31.30%

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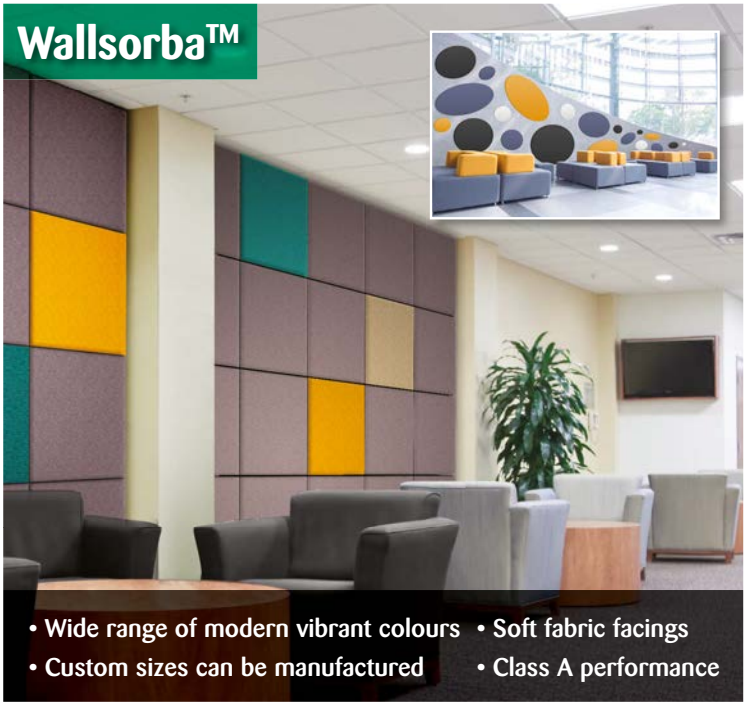

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- Class A performance

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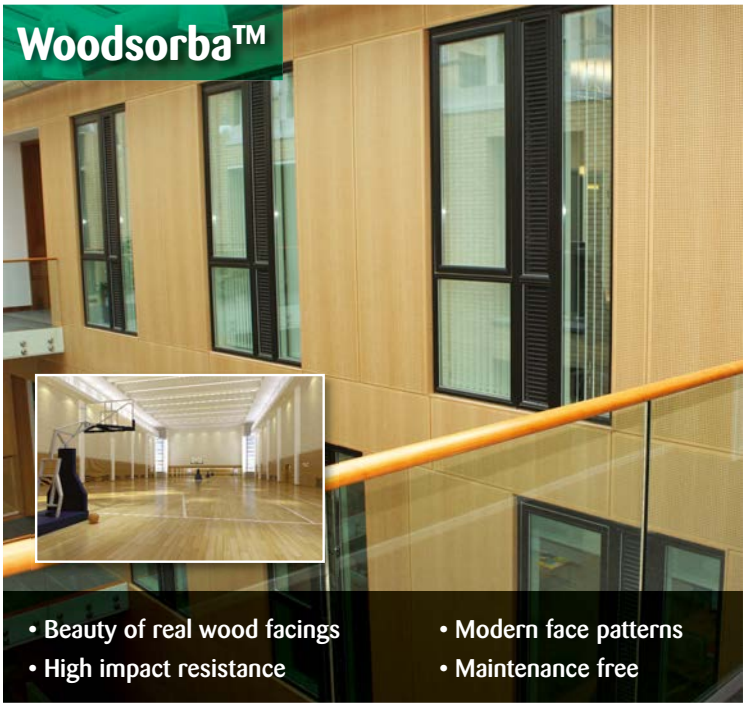

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Click activities using Google AdWords by individual campaigns (1 Jan to 10 March 2022)

- Underwater acoustics (search) – *517 clicks*
- Underwater acoustics (display to event website) – *3,889 clicks*
- Hear for Tomorrow – *795 clicks*
- Inter-Noise Search (to event website) – *5,879 clicks*
- Find a Specialist – *1,316 clicks*
- IOA Innovations and new Transport Noise supplement – *2,246 clicks*
- Job ads – *1,805 clicks*
- Diploma campaign – *1,162 clicks*
- Video awareness on YouTube – *21,718 engagements*
- Website membership, generic – *532 clicks*

In March 2022, the most visited pages on the IOA website (clicks to the page) were:

- Jobs in acoustics: 4,611
- Training, Diploma in Acoustics and Noise control: 4,570
- Membership: 1,631
- General education training page: 1,077
- Find an acoustics specialist or supplier: 1,014
- Events: 927
- IOA publishes the new transport noise supplements: 872
- Publications: 617
- Certificate of Competence of Environmental Noise Measurement: 443
- Recent Acoustics Bulletins: 440
- Central and London Branch: The Sound from Domestic Air Source Heat Pumps article: 428
- IOA launches primary and secondary schools' competition: 405
- Careers: 403

Social media

The use of social media has grown to become part of the IOA's digital footprint, and in the chart below we can see the growth of followers across main social media platforms over a period of six months.

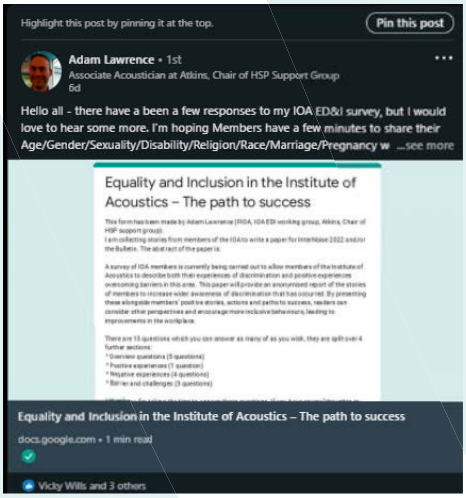
Although these figures are by no means exhaustive, they do provide a snapshot of the kind of interest that the IOA is receiving online. Apart from online marketing, there are ads running in trade publications and the response to these are much harder to measure.

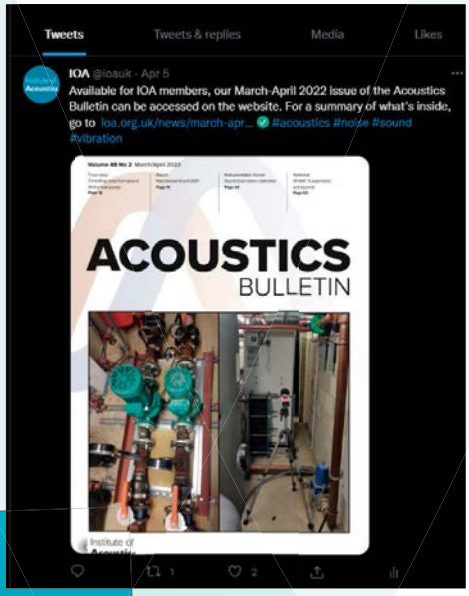
Focused marketing

Areas of marketing development in the months ahead will include focused educational campaigns mainly via digital media, promoting Inter-Noise 2022, other IOA-led events, our schools' competitions, pushing our various initiatives as an Institute and more.

Further marketing insights are planned in future issues of the Acoustics Bulletin. If you'd like to share any thoughts on the above, you can email us at **marketing@ioa.org.uk**

Below:
Social post





Above:
Social media posts

Left:
Templated meetings advert

Below:
Stats for IOA social media platforms

Social Media	Oct 21	Dec 21	March 22
Twitter	3439	3451	3468
Facebook page	1831	1887	1986
Facebook Group	1058	1062	1073
Buying and Selling FB	226	233	228
Linked in Page	604	705	875
Linked in Group	15246	15530	15805
Instagram	391	394	401
YouTube subscribers	568	623	656

Environmental Monitoring

The SV 307A is designed for long-term and short-term noise monitoring applications such as road and rail traffic, industrial plants or construction sites.

The station firmware has the functionality of advanced triggers that supports unattended measurements. A unique feature of the SV 307A Class 1 sound level meter is it can be calibrated remotely on site saving you time. The SV 307A is based on patented MEMS microphone technology covered by a lifetime warranty.

SV 307A

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Approved Membership Applications

The Membership Committee reviewed 106 application forms on 17 February 2022 at their meeting, which was held in person at the IOA HQ. 30 applications have recently been approved by the Council following the recommendations of the Committee. 66 new candidates have joined the IOA, and the remaining were members upgrading or being re-instated.

FIOA

Richard Grove

MIOA

Ben Cahill
Martyn Chambers
Nina Cherian
Kim Coleman
Ben Dawson
Pritham D'Souza
Adam Ford
James Geary
Rahiel Ghani
Christabel Goode
Keir Hannan
Chris Holmes
Chris Jones
Ross Latue
Sam Laws
Jonas Lopez
Ignacio Martin-Granizo
Mike McCabe
Bruno Mendes
Karen Mortby
Justyna Pitera
Viviam Reyes
Patryk Rowinski
Doug Shearer
Rasmus Sloth Pedersen
Sam Williams
Jacob Willmott
Adam Woolley
Sharon Yung

AMIOA

Adnan Alnajjar
Thomas Bergmanis
Kelvin Carray
Conor Chambers
Alex Champion
James Chrisholm
Chris Corradine
James Dennis
Andrew Dent
Aidan Duffy
James Gardner
Jennifer Glover
Daniel Gonsalves
Paul Gurney
Aarron Hamilton
Liam Harrison
James Hendley
David Hible
Sean Horsman
Aharon Horwich
Matthew Hunt
Aaron James
Thomas Jenkins
Kyungmin Kim
Joshua Large
Xiaoyi Li
Phil Lodge
Nagi Shing Lui
Jameel Malik
Rachit Manchalwar
Cameron Maskew
Thomas Mays
Euan McIntosh
Paul Monaghan
Brad Nicholson
Monika Pachla
Tim Patzke
Thomas Philip
Anthony Robinson
Andrea Rodriguez
Aleksandra Rogowiec
Ahmed Sheriff
Nicola Sim
Charles Southgate
Kartikeyan Subramaniam
Po Lai Tam
Ning Tang
Pawel Tatar
Jack Tunstall
Gunasekar Venkateswaran
Ewan Watson
Andrew Wood
Zijang Yang
Jimmy Yap

TechIOA

Tom Grove
Ellen Martin
Matthew Harper

Affiliate

Iwan Williams
Andrew Hayes
Harry Johnson

Sound Masking

from aet.gb ltd

Open plan offices benefit from Sound Masking

Cellular offices achieve better speech privacy with Sound Masking

Sound Masking is a cost effective solution to the problem of improving speech privacy in today's modern office environment. Best installed during office fit out but often installed as retrofit, Sound Masking from AET has improved the office environment for many international companies throughout Europe over the last 20 years.

In today's office speech privacy becomes a key aim and open plan offices can suffer from two speech problems:

- Other people's conversations can be an irritating distraction
- Confidential conversations can be almost impossible to conduct

Similar problems also exist in cellular offices. Apart from noise breakthrough via partitions, flanking over, under and around them, other problem areas include light fixtures, air conditioning systems and services trunking. Sound masking compensates for these problems.

An investment in increasing privacy of speech is certainly cost effective, with Sound Masking one of the easiest ways of achieving this aim. Sound Masking systems along with acoustic panels and acoustic door seals are increasingly used to achieve the desired level of privacy by a number of our major clients including:

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- BP

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Sound Masking is also known as sound conditioning or white noise systems

3,065* heads are better than one

In our new series of specialist Q&A columns we want to look at common day-to-day issues experienced by readers working in the diverse acoustics disciplines. We aim to provide solutions from different perspectives and in a language that doesn't use jargon, but makes sense to all acousticians, where ever their main interests lie.

We are offering an open ground to discuss old and new problems experienced by designers, environmental acoustic consultants and musicians etc.

We know that many IOA members share a great passion for music so, is it possible that we could resolve general acoustics problems by considering solutions for them from a musical perspective?

Or, vice-versa, could we solve musicians' problems with a pinch of expertise from the acoustic Jedi Masters? Hopefully, with a common language.

So, to **all musician members**, what are the problems that you face on a regular basis?

- Lack of clarity while rehearsing?
- Lack of intelligibility while you perform?
- Background noise ruining an important session?
- Poor acoustics in your studio?

Tell us about it, because those issues can often be resolved by just putting them in front of a fresh set of eyes. Our experts will answer your questions in print.

Send your queries to the editor, Nicky Rogers (**nickyr@warnersgroup.co.uk**) and we will print solutions or suggestions in the following issue.

*number of IOA members.

The deadline for your music questions is 31 May 2022 please and we will not divulge details of the questioner's identity.

IOA Early Careers Group webinar – indoor soundscapes

Diogo Pereira (BAP) reports on a presentation on indoor soundscapes given by Dr Simone Torresin from EURAC Research. This online event was organised by the IOA Early Careers Group (ECG) on 15 March 2022.

By Diogo Pereira

In the presentation, Dr Torresin pointed out that due to the COVID pandemic there would be an increase in ventilation requirements. This, together with the fossil fuel consumption of mechanical ventilation and sustainability policies, would increase the awareness and demand for the former.

Simply reducing noise levels from external sources increases human exposure to indoor noise sources, and, as such, using traditional decibel-based metrics is not enough to provide acoustic comfort within residential environments. It is here where environmental noise management is distinguished from the soundscape approach. The former manages sound as a 'waste' while the latter uses it as a 'resource'. This leads to the noise management approach working solely to reduce sound levels while the soundscape approach differentiates between wanted and unwanted sounds and encourages the decrease of unwanted sounds while also making use of the masking capabilities pertaining to wanted sounds.

If sound is used as a resource, it becomes fundamental to characterise human reaction to the surrounding sound environment. It can be then used to classify the design effectiveness, allowing for improvement and increase in both comfort and relaxation within the residential environment.

Listening test

Dr Torresin then designed a listening test where several indoor and outdoor sounds were played back and asked webinar participants to provide a rating on 97 attributes and their appropriateness to the surrounding sound environment. The principal component analysis showed that comfort, context and familiarity are the main factors affecting the total variance. Londoners seemed to find it more appropriate to have comfortable yet less engaging sounds for working from home while preferring more "comforting" sounds for when they want to relax.

Simone then presented an approach applied to indoor soundscapes, where it allows for consideration of both the indoor and outdoor soundscape design, context and noise sources. He also wanted to use sounds without causing health impacts. The researchers found that there should be a threshold, however this is highly activity dependant.

Room for a soundscape and noise control approach

The presentation concluded that there is a need for both the soundscape and noise control approach – the soundscape approach should be applied up to the activity-dependant threshold, while the noise control approach should be used when this level is reached; quoting Dr Francesco Aletta, "assessing an acoustic environment solely as loud or quiet is like 'judging a soup only by its temperature. Of course, if it's too hot, you need to know, but if you want to think about spices and flavour, you need a different approach."

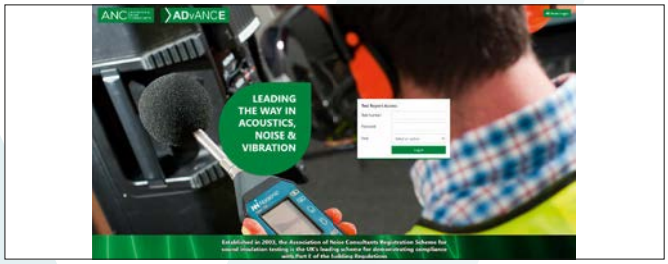
There was time for plenty of questions at the end of the presentation, as well as fruitful discussions on the role of the soundscape approach in consultancy.

The presentation was based on Dr Torresin's research for his PhD thesis, which was carried out in collaboration with Trento University and University College London. P20

Below: Sound, as a resource, can be used to classify design effectiveness, allowing for improvement and increase in comfort and relaxation within the residential environment

ANC launches sound testing CPD

The Association of Noise Consultants (ANC) has launched a CPD programme setting out the key issues around sound testing in buildings.



Approved Document E Sound Testing Registration Scheme,' has been produced by a cross-industry group of acousticians, to provide insight into the key factors surrounding this specialist area of property development.

Produced for building inspectors and other construction professionals with an interest in noise in buildings, the CPD can, depending on the situation, be delivered by ANC members in their local area if requested.

To arrange a CPD presentation please contact **info@theanc.co.uk** or approach your local ANC member.

The ANC provides independent verification of pre-completion sound compliance testing in the housebuilding sector, through its ADE (Approved Document E) ADvANCE Registration Scheme.

Providing pre-completion sound insulation tests in accordance with Approved Document E 'Resistance to the Passage of Sound' of the Building Regulations and its equivalent in Scotland, the ANC service meets these requirements to test new and converted dwellings for sound insulation. More than 500,000 tests have been recorded under the scheme.

Russell Richardson, Vice Chair of the ANC, is senior examiner for the ADvANCE scheme, he said: "Acousticians are regularly asked for more information on sound testing and with this in mind, we've drawn together experts from our membership to produce a CPD, which addresses the key issues.

"The ANC Registration Scheme for pre-completion testing was established in 2004 by members of the association, who wanted to make the process as streamlined, cost effective and straightforward as possible.

"Since then it has gone from strength-to-strength in the industry. Benefits include the ability, if required, for the ANC's registered testers to provide advice on overcoming problems which may be identified during the test.

"The mechanics of recording the test through the online ADvANCE system are also well-regarded.

"Clients are provided with a unique task number and password for every test undertaken using ADvANCE. This, with an ANC sound insulation test report, allows the Building Control Officer to verify the test has been undertaken by a qualified tester and confirm the results.

"The information is then included in all ANC sound insulation test reports and access can be gained of all the results for a site."

To search for ANC members registered to carry out pre-completion testing please visit **www.association-of-noise-consultants.co.uk/members-search**

The 'Art of Being a Consultant' series

After a two year break, an 'Art of Being a Consultant' event was held at Manchester Conference Centre in Manchester on 23 March. Tom Galikowski, Chair of the IOA Early Careers Group, and Josie Nixon report.

Above: Ed Clarke starts his presentation with a quiz

The Art of Being a Consultant is a long-running series aimed at young consultants, those new to the profession and students who are considering a career in acoustics. Presentations cover a wide range of issues that are bread and butter for any consultant.

All speakers are practicing consultants and their combined wealth of industry knowledge is extensive.

As usual, the event was kicked off by David Watts (AIRO) who – with the aid of a cake analogy – answered the question; 'what is acoustics consultancy?' Ed Clarke (a Managing Director at Clarke Saunders Associates) explained why quality matters and why is it important. Russell Richardson (Director at RBA Acoustics) dived deeper into some elements of doing the job such as the consultant's role, brief, or standards. Mike Hewett (Acoustical Control Consultants Ltd) built on that and explained the intricacies of working with teams, the importance of communication and expectation management along with some pitfalls to look out for when working with others.

Writing the report is a key element of the acoustic consultant's job and this part was presented by Stephen Turner (ST Acoustics and President of the IOA). Stuart Dryden (retired chartered engineer and acoustic consultant) spoke about the rules of the game and the ethics of consultancy, then Paul Shields (Head of Acoustics at AECOM) talked about significance of gaining professional recognition, CPD, and why it matters.

This year, the topic on negotiating contracts was presented in a form of a conversation with all of the presenters. The usual speaker, Mark Murphy, was unable to attend due to a last minute emergency but provided us with the key points for the discussion.

For the first time, we have welcomed a presentation on Equality, Diversity and Inclusion by the IOA EDI Working Group Chair, Angela Lamacraft (Principal Consultant at dBX).

The event was concluded by a panel discussion which allowed the attendees to ask questions to the speakers. The discussion continued in Joshua Brooks bar nearby.

The Early Careers Group would like to extend enormous thanks to all of the presenters for donating their precious time to share their knowledge and experience with the future acousticians. We would also like to thank Linda Canty and Chris Turner for the support off and on the ground!

The events are organised yearly on a rotation in London, Southampton and Manchester/ Salford. Next year the event will be hosted in London.

Upcoming events

Our webinar in May will be about obtaining a CEng status. It will provide information about individual competencies and how to provide suitable evidence. It is open to all members although the talk will be focused on consultancy where typical work duties make it difficult to satisfy the CEng requirements.

We are also busy planning a summer social at the end of June, which we hope to host in multiple places on the same day. Look out for announcements soon!

ECG vacancies

There are ECG vacancies at Central Branch, North West, Measurements and Instrumentation, Sound and Health, Research Committee and Physical Acoustics Group – if you are interested, please get in touch with the ECG or the relevant groups directly.

Come and join us

The ECG is open to all members of the IOA (both corporate and non-corporate) who shall normally be under 35 years of age or within first five years of their career.
The group is always keen to hear from members and non-members alike.
To join the Early Careers Group, to find out more information or to ask questions, visit **https://www.ioa.org.uk/early-careers-group**

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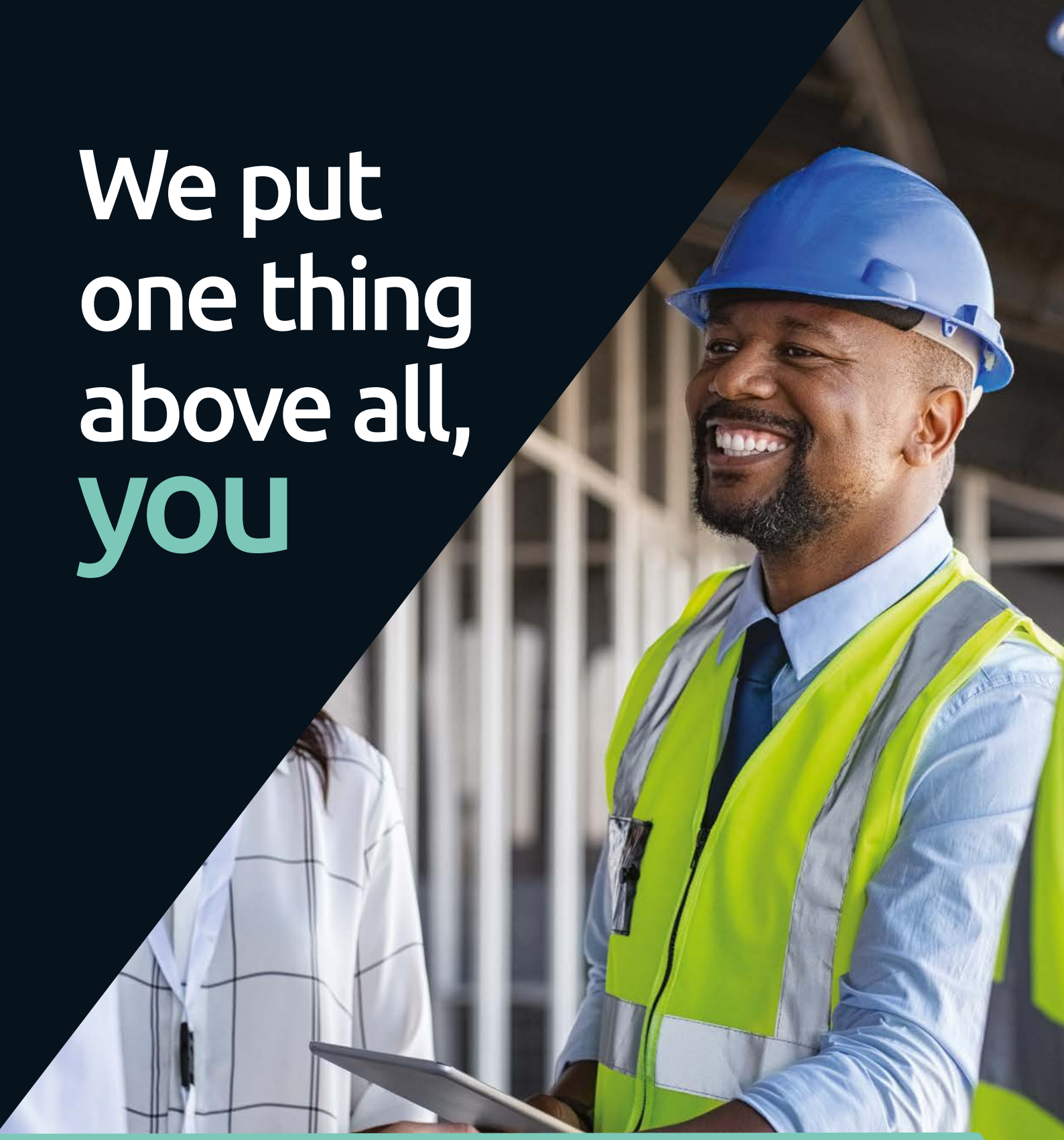

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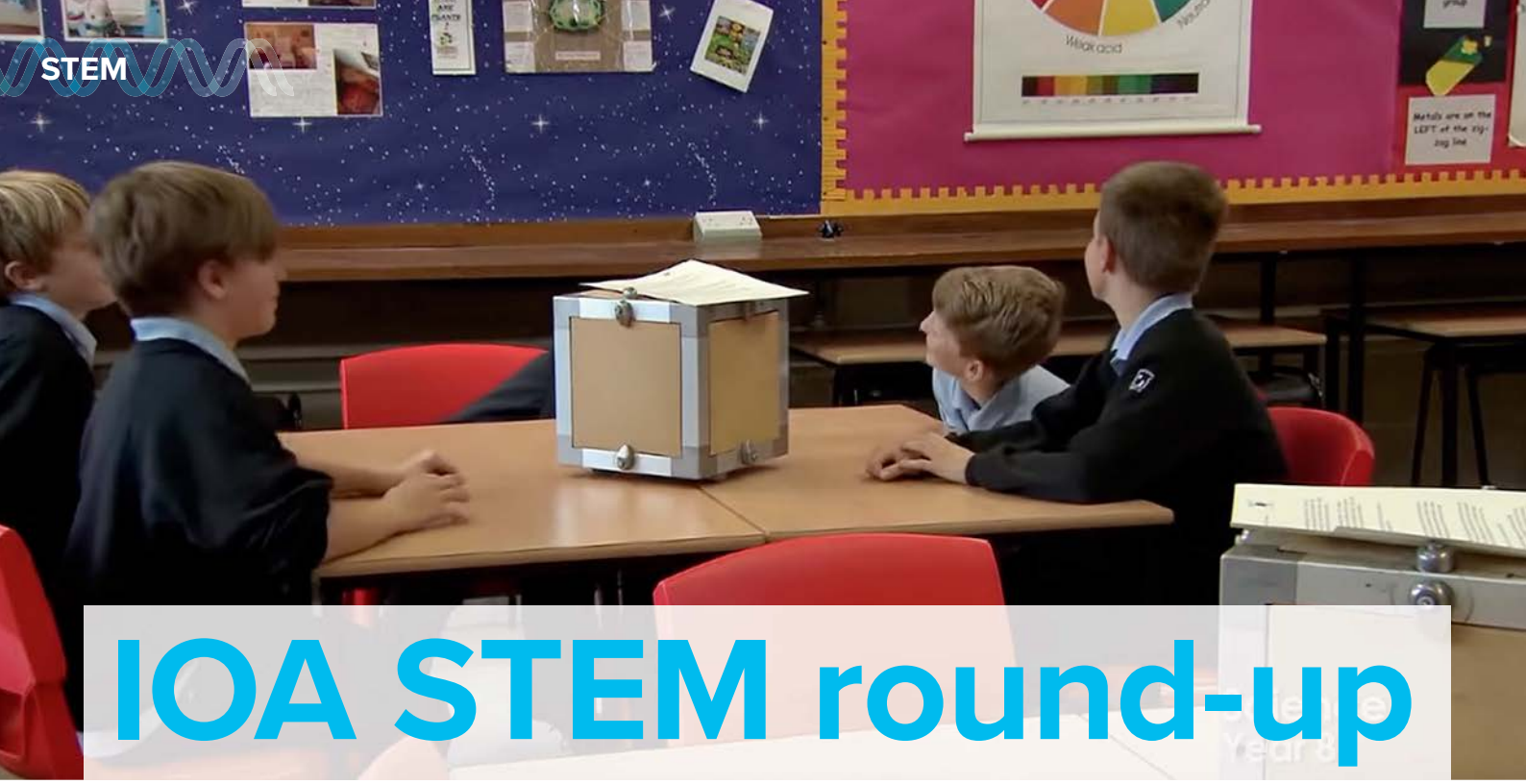

IOA STEM round-up

In this issue, we bring you a report of IOA STEM activity undertaken at British Science Week.

By Ruth Frost, Aecom

British Science Week took place between 11 and 20 March 2022 and was organised by the British Science Association, it provided a platform for STEM ambassadors to engage with the public, particularly school pupils.

To support British Science Week, Alex Krasnic and I were given the opportunity to use some of the IOA's STEM resources to promote acoustics to some secondary school pupils.

'You're Banned' – or 'Your Band' – take your pick!

On Monday 14 March, Alex and I visited The Marist School in Ascot to promote acoustics. One of the main highlights of the day was using the IOAs 'You're Banned' kits with the year 10 pupils.

The You're Banned kits allow students to investigate the sound-proofing of a rock band's practice room using a model test frame and sheets of various materials.

The kit consists of a cuboid frame and panels made of various materials. These materials can be inserted into the sides of the frame to create the walls, floor, and ceiling of the room. The aim of the exercise is to choose the best materials to soundproof the room. Once students have chosen their materials and set up their test rig, a speaker playing music is placed inside the test rig. The sound level outside the test rig room is then measured using a sound level meter to test how effective their choice of materials is. The test rig also includes a simulator for drums and bass so that the students must tackle the problem of both airborne and structure-borne sound.

The activity involves working within a budget so that the students come up with a usable and cost-effective solution.

The activity was run as a competition to see which group of students could soundproof the room most effectively. It was wonderful to see them so engaged in the activity and everyone got very competitive trying to come up with the best solution!

Further presentations

As part of the visit, we also gave a lunchtime presentation to year 9 to year 13 pupils about what an acoustic consultant actually does. We talked about what subjects we enjoyed at school, why we chose to go into acoustics and what we do day-to-day in our jobs.

In the afternoon we introduced some sixth form students to the basics of conducting sound surveys. We went through the key components of doing a survey with them such as identifying noise sources, what factors can influence the survey results and how to use a sound level meter. They were also introduced to the concept of 'A-weighting' when undertaking measurements. The exercise allowed them to apply their knowledge of sound that they had been taught in physics lessons at school to real-world situations.

As usual, if you have any questions about the above initiatives or just some ideas or comments on STEM in general, please get in touch at **STEM@ioa.org.uk**

Above and below: STEM ambassador, Emma Shanks using the IOA 'You're Banned' kits with pupils from Buxton Community School, Derbyshire

You're Banned kit information

If you are interested in using the You're Banned kits for acoustics-based STEM activities in schools, these can be booked through the IOA. There are currently at least eight working kits and some spare parts in case of any problems. It is recommended that the students work in groups of five or six to do the exercise. You can book the kits or get further information by emailing **Linda.Canty@ioa.org.uk** and you can see them in use here **https://youtu.be/4iTLSz0u6P8**

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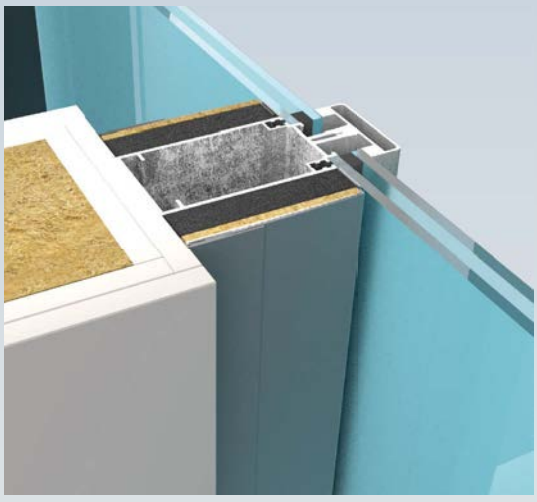

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Government policies

The IOA continues to actively monitor developing noise policy across the UK Government administrations and members respond to consultations highlighting areas where and how noise and acoustics should be considered. Mary Stevens, IOA Policy Support, reports on the most recent activity.

National Planning Framework for Scotland: The IOA Scottish Branch responded to the Scottish Government's draft National Planning Framework 4 (NPF4). When adopted the framework will set out Scottish Government's planning policies and priorities to 2045 and how their approach will help to achieve a net zero, sustainable Scotland.

IOA took the opportunity to highlight areas where noise and acoustics should be considered. Comments on the extensive document included noting that the policies on design, quality and place mention noise throughout the draft, with "vibration" only referenced in relation to minerals, and recommending that vibration is considered along with noise for all relevant development.

In considering heating and cooling policy to support the achievement of net zero and adaption to changing temperatures, IOA advised that both active and passive systems have potential noise impacts, and this should be accounted for in policy. Given some low carbon energy technologies are permitted development, there must be acknowledgement that noise should be considered in their deployment, as adherence to planning does not confer immunity to noise nuisance.

On health and well-being, IOA would like to see emphasis on promotion of sound and soundscapes as a positive resource, including in blue green infrastructure policy, rather than only as a problem to address. It is advised that the Agent of Change principle is acknowledged both to achieve delivery of high quality sustainable homes, and in the context of development for culture and creativity. Looking at low carbon living, urban edges and green belt it is noted that there is no acknowledgement of the Quiet Areas adopted under the *Environmental Noise (Scotland) Regulations 2006* or of strategic noise mapping outcomes, and these should be taken into account.

Read the consultation here: **https://www.gov.scot/publications/scotland-2045-fourth-national-planning-framework-draft/documents/**

Soundscape and biodiversity net gain: Defra have undertaken a consultation on how biodiversity net gain (BNG) will work in practice, for development under the Town and Country Planning Act and for Nationally Significant Infrastructure Projects (NSIP). For anyone unfamiliar with BNG, it is an approach to development, and/or land management, that aims to leave the natural environment in a measurably better state than it was beforehand. Peter Rogers submitted a response on behalf of IOA, drawing attention to the need to ensure that the value of natural soundscapes is recognised in planning given the restorative health benefits quality soundscapes can have.

The IOA response agrees with a proposal not to exempt development within statutory designated sites for nature conservation from the BNG requirement, given the important social and health benefits that can be gained by identifying areas where soundscapes are relatively undisturbed by manmade noise. In addition, the response advocates the value of improving soundscapes to support thriving biodiversity by contributing to breeding success, as well as sustaining human wellbeing by providing restorative places. For NSIP it is recommended that a soundscape assessment be included in a biodiversity gain plan, benchmarking the baseline and explaining what predictions for improving the quality may be over time.

Read the consultation here: **https://www.gov.uk/government/consultations/consultation-on-biodiversity-net-gain-regulations-and-implementation**

Continuing noise in Parliament about protests

In Parliament, MPs and the House of Lords continue to make a noise about noise, as (at the time of writing) they have failed to reach agreement on the Police, Crime Sentencing and Courts Bill. A major sticking point is wording around noisy protests. Following the Lords voting to support an amendment to the Bill removing wording giving police powers to halt a protest if it is causing a particular noise disturbance, MPs voted to keep it, albeit with slightly altered wording. Back to the Lords and it was thrown out again. IOA is maintaining a watching brief on the final outcome, to determine whether any input from the Institute might be appropriate. **https://bills.parliament.uk/bills/2839/publications**

About the author:
Mary Stevens supports the IOA to bring acoustics to the attention of policy makers.

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The 51st International Congress and Exposition on Noise Control Engineering (Inter-Noise 2022) will be held in Glasgow, UK at the Scottish Event Campus (SEC) from 21–24 August. The SEC is located in the west end of Glasgow city centre. The campus is accessible by numerous transport options.

KEY DATES:

1 December 2021	Call for abstracts
1 December 2021	Registration opens
4 February 2022	Abstract submission deadline
4 March 2022	Abstract notification
4 March 2022	Paper submission opens
28 March 2022	Paper submission deadline (requiring assessment)
29 April 2022	Paper submission final deadline
29 April 2022	Assessed paper submission final deadline following feedback
29 April 2022	Early bird registration for authors
8 July 2022	Early bird registration for non-authors

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International Conference on Underwater Acoustics

ICUA2022 International Conference on Underwater Acoustics | Institute of Acoustics | acoustics.ac.uk THE UK ACOUSTICS NETWORK | ASA ACOUSTICAL SOCIETY OF AMERICA | Office of Naval Research ONR Science & Technology

The IOA is holding the International Conference on Underwater Acoustics 2022, on 20-23 June 2022 at the Leonardo Royal Southampton Grand Harbour, West Quay Road, Southampton SO15 1AG. Following on from our ICUA2020 virtual conference, we are very much looking forward to holding an in-person conference this time.

The conference will comprise a series of oral sessions covering a broad spectrum of international underwater acoustic research. We have also planned these two plenary sessions:

- Philippe Blondel will be talking about remote sensing; and
- YT Lin will be talking about underwater propagation.

During the conference, Megan Ballard will receive her AB Wood Medal.

On the Monday evening there will be an Early Careers Group event where several companies working in underwater acoustics will be giving a series of short presentations. Conference papers are being submitted to POMA and the IOA to allow timely, editor-reviewed and open-access for delegates.

Social events

We are planning several social events for some informal and relaxed times. These include the conference dinner on the HMS Warrior in Portsmouth Dockyard, and tours around NOCS and ISVR, which provides a great opportunity to see their facilities and hear about some of their world-leading research.

The conference hotel is centrally located close to the main historic area of Southampton and many restaurants. The nearby ferry port offers regular sailings to the Isle of Wight.

We look forward to welcoming our friends and colleagues from all over the world.

https://icua2022.org/

‘Hear for Tomorrow’ – The first in-person event for two years!

The Royal Academy of Engineering hosted the 103-week delayed ‘Hear for Tomorrow’ event on 30 March 2022. This was the first in-person event post-Covid but did use a flexible delivery scheme with four presenters using Zoom. The capacity had to be reduced from 70 attendees down to 45 to maintain social distancing.

By Professor Stephen Dance

As we approached the Royal Academy of Engineering building on Carlton Terrace, London, two construction workers were drilling a hole in the pavement, which was rather apt given the coming event.

‘Hear for Tomorrow’ was jointly organised by the IOA with the newly formed UK Hearing Conservation Association (UKHCA) (**https://hearingconservation.org.uk/**) their first ever event.

Below: One of the presentations in a packed programme

The event had the support of the UK Acoustics Network (UKAN) **www.acoustics.ac.uk** with three special interest groups coming together:

- Communication and Room Acoustics,
- Hearing, and
- Biomedical Acoustics working with the IOA Musical Acoustics Group.

The day was split into two parts: a full day programme of presentations followed by an evening event centred around an exhibition.

Programme

The programme started with a welcome from **Professor Stephen Dance** (London South Bank University) who gave an overview of the sponsor, UKAN. This was followed by **Dr David Greenberg** (Eave.io), who explained the reasons for the formation of the UK Hearing Conservation Association.

Chris Steel from the Health and Safety Executive detailed the recent changes to noise regulations and the role of the regulator. To finish the first session, **Dominque Perrissin-Fabert** gave an overview of the journey the Royal Opera House had taken with regard to hearing safety.

The second session focused on ‘solutions’ and began with a two hander by **Dr Robert Shepheard** (James Paget Hospital) and **Dr Finola Ryan** (UCL Hospital). Dr Shepard gave a clinical view on a new tool used for the early diagnosis of otoacoustic emissions (sounds that are generated from within the inner ear), which had been used to assess the hearing of Royal College of Music students.

This was followed by Dr Ryan’s update on the new British Association of Performance Arts Medicine Hearing Conservation Guidance for the Performing Arts. Dr Tobias Goehring (University of Cambridge) then gave a virtual presentation (a Covid precaution)

on the technological improvements available in terms of hearing devices, in particular, machine learning to improve speech in noise. The session ended with a short discussion on the presentations.

During the afternoon the presentations continued on the theme of 'guidance'. In a change to the published programme, **Professor Dance**, gave a presentation on his otoacoustic emission testing with the Royal Academy of Music. He showed how the categorisation breakdown (normal, mild, severe) of the musicians closely matched the HSE guidance when the OAE tests were used, but with pure tone audiometry the results were favourably skewed.

This was followed by a presentation by **Dr Adam Hill** (University of Derby) on recently introduced WHO guidance on entertainment noise in an outdoor setting. He showed there was agreement around sound levels (LAeq, 15min 100dBA) for the audience with a wide discrepancy between countries, but at least a starting point had been set.

The final talk of the session before tea was an engrossing virtual presentation by an international presenter, **Professor Colleen Le Prell** (University of Texas) on 'noise induced hearing loss: pathophysiology, treatment and prevention', focusing on animal studies (rodents and monkeys).

The virtual keynote was given by another international presenter, **Professor Kathleen Campbell** (University of Southern Illinois) on the results from a new pharmacological solution to noise induced hearing loss, D-MET. Here she outlined the 23-year journey taken to test a pharmacological preventative measure, involving 7g per day dose per drill sergeant candidate, for an 11 day course, and a placebo in a randomised double blind study. At the US Army training camp, South Carolina, the personnel fired M16 rifles (600 rounds) using approved hearing protection to gain promotion in a competitive setting. Professor Campbell's experience of military processes and hierarchy emphasised the difficulty in running a medical trial.

Eventually, independently verified statistical data showed an 80% confidence in the treatment, not high enough for Federal Drug Administration approval, and this was due to a lack of test subjects. Professor Campbell explained that failing the tests resulted in immediate dismissal from the training camp, hence the lack of test subjects completing the prescribed course of medicine.

Above: Exhibition at the 'Hear for Tomorrow' event

The final thought-provoking presentation was given by **Dr Noe Jimenez** (University of Valencia) on brain therapy using acoustic holograms to treat neurological conditions with ultrasound, which was mind-blowing!

The daytime event ended with a discussion panel made up of the presenters talking about the future direction of hearing conservation and the association led by **Francis Rumsey.**

Networking opportunities

The evening session opened with canapés and drinks. This allowed for an informal brainstorming session to bounce ideas around on future events and direction of travel for UKHCA, and to browse the exhibition stands:

- Minuendo showed their new lossless musician-focused multi-filtered earplug.
- Casella brought their latest Bluetooth-enabled octave band dosimeter, and
- Path Medical/Hearing Coach demonstrated their otoacoustic emission hearing assessment instrumentation.

Feedback has been very positive, the event brought people together and many new contacts were established between delegates. The future of the UKHCA seems secure.

Left:
A recent specialist module tutorial in Bristol

Below left:
From the introductory video for the Diploma outlining the GPA assessment

Below:
From the introductory video for the Diploma outlining the structure

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supported by optional attendance at 11 tutorials (5 GPA, 4 specialist, 2 revision) requires attendance at 4 days of lab school and 2 days of written exams in June.

Institute of Acoustics

Diploma tutors wanted!

The IOA Education Division needs more suitably qualified people to become distance learning tutors for the Diploma.

Although we have an excellent group of tutors at present, the IOA policy is to expand the numbers of tutored distance learning candidates based in the UK and overseas, and this will be difficult without overburdening the current tutors.

Since the Diploma is a vocational course, including reviews and discussions of relevant standards, guidance and best practice, candidates benefit greatly from having practising consultants as tutors, but this doesn't preclude tutors from higher education institutions or other professions with sufficient fundamental knowledge and some acquaintance with professional practice.

Expected responsibilities

New tutors don't have to generate tutorial materials from scratch, since they can take advantage of the existing comprehensive course notes and base their tutorials on recently completed blended learning videos. Moreover, the tutorials don't have to be face-to-face. It's possible to deliver some tutorials online.

Ideally, tutors should be willing to tutor the General Principles of Acoustics Module, the Project Module and at least two of the Specialist Modules (Building Acoustics, Noise and Vibration Control Engineering, Environmental Noise Measurement, Prediction and Control and Regulation and Assessment of Noise). This could involve up to 11 tutorial sessions in a Diploma year plus email and/or telephone help in response to requests from candidates. Where enough tutors with complementary expertise are available, we could arrange for the tutorials to be shared.

If the total activity involved with being a Diploma tutor might be too much, then interest in becoming a tutor only for Diploma projects would be welcomed. This involves helping candidates to find an original topic or a new slant on an old topic, giving feedback on the initial project proposal, the draft final report and marking the final report guided by a comprehensive marking scheme.

If you are interested and able to offer your (paid) time supporting our candidates either as a Diploma tutor or in a project mentor capacity for the next academic year 2022/2023, please do not hesitate to contact the Education Team at **Education@ioa.org.uk**

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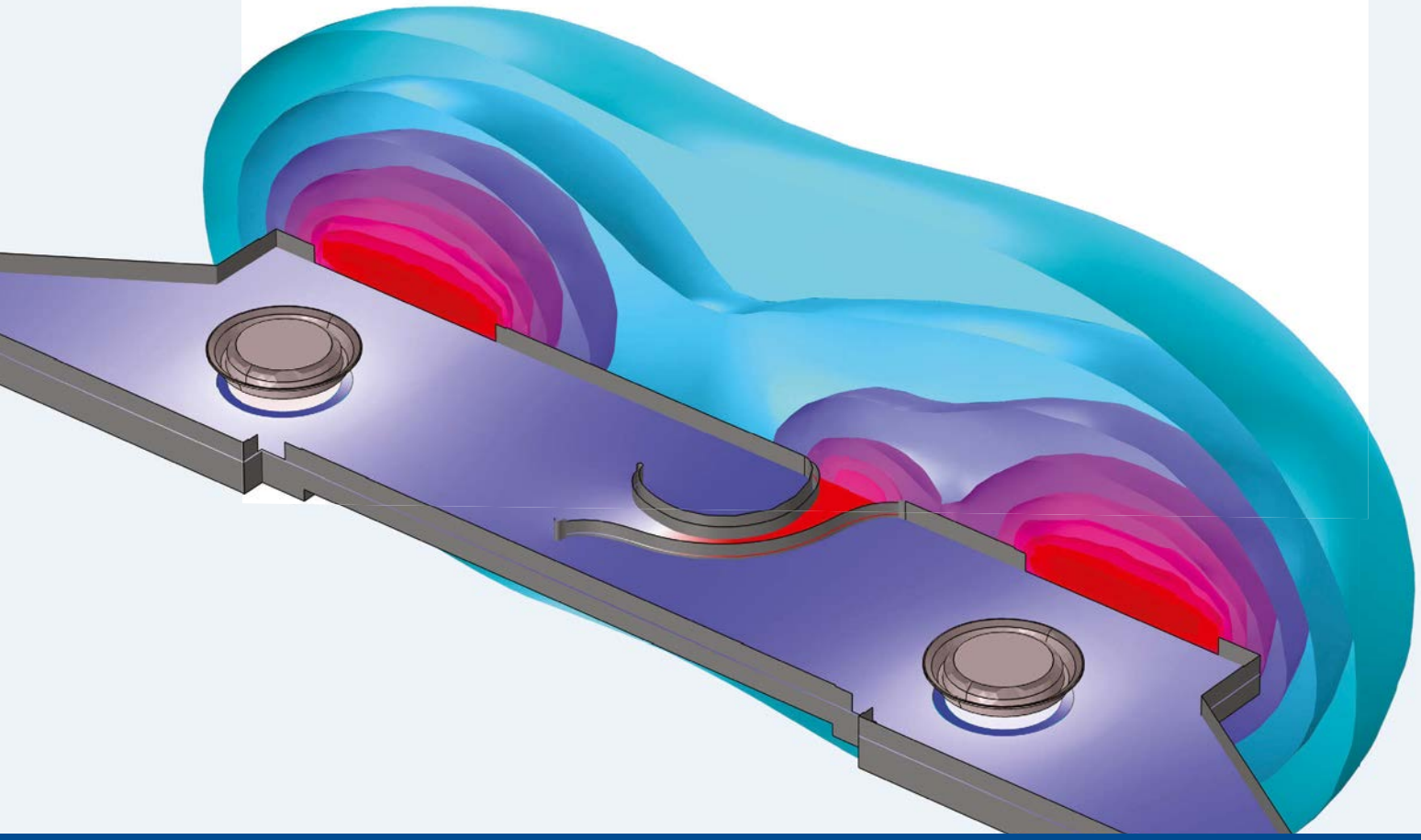

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Blowers on sewage treatment works

By Richard A Collman and Mike Hewett

Many modern sewage processing technologies require large volumes of air to be forced under high pressure through mixtures of sludge and water to provide oxygen for active beneficial microbes and to backwash filter media. This air is provided by blowers, which generate much higher levels of acoustic energy than fans because they provide the required airflow at a much higher pressure (typically between 100 and 1,000 times greater than a fan).

As a result, the blowers are usually supplied with acoustic enclosures and/or installed inside acoustically well insulated buildings. However, they also introduce pressure pulses into the air, which then flows through extensive networks of exposed, often elevated, pipework.

Because of the high pressures involved, the pipe network is effectively directly connected to the blower because, even if a 'flexible' connection is fitted, it will be rigid at these operating pressures. Acoustic energy is therefore transmitted by the blower to the pipework both via the pulses in the air and vibration of the blower itself. This acoustic energy is then radiated as sound from both the blowers (whether enclosed or not) and the pipe network.

Sewage works are necessarily located close to centres of population and have often been in the same location for many years with houses subsequently being built around them. This means that numerous dwellings may be in relatively close proximity to the works, which can result in many noise-related complaints.

The problem

Blowers typically produce high levels of tonal sound in the upper part of the low frequency range i.e. the 80 to 315 Hz one-third octave bands. The tones generally have a harsh character with many harmonics. The load on the blowers varies depending on sewage flow rates through the works and the requirements of each stage of the process. These load changes are accommodated by operating units at variable speeds and bringing additional units on/off-line as and when required. As a result, the sound emitted by an installation can contain tones at several different frequencies at once; including harmonics. In addition to the prominence of the tones, their variation in frequency with time increases their potential intrusiveness.

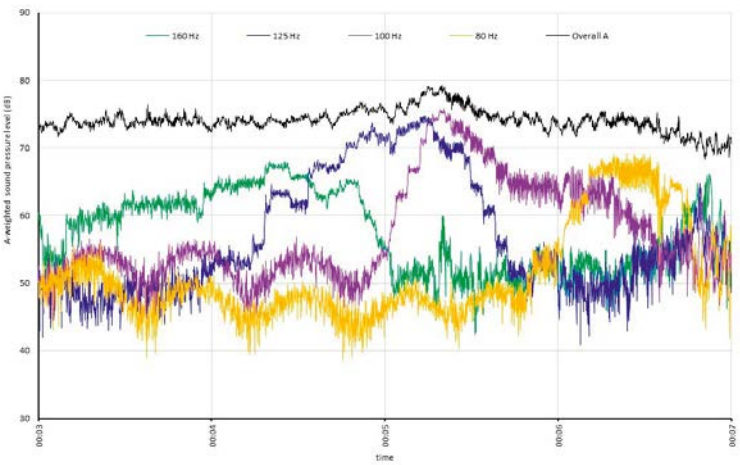
When two or more blowers operate at the same nominal speed, there will inevitably be slight differences in the actual speed of each. This can result in amplitude modulation, 'beating', in the combined sound from multiple blowers. For two blowers, the modulation is simple harmonic, rising and falling regularly; typically over a few seconds. For three or more blowers the modulation is more complex, rising and falling to differing levels with a less apparent pattern, often over longer periods of time. The amplitude modulation increases the perceptibility and potential intrusiveness of the sound.

Figure 2 shows A-weighted time histories of the overall level and four adjacent third octave bands measured over a four-minute period at a point 25 m from a group of five blowers. Tones can be seen to track through the four bands as the blower speeds vary. The levels also modulate with several different periods at the same time.

Tones in the range of frequencies produced by the blowers present a particular problem with residential buildings because typical domestic thermal double glazing has its

Below:
Figure 1: A blower installation with an operator designed rudimentary acoustic screen

Below:
Figure 2: Typical varying and modulating tones

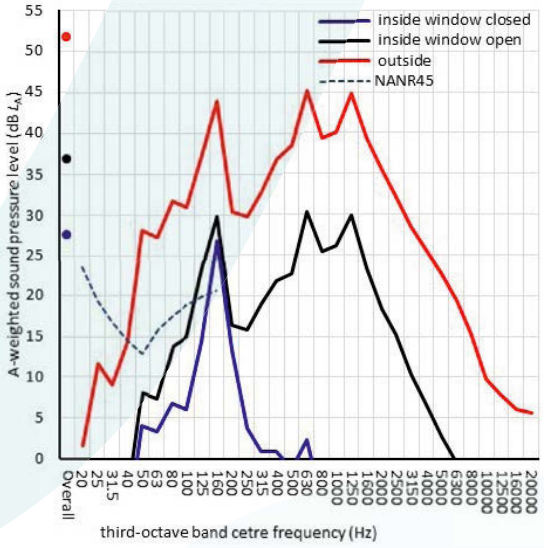


lowest sound reduction index values between about 160 and 200 Hz and the sound reduction through a partially open window is at its lowest between around 125 Hz and 315 Hz. In fact, both arrangements typically result in similar levels of sound reduction in these frequency ranges, in the mid-teens dB.

Figure 3 shows three A-weighted third octave spectra measured at the house shown in the background on Figure 1. The red spectrum was measured immediately outside the house, the black spectrum was measured in an upstairs bedroom with the window partially open and the blue spectrum was measured with the double-glazed window fully closed.

The blowers on this site were emitting several tones evident on Figure 3 in the 160 Hz band.

Below:
Figure 3: Low frequency tonal sound in a bedroom



The tones apparent in higher frequency bands were emitted by other items of plant on the site and were the most audible sound outdoors. However, the frequency-dependent nature of the sound reduction into the room meant that with the window partially open; the tone from the blowers became relatively more significant and with the window closed became the only sound audible in the room.

There is also the possibility of standing waves caused by coincidence of room dimensions with multiples of half wavelengths (for 80 Hz ≈ 2 m and 160 Hz ≈ 1 m etc.), which might further increase the level and noticeability of the sound indoors.

The standard method for the assessment of this type of sound is BS 4142. However, this standard should be applied with great care in this situation. The BS 4142 method is based on outdoor measurements and the character corrections used to derive the rating level are based on how the sound is experienced outdoors.

As BS 4142 notes, BS 8233 provides more relevant guidance for indoor sound levels. However, this is for 'innocuous' sound so will underestimate the impact ofthe blower sound for the reasons noted above. The character of the sound experienced indoors can be considerably less "innocuous" than that experienced outdoors.

Therefore, a BS 4142 initial estimate of impact based solely on the difference between the rating and background sound levels outdoors is unlikely to give a good representation of the real impact and must be reviewed to take account of the context in which the sound is actually experienced.

As a result, guidance from other standards, contextual analysis and subjective assessments will always form an essential part of the evaluation of potential blower noise impacts and complaints.

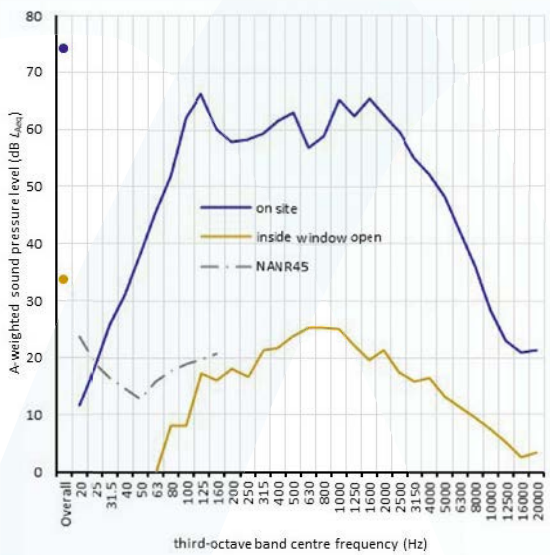
Proving the absence of something

In many cases; the sound produced by the blowers is clearly audible at the sewage works' site boundary, particularly at sites which do not have residences very close. The sites are often large, very evident and may already be the focus of community discord due to odours, lengthy construction projects and sewage (sludge) delivery vehicles. This can lead to the blowers being put forward as the potential source of unexplained or generalised drones, hums and community noise affecting areas some distance from them. This puts water companies and their consultants in the difficult position of trying to establish whether the blowers are actually contributing significantly to the sound at these remote locations or, even more problematically, trying to prove the absence of a connection.

At one large sewage works on the outskirts of a city, a long series of complaints had been received from homes over 2 km away. The area is criss-crossed with major roads and there are numerous other industrial, commercial and distribution facilities surrounding the site.

Figure 4 shows third octave spectra measured simultaneously close to the blowers and inside the complainant's bedroom over a half hour period during which he claimed that the disturbing sound was present. He described the sound as "a low rumbling...roaring". The measurements inside the house were made in an upstairs bedroom on the side of the house facing towards the sewage treatment works (STW) with the window partially open, as these were the conditions under which the complainant claimed that the sound was at its worst. The survey night was chosen to so that there was a gentle wind blowing directly from the STW site to the house, giving optimum propagation conditions. P34

Below:
Figure 4: Third octave spectra measured simultaneously on site and at the complaint location



Subjectively the sound inside the room contained contributions from many sources, including major and minor roads, industry and occasional trains and aircraft. The distinctive sound of the blowers was not perceptible to the acoustician making the measurements, but the complainant was adamant that he could hear it.

Figure 4 shows significant peaks in the on-site blower sound in the 125, 1000 and 1600 Hz third octave bands. The sound inside the house appears to be dominated by mid-frequency broadband sound that correlates with the subjective experience, which was dominated by road traffic noise. There is evidence of a minor peak in the 125 Hz band, although it does not appear to meet the BS 4142 criterion for a prominent tone and has an absolute level below the appropriate NANR45 low frequency noise criterion. However, this needed to be investigated further to establish whether the blowers could be its cause.

Long-term, unattended monitoring was put forward as a potential method of investigation. However, this would be unlikely to yield meaningful results in a soundscape with many potential sources. In complex soundscapes there is no substitute for ears on the ground. What was required was targeted, attended measurements made in very carefully managed propagation and plant operation conditions.

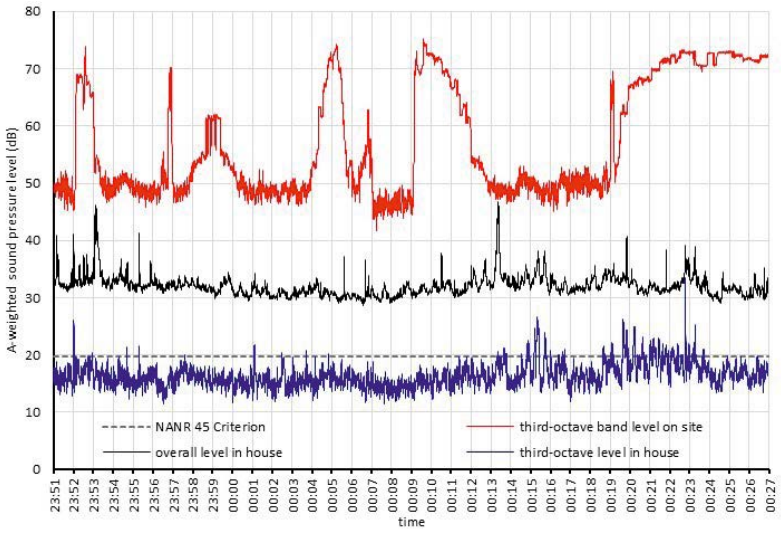
This necessitated waiting for ideal weather conditions for propagation from site to receptor and controlling flows through the STW to create a range of loads on the blower system.

One potential method to would be simultaneous narrow band (FFT) measurements. However, the tones produced by the blowers are not constant in frequency and the distances involved would result in a six second delay between the sound leaving the STW and arriving at the house. As a result, narrow band analysis would be likely to require extensive processing of large data sets without yielding any conclusive information due to the various uncertainties associated with the site conditions.

The most appropriate method of establishing a potential connection was to look for evidence of the large level variations in the tones produce by the blowers in the sound measured at the house using simultaneous third octave time histories. The use of third octaves kept the data set to a manageable size and avoided the potential complications resulting from the continuous small frequency changes.

Figure 5 shows synchronised time histories of the 125 Hz third octave band levels measured at the site (red) and inside the house (blue), along with the overall A-weighted sound level inside the house (black) and the 125 Hz band NANR45 criterion for low frequency sound (A-weighted).

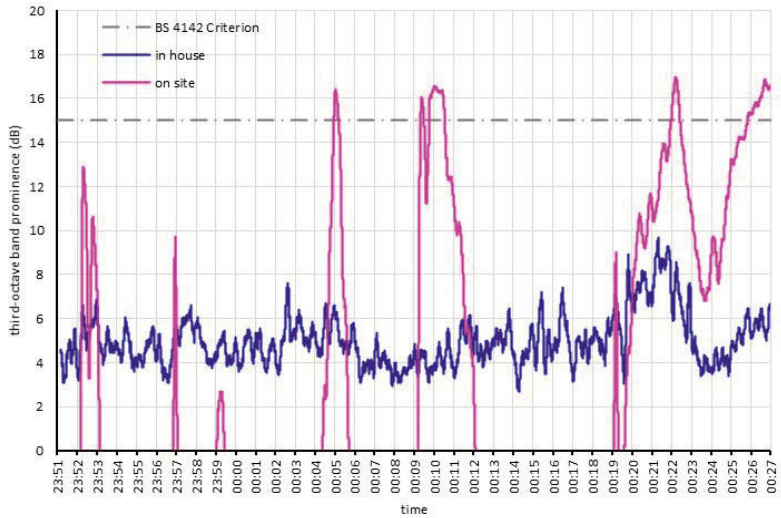
Right:
Figure 5:
Comparison of simultaneous 125 Hz third octave band time histories



The red line shows several periods when the levels measured in the 125 Hz band on site increased significantly. These features are not evident in the blue line measured in the house. There are possible, very subtle, increases of around one or two dB at 23:52, 00:05, 00:10 and 00:00. But there are similar increases at other times when the level measured on site was reactively low. A similar exercise was also carried out for the other third octave bands of potential concern to test for any correlation as the operating speed and frequency of the blowers' changes.

Further conclusions can be drawn by comparing the prominence of the third octave band (the amount by which the band level exceeds the average of its two neighbours) at the two locations. Figure 6 shows time histories of the prominence of the 125 Hz third octave band in the measurements made on site and inside the house. P36

Right:
Figure 6:
Comparison of 125 Hz band prominence time histories at site and house



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There appear to be very subtle potential correlations in the prominence time histories around 23:52 and 00:22 and these coincide with on-site sound pressure level increases visible on Figure 5. However, there is no apparent correlation during the other significant on-site level increases at around 00:05 and 00:10.

From the two figures it can be concluded that the very highest sound levels generated on site in the 125 Hz band resulted in contributions inside house no higher than around 10 dB below the residual sound. This would indicate a contribution of around 6-8 dB L_A at these times and lower than -15 dB L_A at other times. It is therefore clear that blowers are not making a significant contribution to the sound which is disturbing the resident.

What to do about it

At another site, new blowers were installed, having been selected primarily for their effective inlet air filtration, which was required due to the characteristics of the site. Once they were operational, complaints were received from residents approximately 125 m away. An acoustic survey was undertaken, but it was not possible to gain access to the complainants' dwellings so the level and character of the sound in the sensitive bedrooms to the rear of the houses had to be estimated from measurements made outdoors.

This data, together with analysis of measurements made close to the blowers and elevated pipework indicated that the most significant source of sound at the dwellings was probably radiation from the pipework rather than from the blowers themselves. The most significant radiation came from larger manifold piping and the numerous tee connections in that area. The smaller diameter branch pipes above the tanks were radiating much lower levels. It was therefore decided to attenuate the sound from the most significant sections of pipework and see whether this resolved the problem. If the overall reduction in sound at the dwellings was not sufficient to address the complaints, then the next stage would be to improve the attenuation applied to the blowers themselves. However, the work carried out on the pipework would be an essential first step, without which the blower attenuation would have little effect at the dwellings.

To effectively attenuate the sound being radiated by pipework, it is necessary to clad it with an external mass layer that is decoupled from the pipework itself. Applying damping material directly to the pipework may reduce some 'ringing' but cladding can be more effective and, perhaps surprisingly, may be more straightforward to install. For this application the most suitable cladding system was decided to be an outer case of galvanised sheet steel separated from the pipework by a 50 mm layer of moderate density glass fibre. To optimise the performance of the outer 'mass layer' this comprised a combination of sheet steel (1.2 mm thick with a surface density of 10 kg/m^2), and a bonded mass loaded polymer sheet to increase the overall mass and provide damping to the steel to control any resonance that may otherwise occur.

Ordinarily the mass/damping layer would be applied to the inner surface of the sheet steel so that the steel protects the damping layer from mechanical damage. However, in this case the surface of the pipes was hot, to the extent that pipework at ground level had already been thermally lagged to prevent injury. It was therefore likely that the mass/damping layer would start to melt if it was enclosed by the steel, so it was applied to the outer surface instead, with a reinforced foil outer surface to provide some additional protection against mechanical damage.

Below:
Figure 7:
A-original pipe.
B-fibreglass decoupling layer.
C-clad with sheet steel.
D-additional damping/mass layer applied

Due to the variable nature of operation of the blowers it is not practicable to directly compare sound level measurements before and after treatment to assess the effectiveness of the cladding system. A similar arrangement has previously been used to reduce noise radiated by the body of a generator exhaust silencer. Figure 8 shows the sound intensity level emitted by the exhaust silencer body before and after being clad in the frequencies of interest.

Below:
Figure 8: Comparison of intensity radiated by pipe with and without cladding

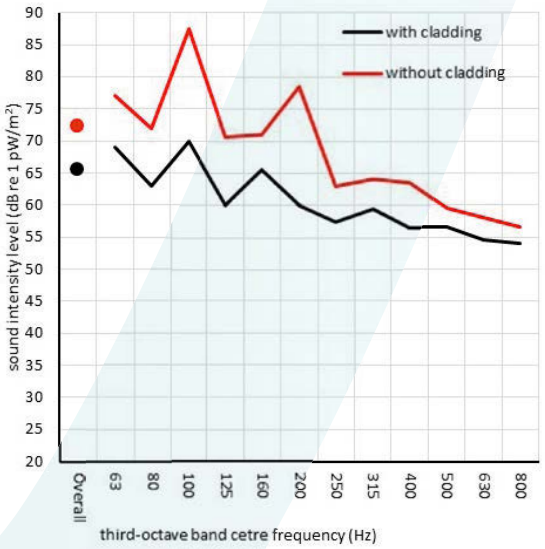
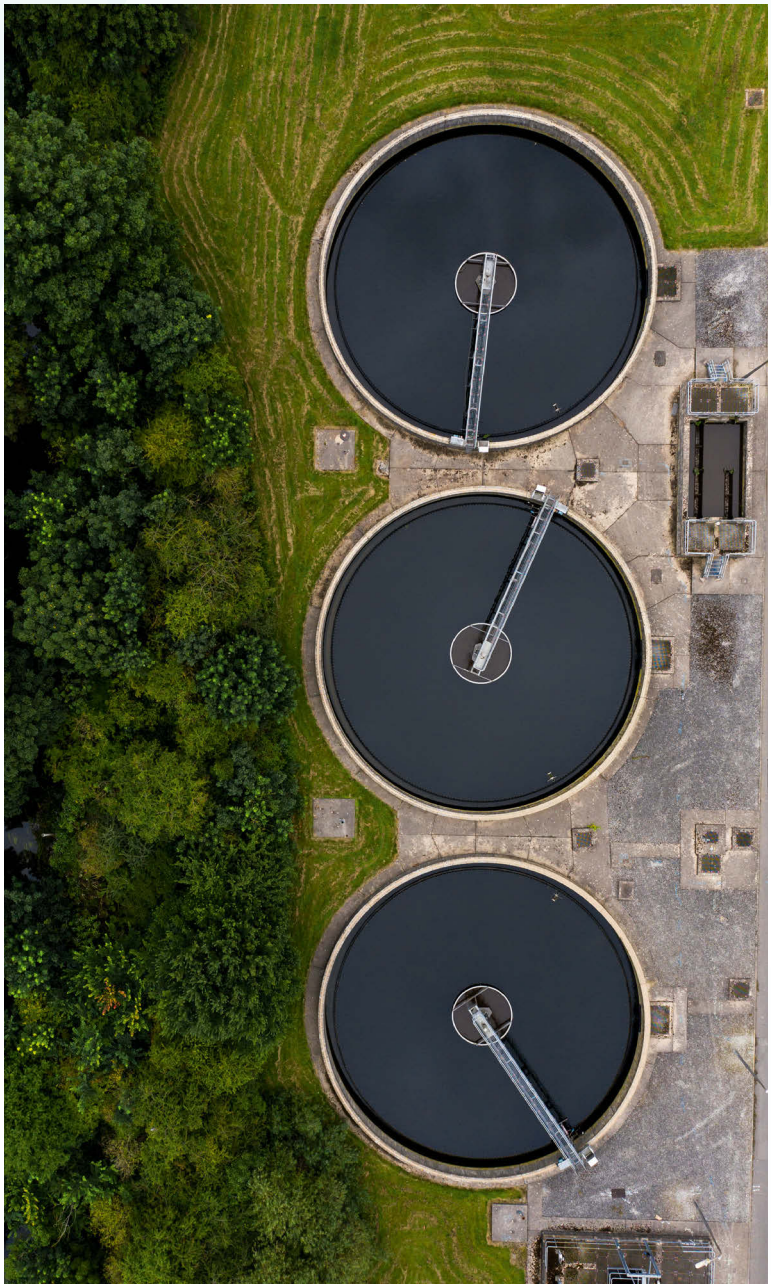


Figure 8 shows a reduction of around 5 dB in most frequency bands, but a significant reduction in the previous peaks at around 100 and 200 Hz.

At a third site, which is in a coastal location, the acoustic enclosures originally fitted to the blowers had corroded relatively quickly and become ineffective. A more durable replacement system was required. A site investigation showed that the original acoustic enclosures probably provided more attenuation than was really necessary to achieve suitable on and off-site sound levels. This is consistent with the observation that the blowers have been operating for some time with missing enclosure panels without generating complaints.

It was decided to avoid using materials that could repeat the corrosion problem, such as pre-galvanised or stainless-steel sheet, and a system based on glass reinforced plastic (GRP) panels in a hot dipped galvanised frame has been developed to provide P38



Below:
Figure 9: The corrosion damaged blower enclosure

sufficient mass to control sound breakout from the enclosures to a suitable level whilst providing good access for maintenance and appropriate corrosion protection.

Summary

Modern sewage treatment processes often require the installation of high volume/pressure air blowers at locations relatively close to populated areas. Blowers emit high levels of acoustic energy with many characteristics which increase its potential impact on residential receptors.

The significant 'visibility' of sewage works sites means that they are often identified as the source of community noise issues with and without justification. This can lead to complex investigation and assessment exercises to establish connections between source and perceived sound, and evaluate appropriate reductions.

The acoustic energy radiates from both the blowers themselves and their associated pipework. So effective solutions often require treatment to the pipework as well as directly to the blower units.

However, the design of any noise control applied needs to take into account the damp and potentially corrosive nature of the sewage works environment.

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The value of the property meant that millimetres mattered. We went through enormous efforts to reduce the envelope required for bearing assemblies within the building. The column capitals included the bearings supporting the structure above, lateral restraints, tension anchors to meet disproportional collapse requirements, fire protection and first fit architectural finishes.

There were approximately 60 columns and each one was engineered differently to save space. Multiple wall interfaces were also isolated; we engineered the bearings and special telescoping lateral restraints which fitted within the existing wall width.

▲ *Render of the completed building, courtesy MSMR architects*

◀ *Mason bearings being placed in one of the core pits*

▼ *Wall and column isolation systems engineered for compactness.*

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Sound level meters calibration – what's it all about? Part 2

This article follows on from the one we published in the March/April 2022 issue on page 44, which discussed the wide range of calibration services on offer to support sound level meters. This article looks at the use of the associated calibrator along with the use of offsets to centre the microphone response in the permitted tolerance band.

By Ian Campbell, Technical Director at Campbell Associates Ltd.

When submitted for a full calibration a sound level meter (SLM) should be accompanied by a sound calibrator, this should be of the make and model specified in the instrument's instruction manual.

Alternatively, it may be a suitable equivalent that has the same nominal level and frequency. The general requirement is that it should conform to BS EN IEC 60942 and have the same accuracy class as the sound level meter.

So, a class 1 calibrator is required for a class 1 sound level meter. The associated calibrator must have been independently calibrated within the previous 12 months prior to the verification of the sound level meter. The intention is that this calibrator will be provided by the user, should this not be possible, there is an option for the calibration laboratory to use one of their own. The sound calibrator is the prime traceability route to national standards and is used to determine the 'on receipt' condition of the SLM. The calibration laboratory may also have a reference calibrator that can be used as a cross check just in case there is a problem with the associated calibrator provided[1]. The initial set up of the SLM is repeated when the calibration is completed.

From this you can see if any off sets were applied before receipt for calibration and adjustments that have been made during calibration. If the difference between these initial values is significant, it may indicate problems with measurement's made with this SLM prior to the calibration.

1. These are the calibrator requirements specified by the manufacturer
Reference level: 94.0dB
Reference Range: 140dB FS
Reference Frequency: 1000 Hz

2. These are the results from the laboratory reference calibrator
Reference Calibrator: WSC6 - B&K-4231-1882939
Reference calibrator level: 93.93
Before calibration:
Environmental corrections: -0.02
Other corrections: -0.15
Notional level: 93.76
Calibrator level before adjustment: 93.8
After calibration:
Environmental corrections: -0.02
Other corrections: -0.15
Notional level: 93.76
Reference calibrator level after calibration: 93.8

3. This is the information and results given from the associated calibrator
Associated Calibrator: Brüel and Kjær - 4231 - 3016820
Associated calibrator level: 94.10
Initial level check:
Environmental corrections: -0.02
Other corrections: -0.15
Notional level: 93.93
Indicated level: 93.9
Final level statement:
Environmental corrections after calibration: -0.02
Other corrections: -0.15
Notional level: 93.93

Right:
Figure 1:
Extract from a typical calibration report giving the detail about the settings for the reference and associated sound calibrators as per BS EN IEC 61672-3 Ed.2 #10

References

1 In a worst-case condition, the calibration data for the associated calibrator may be up to 12 months old

Figure 1 shows a typical calibration report covering the use of the associated and reference calibrators:

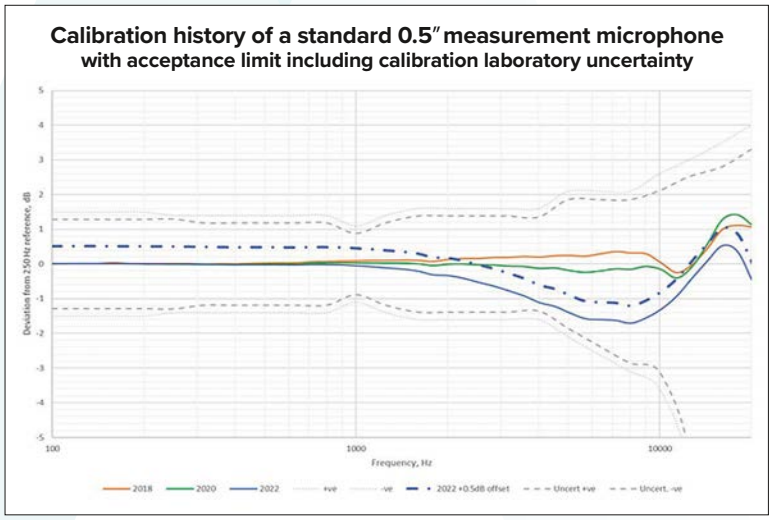
1. Manufacturer's specification: The SLM manufacturer will specify the requirements for the calibrator. These are usually linked to the reference levels for the meter being calibrated.

2. Laboratory reference calibration. With modern self-compensating calibrators, the environmental corrections are not usually significant but still need to be considered. However, there are still plenty of the old-style calibrators where the environmental corrections can be significant relative to the tolerances required. Details should be in the calibrator user manual; barometric pressure corrections are usually the most significant with humidity the least. The other corrections are primarily in respect of the difference between the pressure and free field response of the microphone, these are microphone related. They can also be to take account of the volume load effect on the calibrator, particularly with non-compensating calibrators. In these cases, if the calibrator is exposed to a larger load volume, then the level produced will go down.

3. Associated calibrator results. The tasks outlined here repeat some of the above, but they then relate to the unique coupling between the SLM and its associated calibrator. As there are always some tolerances of fit and levels, these are taken care of by using the final notional level shown in this report to set up the sound level meter for each measurement project. This information is usually repeated on the final calibration certificate as the level to use for each field calibration setting. Remember, you still may need to apply environmental corrections to the result, particularly if you do not have a self-compensating sound calibrator.

As there was no difference between the before and after calibration settings this indicates that the sound level meter and calibrator have been stable prior to the calibration being performed. However, there is a difference between the levels produced by the reference and associated calibrators of 0.13 dB, and as this is well within the expanded uncertainty of the two calibrators indicates all is well at the start of the calibration. At the end of the calibration the associated calibrator is reapplied to the meter and the reading noted, in this case, 93.93 dB as the value to use when the associated calibrator is used for field calibration settings. This locks the sound level meter to the reference calibrator setting and takes out any small variations due to the actual sound pressure level of the associated calibrator and any coupling artefacts associated between the microphone, calibrator and the couplers used.

Once a different sound calibrator is used this relationship is compromised as the alternative calibrator will have a different nominal level as well as different coupling coefficients. The sound calibrator standard (BS 60942) allows a tolerance at 1k Hz of between ±0.25 and ±0.4dB depending on the edition of the standard in use; hopefully there will be a calibration certificate that will give the actual level within this range with its associated uncertainty. From this information it is possible to calculate the correct level that the sound level meter should show in response to the alternative calibrator.



Above:
Figure 2: Six-year calibration history of a half inch measurement microphone with acceptance interval

As soon as possible after the SLM is returned from calibration apply the alternative calibrator to the instrument and note its reading. If this correlates with what you would expect from its notional level, having taken account of expected environmental, coupling and free field corrections; then it's reasonable to use that value in future to set up the SLM.

Once the SLM has been in service for a while, things will change, as can be seen from Figure 2. Here a microphone has had a full calibration biennially over its six-year working life. The results are shown as the orange, green and blue solid lines along with the tolerances and calibration laboratory uncertainty to give an acceptance range. The first four years seem to have gone well with the drift almost within the uncertainty of the calibration laboratory. However, the last two years have seen a change in the mid-frequency range; with the 4k Hz point coming within 0.24dB of the acceptance limit for a microphone; but as we saw in Part 1, this has to be combined with the SLM's electrical and acoustic response to determine the overall performance. If these factors are constructive, it will move the result further into the acceptance limit but if they are destructive, it goes the other way.

Staying with the associated calibrator situation for a while; we can see that the level at the 1k Hz P42

calibration check frequency has fallen by 0.2dB over the six-year period. This will be compensated for by the recommended setting for the associated calibrator. This calibration offset helps as it has the effect of lifting the complete response curve by 0.2dB thereby giving a bit more head room over the lower limit. This is all fine when the microphone response is flat; but as we see in this case, the changes that have occurred over time are frequency specific, by 2020, the microphone has significant non-linearities in its frequency response. As a result, it will under report levels in the 2k to 10k Hz range. In these circumstances the standards[2] also allow further calibration offsets to balance the overall response in the middle of the acceptance band. So, in this case, an additional 0.5dB could be added to the recommended calibration level and this would give the response shown as the dash-dot blue curve in Figure 2. This will place the overall response nearer to the centre of the acceptance band, but we are using the tolerances in the low frequencies to keep the higher ones in specification. There are obviously plus and minus points with this procedure, and it is important that the user is aware of any such compromises made to allow a meter to pass. With class 1 instruments this is not often necessary, but the practice is more common with class 2 meters and sound level indicators, the key point is that the user must know if such offsets have been used.

Below:
Figure 3:
True problem masked by use of nominal acoustic data

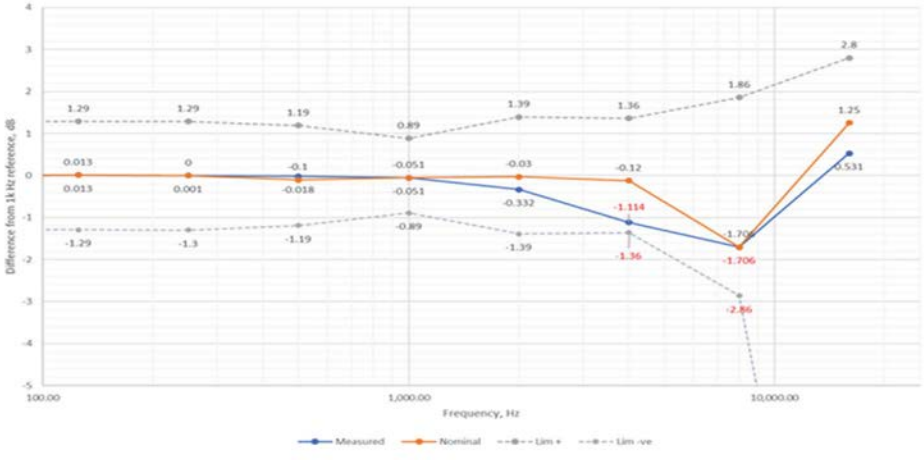
In the example given here it was difficult to decide if the changes in microphone response were due to drift or damage. Having given all the facts of the case to the client, they decided to retire the microphone rather than accept a recommended six-month recalibration interval for the for the kit. Data was important in making this decision, we are looking here at 1/6th octave data as there was a complete microphone calibration included in the calibration. If just the mandated octave resolution was used as required by the sound level meter standard the situation would be as shown in Figure 3 for the 2022 data. This is shown for the two conditions mentioned in the earlier part of this series i.e. with nominal or measured acoustic data. The orange curve shows the resultant if only the nominal data method had been used. The eye would go to the 8k Hz point were there appears to be at least 1dB headroom to the limit. However, the blue curve shows the result if measured microphone data was available, here it is apparent that the problem is going to be at 4k Hz where only another 0.2dB of drift would put the microphone out of specification.

Access to the data from a full calibration report can provide all sorts of flexibility in mix and matching kit, for example the need to be able to use either high sensitivity or high frequency microphones with a sound level meter. It is not necessary to have full calibrations of the meter with each microphone, just have the alternative microphone calibrated and replace the associated microphone data with the alternative at each of the octave test points to see if it still conforms to the standard. This probably holds true with changing one half-inch microphone capsule for another but may not for a different preamplifier of different length as that could well affect the case reflection data.

Validity of calibration in different instrument configurations

Sometimes sound level meters have additional post measurement apps built-in, such as sound power, building acoustics, noise nuisance evaluation (BS 4142) etc. These apps are post-processing the output of the sound level meter, so if the firmware algorithms they are based on are correct the results will be as good as the calibration and uncertainty of the input data from the sound level meter. These are not the 'configurations' we are considering here. As sound level meters are required to operate in many different ways to meet measurement needs so, they need to be set in suitable measurement configurations. They may at times need to operate in a handheld application whilst at others they are deployed in long term projects in exposed locations. So, size and convenience of manual control must be sacrificed to provide for the necessary weather protection, remote control and power supply requirements necessary to keep the kit running and the data flowing. In these latter cases the normal procedure is to take the handheld instrument and then add the necessary weather protection to it, and it is the acoustic effect of these front-end accessories that can impinge on the results of a full calibration, and therefore this needs to be considered when specifying the calibration of your kit. Each laboratory would have its own rules, but generally if a front-end accessory is supplied with the instrument at the time of calibration it is assumed that it will be used in the final calibration

Overall sound level meter response comparing measured with data for 2022 certificate with acceptance limits



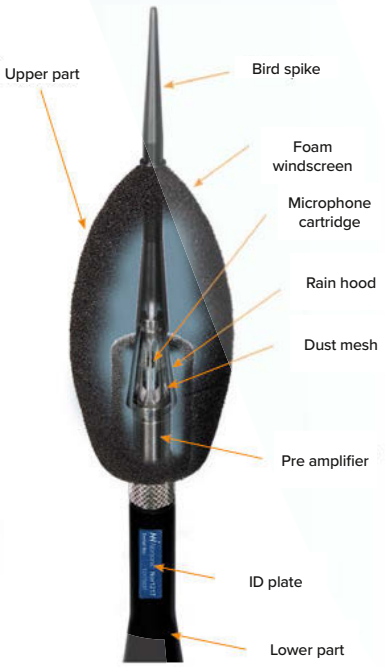
References

2 BS EN IEC 62585:2012 #8 and Annex A cover the detail about setting the optimum calibration check level. This publication is directly referenced in BS EN IEC 61672 Ed2 sound level meter standards

configuration. So, if there is a windscreen or extension cable in the box it would be assumed to be part of the calibration configuration required unless you have specified otherwise[3].

We have seen earlier parts of this article that the final output of a full calibration is the sum of both the acoustic and electrical measurements along with the manual corrections for the effects of the instrument housing that were obtained during the pattern evaluation testing. The configuration described in Part 1 already accounted for the option to include a simple foam windscreen that would be used in handheld configurations. As modern sound level meters often have built in windscreen correction filters that compensate for the insertion loss of the windscreen, so then it is a simple matter to turn the filter on and off as the windscreen is added or removed. It is important to remember that the compensation provided is for that manufacturer's design of windscreen[4]. These correction characteristics would have been verified as part of the pattern evaluation, so it is reasonable to assume they are correct. If there is no compensation network for the windscreen built in, then it would be necessary to do a quick check by adding or removing the windscreen data from the summation of results table provided in the calibration report.

For longer-term measurements, or to reduce the effect of the operator holding the meter, a tripod-mounted configuration could be used. If this results in the introduction of an extension cable between the microphone/preamplifier and the SLM, then we have another configuration that will change the data that must be summed to determine conformance. As the microphone has now been removed from instrument the case reflections no longer apply. If a properly designed microphone stand has been used it is unlikely that any additional acoustic effects would have been introduced and, hence, the case reflections could be deleted from the determination of the overall response of the instrument. Usually this improves the result, but this is not always the case, so it is best to check. Note that the electrical performance may be affected by the loading provided by the extension cable; but as for both standard voltage and IEPE (constant current) microphone cables the corrections are usually negligible for cable lengths under 50 meters. Beyond this the manufacturer's specification needs to be checked for any additional corrections necessary.



Above:
Figure 4: Typical weather protection for class 1 measurement microphone system

So much for simple systems, but once we consider permanent outdoor installations more elaborate weather protection is required, mostly to keep the rain and detritus out of the microphone; to do this the microphone has to be orientated vertically. A typical arrangement is shown in Figure 4, where in addition to a larger foam windscreen, there are both rain and dust covers around the microphone as well as bird spikes etc to keep the vermin out; these must be carefully designed to make them as acoustically transparent as possible. These solutions tend to fall into two types; firstly, there are those that are complete integrated plug and play systems with integrated microphone and preamplifier; whilst the other group are retrofit kits that allow the use of the existing microphone and preamplifier from the SLM.

At this point we need to consider the polar response of the microphone and the effects rotating by 90° will have. A handheld sound level meter is normally designed to have the microphone pointed at the sound source; hence sound arrives horizontally with an incidence angle of 0° to the diaphragm. Rotating it by 90° will cause the sound to arrive at a grazing incidence to the diaphragm; in doing this its frequency response at higher frequencies will be progressively reduced as the frequency increases reaching to around -10 dB at 20k Hz. The complete integrated systems can have a microphone that is designed to give the correct acoustic response when it is mounted vertically, i.e., with the sound arriving at grazing (90°) incidence to the microphone diaphragm. This would give the correct response for sources that are co-planar with the horizon, such as traffic noise, but for aircraft noise a 0° incidence would be required, so be sure of the type of incidence the device selected has. These integrated weather protected microphones normally must be calibrated as a complete assembly in an acoustic chamber and the results of those tests combined with the other data in the meter's periodic verification as though it were an alternative microphone. Some of these systems allow the microphone capsule to be removed and calibrated separately and, in these cases, the correction data to compensate for the insertion of the weather and vermin protection would need to be available[4] to confirm that the complete assembly still meets the specification.

In respect of the retrofit kits, they will have to use the microphone supplied with the SLM which would normally have been designed to respond to noise propagating horizontally (0°), which must therefore be rotated by 90° to allow the weather protection to work. Correction data needs to be available to compensate for this realignment. P44

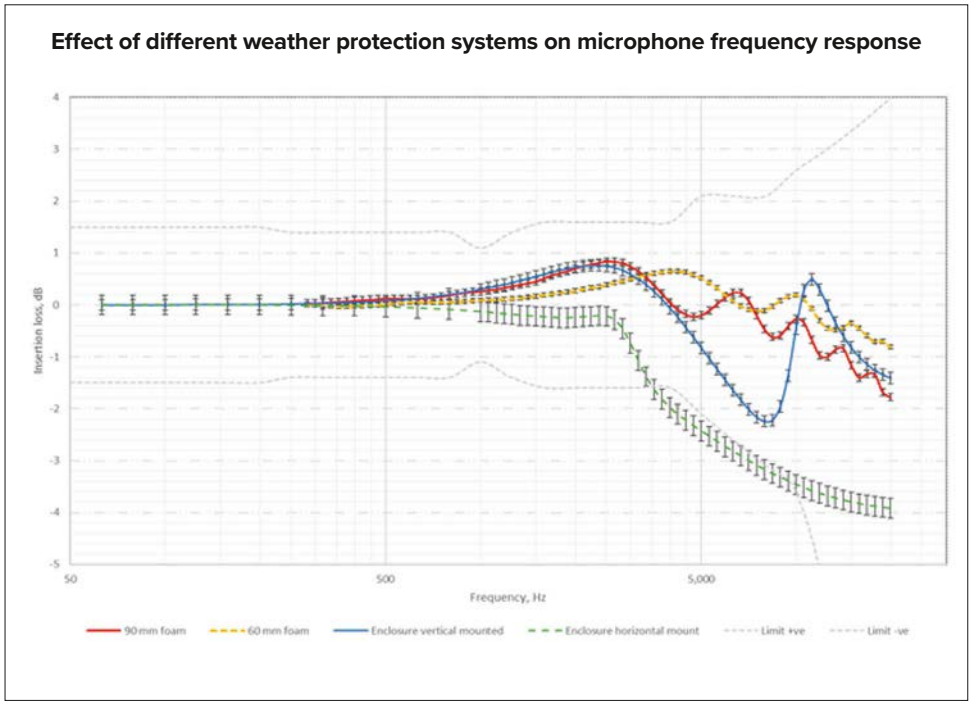
References

3 If correction filters are provided, they are normally assumed to be correct making the windscreen acoustically transparent
4 For Edition 2 meters this information will need to be in the format required by BS 62585:2012

Again, if all the kit comes from the same manufacturer it is also possible to include correction filters to the SLM's response so that direct readings of weighted sound level can be made. In addition to the angle of incidence correction, we must consider the effects of the weather protection, so there is a separate set of corrections needed for these as well.

Bear in mind the data provided by the manufacturer of the weather protection system will probably be based on the premise the microphone had the 'nominal' response; during the calibration the actual performance of the microphone will be obtained and the insertion effects of the weather protection will be added to this actual, and not the nominal, response.

The data in figure 5 shows the effect of simple foam ball windscreens as the red and yellow curves for both the 90 mm and 60 mm sizes of 35 ppi windscreens. The trade-off here is the bigger the ball the higher the attenuation of wind noise but the bigger the insertion effects on the microphone performance. The curve also shows error bars for the expanded uncertainty with which the data was obtained, with these devices this is very low.The blue and green curves show results for a typical retrofit weather protection system representing the vertical and horizontal incidence of the sound. Here you can see that the corrections are larger than for the simple foam balls as well as having higher uncertainties associated with them. Those for the horizontal incidence include the angle of incidence effect and hence corrections are much larger and also have more significant uncertainties associated with them.



Above:
Figure 5: Windshield comparisons with uncertainties. Foam ball types of different sizes and retrofit weather protection systems with different incidence angles

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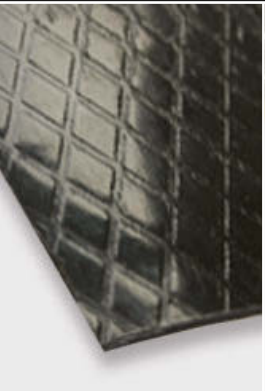
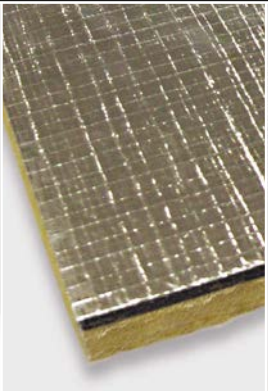

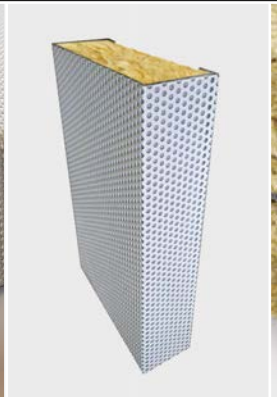

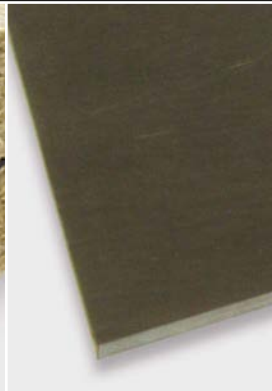

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The relationships between frequency response and the speech transmission index, with respect to word scores and road tunnels – part 1

This article is the first of two, which take another look at the relationships between frequency response and the speech transmission index (STI).

By Glenn Leembruggen FIOA, Acoustic Directions and ICE Design, Sydney, Australia

Experience gained by the author and colleagues over many years of designing and commissioning sound systems has shown that a degraded frequency response can greatly reduce speech intelligibility.

In reverberant, low noise environments, major degradation in responses can make speech essentially not understandable, and this loss of intelligibility is often barely reflected in the STI performance.

Additionally, relatively small changes over an octave bandwidth, sometimes as small as 1 dB, can noticeably improve the perceived intelligibility of conversational speech under low noise conditions and this change in perceived intelligibility is not reflected in the STI.

Both of these situations suggest that the psychoacoustic masking mechanism that occurs with relatively low speech levels is not fully accounted for by the STI process.

The author's interest in intelligibility concerns situations where word recognition by listeners should not rely on the context of the sentence, and could contain unfamiliar words such as place names, proper nouns or single words that are vital to the correct interpretation of the speech.

Situations involving sound systems should allow listeners to understand speech without concentrating on the listening process itself. There are many situations (for example rail and bus stations) which have sound systems meeting a specified STI performance, but in which listeners must concentrate to understand the speech, especially when that speech is delivered rapidly or with poor articulation. Other situations such as parliaments and courts are more demanding, requiring participants to listen for long periods and concentrate on the subject matter. These systems should not only deliver satisfactory speech intelligibility, but should provide 'acoustic comfort' for listeners, so that they can actively engage with the speech without straining to understand the content. To achieve this robust intelligibility, the system must accurately reproduce the full range of voice types and speaking styles.

Part 1 of this series explores the relationship between the STI and word scores with different frequency responses, while Part 2 (that will be published in the July/August 2022 issue) takes a look at the effect of frequency response on the measured STIs in a road tunnel.

Revisit of 2003 STI work

Part 1 revisits work presented by the author and a colleague[1] in 2003 to the Reproduced Sound conference in Oxford. That paper explored the apparent inability of the STI metric to properly account for the perceived loss of speech intelligibility that occurs with poor frequency response in public address situations, particularly in reverberant environments.

The author stresses that the work in 2003 was not carried out with the rigour that is normally used for proper validations of STI, such as more recently described by Morales et al[2]. Nevertheless, it was sufficiently well controlled to enable a potential issue with STI to be explored.

Measurements of STI were made in a reverberation chamber using a loudspeaker with seven frequency response scenarios. The scenarios were derived from seven sets of equalisation filters that were grossly different. Those measured STI results were compared with the equivalent STIs computed from word scores obtained from listening tests with recordings made in the same reverberation chamber with the same seven frequency responses. As the ambient noise levels were low in both the speech recording and listening situations and there were negligible echoes in the reverberation chamber (compared to the reverberation), intelligibility degradation was only due to reverberation and the frequency response filters. The shape of the filters was selected to represent highly exaggerated situations that would rarely be encountered in real life public address situations.

The 2003 paper concluded that in reverberant and noise free conditions, STI measurements of situations with highly degraded frequency responses were essentially unable to match the equivalent STI from the word scores.

This article uses the measured data from 2003 to revisit the relationship between measured STIs and equivalent word score STIs and addresses the following issues:

a) critique from colleagues concerning the true ambient noise and listening levels during the word score tests. In response to this critique, this current analysis P48

References

1 Leembruggen, G., Stacy A. Should the Matrix be Reloaded? Proc IOA Vol,25 Part 8. 2003

2 Morales, L; Dance, S; Shield, B; Leembruggen, G. Speech Transmission Index for the English Language Verified Under Reverberant Conditions with Two Binaural Listening Methods: Real-Life and Headphones. J. Aud. Eng. Soc. Vol 62 Issue 7/8 pp. 493-504; July 2014

uses a range of ambient noise levels and spectra that could better represent the listening environments of the 2003 study;

b) application of the speech spectrum during the STI calculations, rather than applying a speech shaped filter to the actual test signal, which was the case in 2003. This provides a higher signal-to-noise ratio for the speech signal;

c) application of the continuous auditory masking mechanism specified in STI standard IEC 60268-16 -2011[3] (Rev. 4); and

d) the new relationship between phonetically-balanced word scores and STI for real-world listening developed by Morales et al.

Overview of 2003 work

Objective measurements

An investigation was conducted into the relationship between the subjective intelligibility of speech and the measured STI for a range of frequency responses in a reverberant environment. The method consisted of measurements of the STI for each response, subjective testing of word scores for each response, and processing of the measured STI results and word scores.

A loudspeaker and dummy head with binaural microphones were set up in an anechoic chamber at AMS Acoustics in London. The loudspeaker was fed with an MLS signal via a speech weighting filter and power amplifier. The response of the speaker was then measured at each ear using binaural microphones at a distance of 1.5m from the speaker on axis and processed by MLSSA v10w analyser to yield the anechoic frequency response of the speaker and the STI. This anechoic measurement is Scenario 1.

The loudspeaker was moved into a reverberation chamber at AMS Acoustics, and the STI was again measured at a distance of 1.5m from the speaker on axis using binaural microphones. Using acoustic absorption material, the reverberation time of the chamber was adjusted so that the measured STI was approximately 0.5;

Frequency	125	250	500	1000	2000	4000	8000
RT (secs)	3.5	3.3	2.2	1.7	1.7	1.4	1.1

Above: Table 1: Measured reverberation times in the reverberation chamber with applied sound absorption material to produce an STI of approximately 0.5

this is Scenario 2. The measured reverberation times in the chamber are shown in Table 1.

Seven different filters were then used sequentially to shape the frequency response of the loudspeaker (Scenarios 3 to 9) with the same arrangement of sound absorption material. For each filter, the impulse response was captured and the frequency response and STI of the system computed.

Subjective measurements

A compact disc of anechoically recorded speech was prepared and consisted of 1,000 carrier sentences and words arranged into 20 groups of 50 words. The words were spoken by a female voice artist, and were single syllable, phonetically balanced (PB) types from Harvard situated at the end of each sentence.

Following a similar process to the objective measurements in the anechoic and reverberation chambers, three groups of 50 words were replayed through the loudspeaker and recorded onto digital media using binaural microphones on the dummy head at a distance of 1.5m from the speaker. Recordings made in the reverberation chamber were made with the same arrangement of sound absorption material as the objective measurements, with a total of seven scenarios being recorded corresponding to the seven response shaping filters. When the groups of words were exhausted, a reshuffled version of the lists was used.

The recordings of the nine scenarios were then distributed to listeners in the UK and Australia. In the UK, seven listeners evaluated all or part of the three lists for each of the nine scenarios, to give a total of 135 listening sessions. In Australia, three listeners evaluated all three lists for each of the nine scenarios, to give a total of 81 listening sessions. The sentences were presented to listeners through headphones or loudspeakers, and the listener wrote down the word at the end of the sentence.

The long term L_{eq} levels of the speech with each filter scenario were normalised and broadcast at a listening level of 66 dBA at the listeners' ears. The presentation over headphones or loudspeakers is likely to have affected the results to a minor degree, however, as noted above, this was not a rigorous study and was only intended to explore trends. The ambient noise level in the listening areas was relatively low, and typical of a living room environment.

Test scenarios and frequency response filters

The responses of the tonal filters were chosen from our experience to grossly exaggerate the difficulties for perceived intelligibility. Table 2 lists the environment and filters pertinent to each scenario. The frequency responses of the loudspeaker when fed with the filter and the responses of the filter itself are given in the Appendix. P50

Table 2: Details of temporal and filter parameters for each scenario

Scenario	Situation	Tonal filter
1	anechoic	None
2	reverberant	None
3	reverberant	5 dB/octave cut
4	reverberant	5 dB/octave boost
5	reverberant	2.5 kHz 12dB notch Q=0.7
6	reverberant	Plateau @-3dB 400Hz to 1 kHz, plateau @ -10 dB 1.2kHz to 6 kHz
7	reverberant	250 Hz 18 dB boost Q = 1.5
8	reverberant	630 Hz 18 dB boost Q = 1.5
9	reverberant	Notches: 500 Hz & 2 kHz -18 dB

References

3 IEC. Sound System Equipment Part 16: Objective rating of speech intelligibility by Speech Transmission Index. 3rd Edition, 2011. International Standard No. 60268-16

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- 50mm wooden battens
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- 8 mm OSB

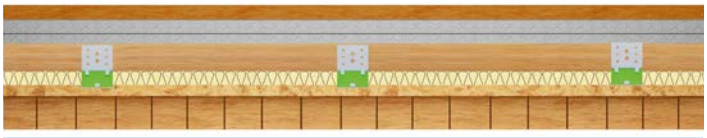
SYSTEM A3 A3

- DLT floor 151 mm (140 mm DLT +11 mm OSB)
- 50mm wooden battens
- **Akustik + Sylomer® floor mount 25**
- 89mm Rockwool insulation
- 8 mm OSB

SYSTEM A4 A4

- DLT floor 151 mm (140 mm DLT +11 mm OSB)
- 50mm wooden battens
- **Akustik + Sylomer® floor mount 25**
- 89mm Rockwool insulation
- 1 layer cement board

SYSTEM A7 A7



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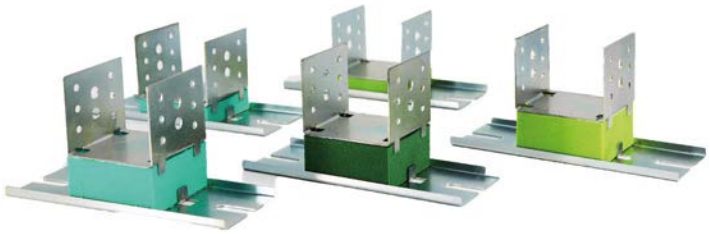
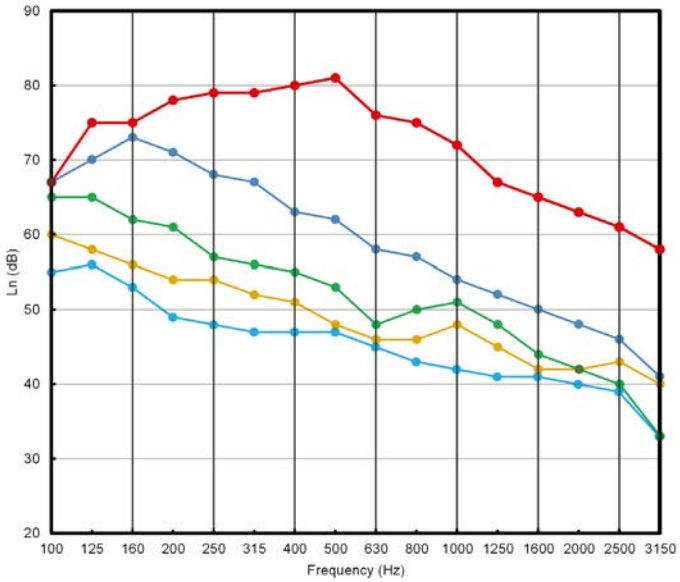


RESULTS OF THE LABORATORY TESTS

OVERVIEW IMPACT NOISE RESULTS
Calculated according to Standard ASTM E1007



A1 A1 - 74 dB
A3 A3 - 55 dB
A7 A7 - 48 dB
A2 A2 - 63 dB
A4 A4 - 52 dB

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Computation of STIs with refined parameters

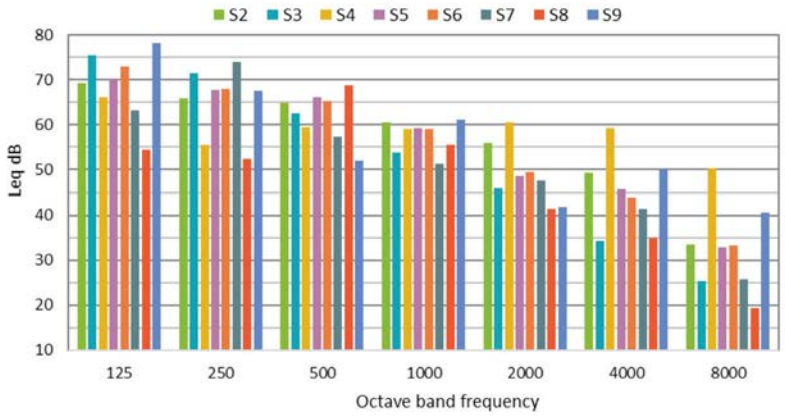
To compute the STIs for the conditions under which the word scores were obtained, a two-part process was used in accordance with the method laid out in Annex M of [2].

- In Part 1 of the process, the modulation transfer function (MTF) results obtained using the MLSSA analyser in 2003 were corrected to remove the effect on the STIs of ambient noise and masking computed by MLSSA. This process yielded MTF matrices that included degradation only by temporal effects, and hearing threshold.
- In Part 2, adjustments to the corrected MTF matrix were made for new ambient noise and listening levels and the masking algorithm specified in Rev 4 of the STI standard.

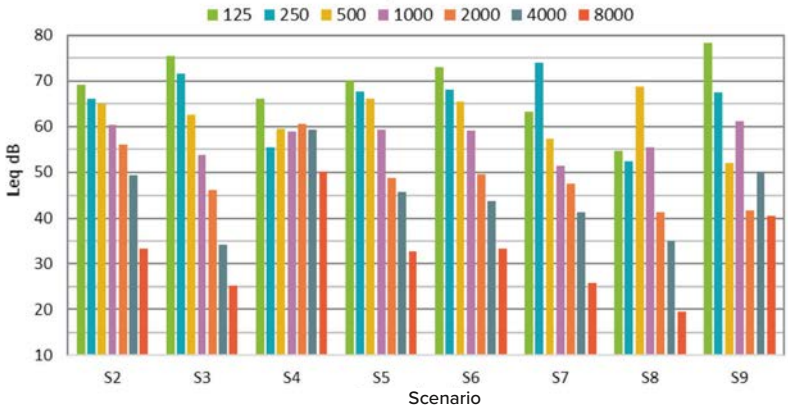
Possible listening conditions

Five possible ambient noise levels for the listening situations were used for the STI calculations using the corrected 2003 MTF data. An air conditioned listening environment is assumed with noise levels ranging from a typical low-noise situation to an unlikely high-noise situation (NR35). The octave band Leq levels corresponding to the five noise situations are shown in Table 3.

The speech level for the STI calculations was set to 66 dBA for each filter scenario. The male speech spectrum presented by Cushing et al[4] was used for the calculations as it has greater similarity to spectra measured by the author, Byrne et al[5], and the ANSI standard S3.5[6], compared to the spectrum specified by the STI standard.



Above:
Figure 1: Octave band levels of speech when filtered with Scenarios 2 to 9 (abscissa is frequency)



Above:
Figure 2: Octave band levels of speech when filtered with Scenarios 2 to 9 (abscissa is Scenario)

Figure 1 and Figure 2 show the octave band levels after normalisation and provide two alternative views to assist visualisation of the differences in the filtered spectrum.

STI results

Computed STIs with listening noise

The MTF matrix for the left ear was used for the STI calculations, as this ear gave the highest measured MTF values in the reverberation chamber. P52

Noise Situation	Frequency Hz							
	dBA	125	250	500	1000	2000	4000	8000
AC Low	32.3	36	34	29	27	22	18	15
NR 25	33.3	44	35	29	25	22	20	18
AC High	36.3	46	38	32	30	26	20	20
NR 30	38.0	48	40	34	30	27	25	23
NR 35	42.8	52	45	39	35	32	30	28

Above:
Table 3: Spectra of possible noise levels for the listening situation applied to the STI calculations

References

4 Cushing, Li, Cox, Worral, Jackson. Vocal effort levels in anechoic conditions. Applied Acoustics. 2011, Vol. 72, pp. 695-701
5 Byrne, et al. An international comparison of long-term average speech spectra. JASA 1994, Vol. 96
6 ANSI. Methods for Calculation of the Speech Intelligibility Index. American National Standard. S3.5-1997

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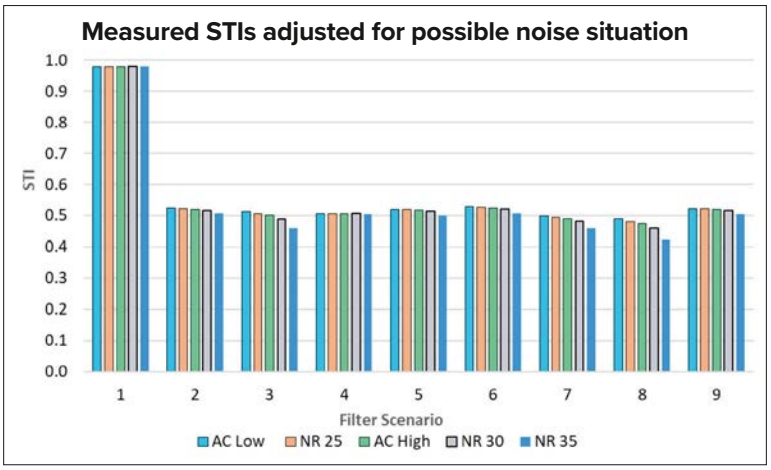
Filter scenario	AC Low 32.3 dBA	NR 25 33.3 dBA	AC High 36.3 dBA	NR 30 38.0 dBA	NR 35 42.8 dBA
2	0.52	0.52	0.52	0.52	0.51
3	0.51	0.51	0.50	0.49	0.46
4	0.51	0.51	0.51	0.51	0.50
5	0.52	0.52	0.52	0.51	0.50
6	0.53	0.53	0.52	0.52	0.51
7	0.50	0.49	0.49	0.48	0.46
8	0.49	0.48	0.47	0.46	0.42
9	0.52	0.52	0.52	0.52	0.50

Table 4 shows the computed STIs for each filter scenario after being adjusted for the possible noise level during listening with Figure 3 showing the results graphically.

Above:
Table 4: STI result for each filter scenario and ambient noise level for a listening level of 66 dBA



Above:
Figure 3: Comparison of measured STIs that have been adjusted for each noise situation

Word scores and associated STIs

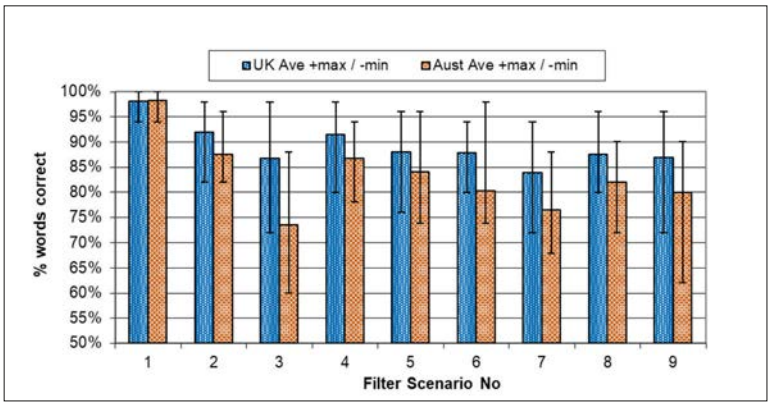


Figure 4: Plot of PB word score vs filter scenario. (The error bars indicate the maxima and minima)

Figure 4 shows the word scores for both the UK and Australian listeners for nine scenarios.
The following points are pertinent to the results:

a) Although the word score testing was not carried out rigorously in accordance with the ISO TR 4870 standard, and there was a wide range in the results, the trends were clear. There was a substantial difference between the maximum and minimum scores for each scenario.
b) The average Australian scores for each scenario were generally lower than the corresponding UK scores. Judging by the difficulty the Australian author has with the intelligibility with some British television productions, it is concluded that this difference was likely to result from accent differences.
c) If the words had not been spoken by a voice artist with good articulation, it is likely that the word scores would have been lower.
d) Compared to Filter Scenario 2 (no filters), there was a noticeable reduction in the word scores when the tonal filters were inserted, except for Scenario 4. However, given the boost in the high frequency energy provided by Filter 4, we would expect the intelligibility would be retained with this filter, although the boost makes the sound quality poor.
e) Even though the test words were well-articulated, each Australian listener found it necessary to concentrate while listening in order to discern the test words. More concentration was required for the filtered words. If this concentration had not been applied and the words had not been so well articulated in the original recording, the scores would have been lower.
f) Overall, the Australian listeners found the process to be quite tiring.

Associated STI results

In the 2003 paper, the equivalent STIs were computed from the word scores using the relationship between phonetically-balanced (PB) words and STI determined by the Common Intelligibility Scale (CIS) described by Barnett[7]. Two scales are provided in the CIS, 256 PB words and 1,000 PB words. Barnett notes that the PB256 conversion is from the articulation index specified by ANSI[6]. On the other hand, the PB1000 words conversion is taken from Steeneken and Houtgast[8] which was undertaken in the Dutch language. Possibly through naiveite, the conversion for PB 256 words was used, rather than the conversion for PB1000.

References

7 Barnett, P. and Knight, R. The Common Intelligibility Scale, Proc. I.O.A. Vol 17, part 7 1995
8 Steeneken H. and Houtgast T. A physical method for measuring speech-transmission quality J. Acoust. Soc. Am Vol 67 1980 pp 318-326

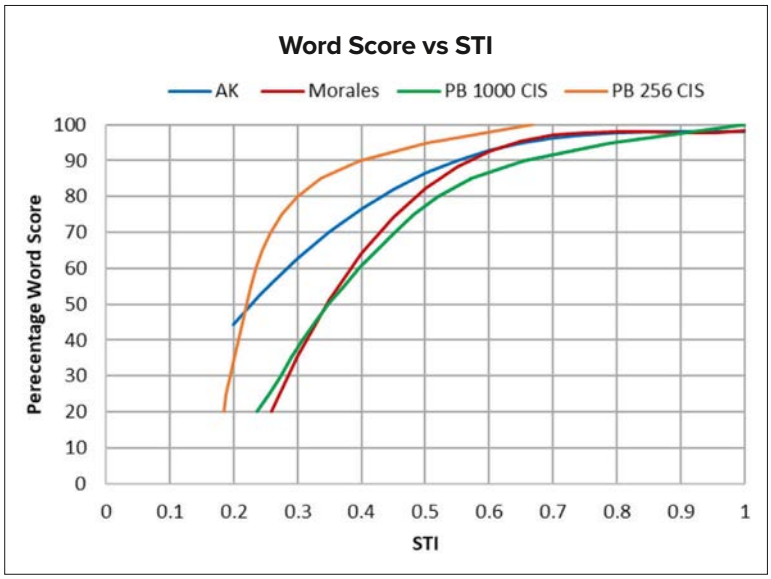
A conversion between PB1000 words and STI for the English language was published in 1985 by Anderson and Kalb[9] (AK) and is presented in Figure E1 of Annex E of both the 2003 (Rev 3) and 2011 versions of standard 60268-16.

Using an improved experimental method compared to AK that Morales et al[2] claim to better replicate real life situations, they revised the relationships between the intelligibility of Harvard PB1000 words and STI for the English language with real-world listening in both reverberant and noisy environments. As this study relates to reverberation only, the relationship between monaural measured STI and average scores of real-life PB word intelligibility tests under reverberation shown in Figure 4 of Morales[2] was used.

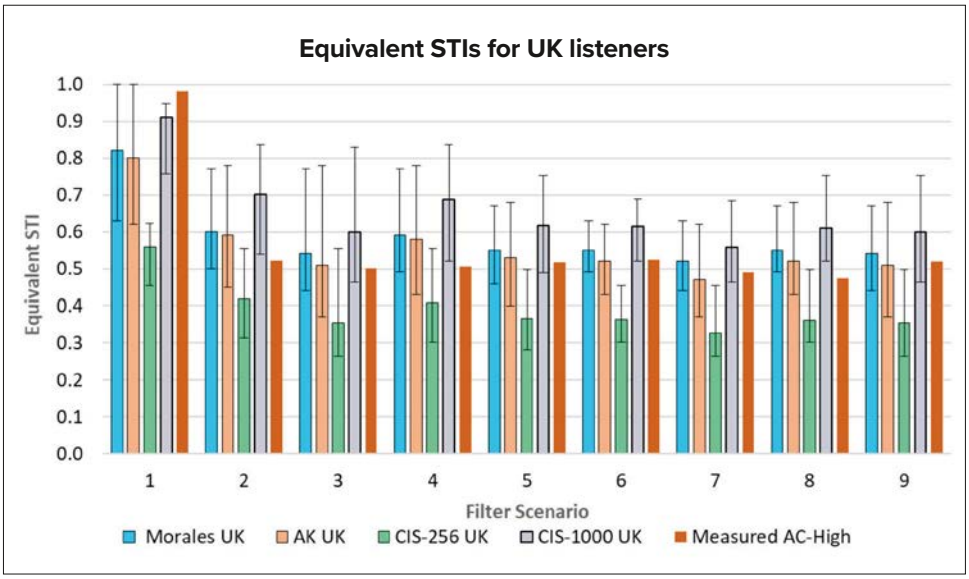
Figure 5 shows the four relationships between PB word score and STI: PB 256 and 1,000 from the CIS, AK and Morales. It is interesting that Morales' relationship shows some similarity to that of Steeneken and Houtgast[8]. It is noted that none of the validation work conducted to develop these four relationships included the effects on word score of the types of filters that are used in this study.

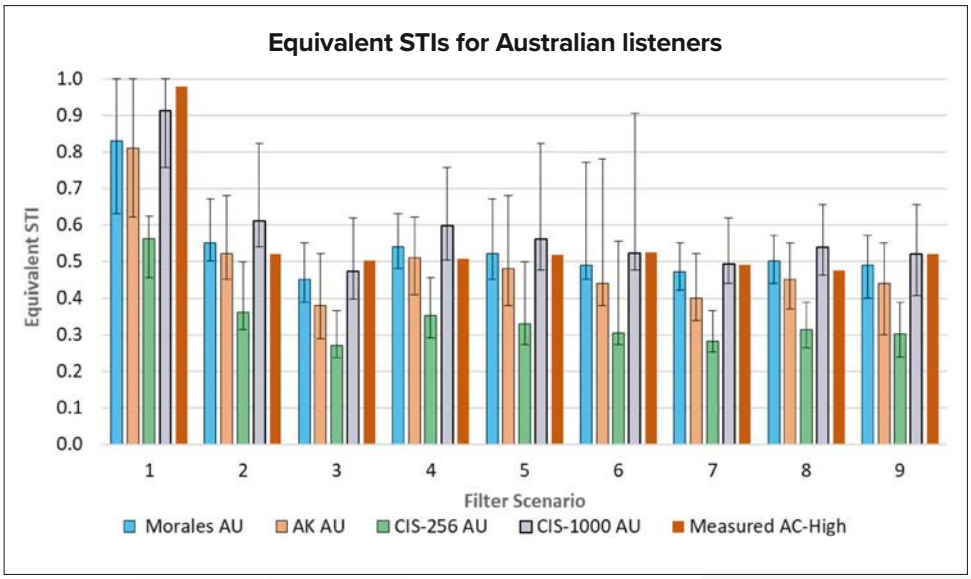
Figure 6 presents the equivalent STI results for each scenario using the four PB conversion methods with the UK listeners, while Figure 7 shows those results for Australian listeners. The graphs also include the measured STI, which was adjusted for AC-High noise situation. P54

Right: Figure 5: Relationships between the monaural measured STI and the average PB scores for four sources



Below: Figure 6: Comparison of equivalent STIs of word scores with the four conversion methods for UK listeners. Error bars indicate the maxima and minima





Right: Figure 7: Comparison of equivalent STIs of word scores with the four conversion methods for Australian listeners. Error bars indicate the maxima and minima

References

2 Morales, L; Dance, S; Shield, B; Leembruggen, G. Speech Transmission Index for the English Language Verified Under Reverberant Conditions with Two Binaural Listening Methods: Real-Life and Headphones. J. Aud. Eng. Soc. Vol 62 Issue 7/8 pp. 493-504; July 2014

8 Steeneken H. and Houtgast T. A physical method for measuring speech-transmission quality J. Acoust. Soc. Am Vol 67 1980 pp 318-326

9 Anderson, B.W., and Kalb, J.T. "English verification of the STI method for estimating speech intelligibility of a communications channel," J. Acoust. Soc. Am. Vol 81, 1987, pp 1982-1985

Discussion

a) The plots in Figure 6 and Figure 7 show:
- Although the measured STI for the anechoic situation is virtually unity, the equivalent STIs for the actual word score are substantially lower.
- The measured STI values with the AC-High noise for Filter Scenarios 2 to 9 show only a tiny range of up to 0.02.
- The four conversion relationships produce a spread of approximately 0.25 in equivalent STI over all filter scenarios.
- The range of maximum to minimum equivalent STIs for each filter scenario is typically between 0.2 and 0.3.
- The PB 256 words conversion produces the lowest equivalent STI values with highest STIs being produced by the PB1000 words conversion.
- The Morales conversion produces STIs that range from 0 to 0.08 higher than with the AK conversion.
- With the UK listeners, the equivalent STI scores with Morales, AK and PB 1000 are higher than the measured STIs.
- With the Australian listeners, the Morales equivalent STI scores are quite similar to the measured STIs.
- With the Australian listeners, the AK equivalent STI scores are up to 0.1 below the measured STIs.

b) Figure 8 shows a reversed and expanded view of the four relationships between word score and equivalent STI in reverberation-only situations for the word score loss between 5% and 30%. Table 5 states the corresponding range of equivalent STI values.

When viewed in these forms, it is recognised that a substantial loss in PB words can cover a small range in STI.

In terms of the general awareness of STI users, the range of 0.7 to 0.4 is within a familiar range. What may be more unfamiliar is that this range encompasses such a large extent of lost words. Given that complex instructions or unfamiliar words could be regarded as having some similarity to PB words in their degree of difficulty for recognition, this potential loss in word recognition is much greater than the STI value suggests.

c) Morales' relationship assigns a given loss of intelligibility to a higher STI than the AK relationship. For example, Morales equates a 30% loss of PB words to an STI of 0.43 compared to AK's STI of 0.35. Morales' relationship therefore compresses the range of word losses into a smaller STI range with higher absolute values than AK.

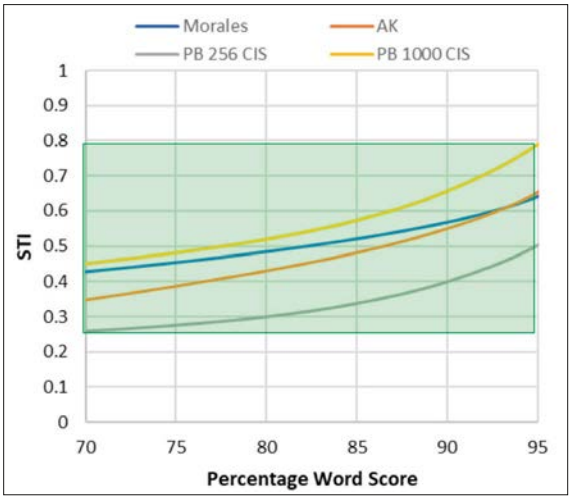
d) As such, an organisation wishing to nominate or approve a given STI performance for a situation based on a limited understanding of STI could readily use the STI value without an understanding of the potential loss of intelligibility, particularly with respect to unfamiliar words and poor talker articulation. For example, an approval of STI of 0.5 for a system with a poor frequency response could have a PB word loss of up to 30% as shown by Scenario 3.

Conversion type	Morales	Anderson & Kalb	PB 1000 words	PB 250 words
STI range	0.21	0.31	0.34	0.24

Above:
Table 5: Range of STI values for word-score losses of 5% to 30%

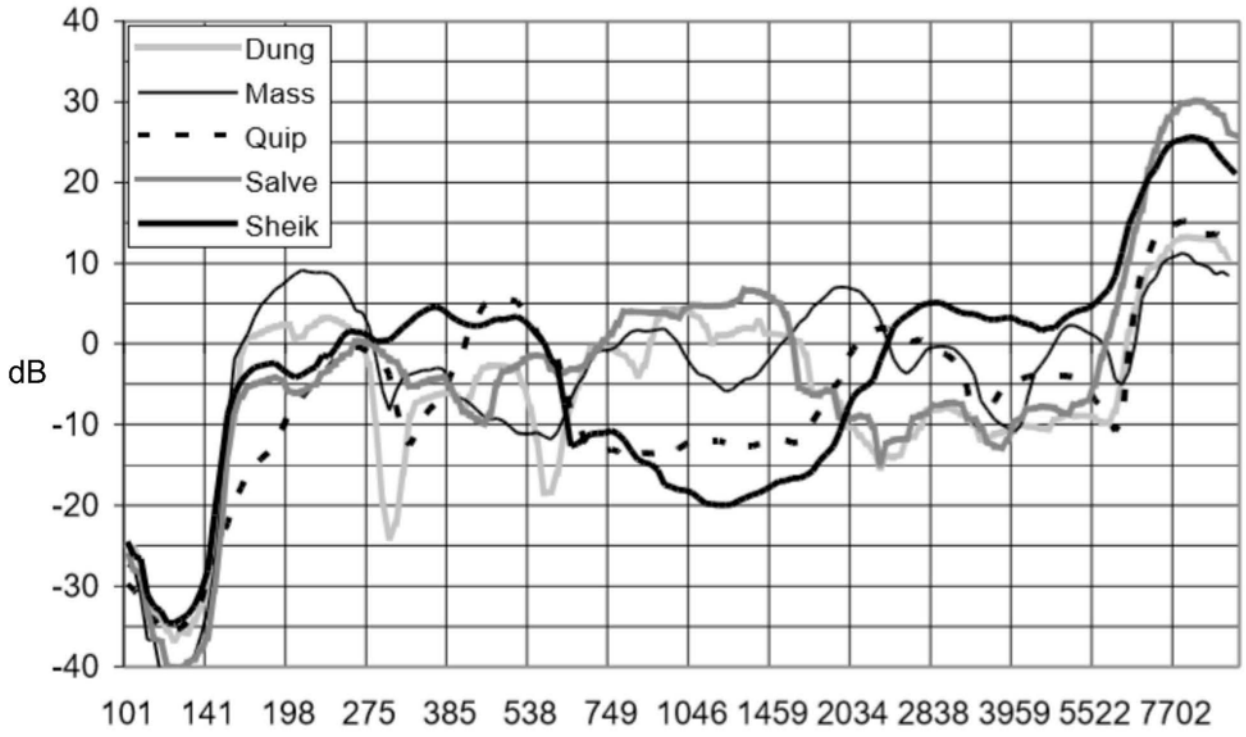
e) A primary difficulty is that no STI verification has been done for speech in which the tonal structure within the 250 Hz to 4 kHz has been significantly distorted. As such, none of the four relationships may properly represent the increased loss of intelligibly that occurs from self-speech masking when poor frequency responses cause higher-energy vowels to mask lower-energy consonants.

f) The measured STI values are based on a long-term average speech spectrum, whereas the spectra of individual words can show large differences with that average spectrum. This is illustrated in Figure 9, which shows the difference between the standardised IEC speech spectrum and the spectra of five PB words used in the 2003 study. Differences of up to 20 dB are evident. The possibility of self-speech masking with these types of spectra becomes much more likely during words with soft consonants at the end such as 'salve', 'sheik', 'quip' and 'dung'. The self-masking that can occur with these types of words is essentially not recognised by STI's masking algorithm.



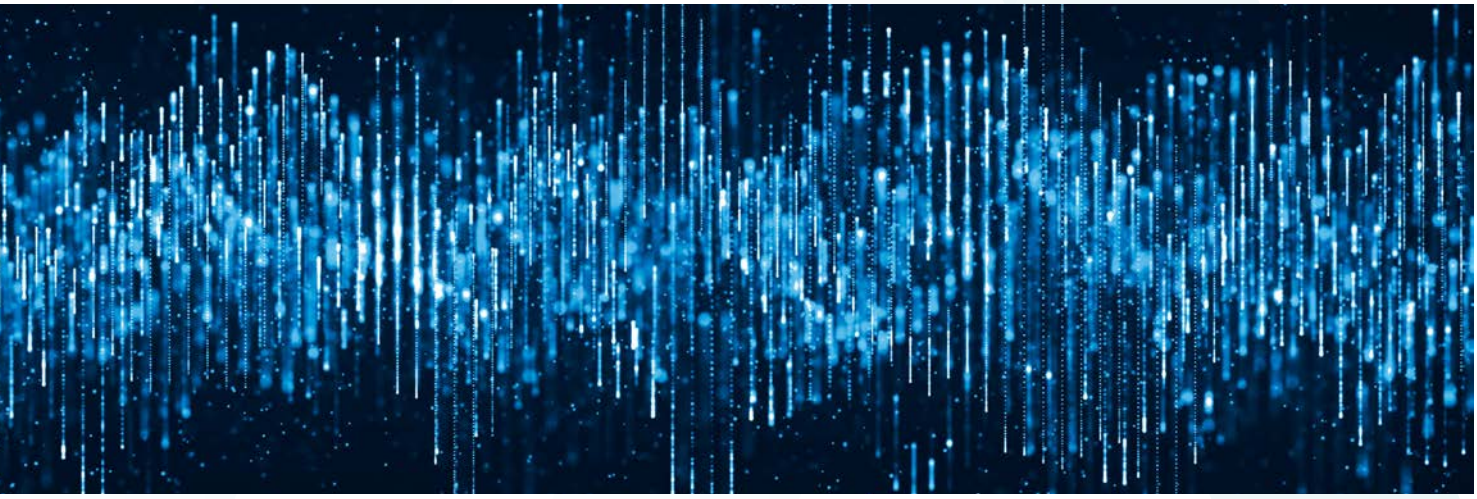
Left:
Figure 8: Expanded view of reversed relationship between STI and word score

Below:
Figure 9: Differences in the spectra of five PB words and the standard IEC speech spectrum



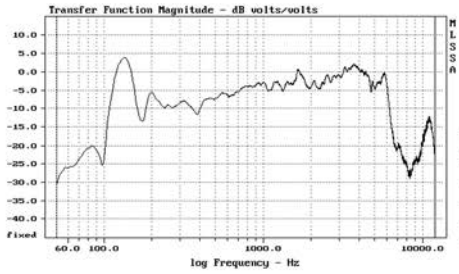
g) As a 'broad brush' approach, the measured STI results appear to reasonably represent the word scores if the Morales or AK conversions are used. However, when the receipt by listeners of critical information is at stake and the talkers are untrained, the broad brush of the STI is not able to satisfactorily quantify the actual loss of intelligibility.

h) In summary, the speech transmission index is an extremely valuable tool to understand the ability of a reverberant transmission channel to provide intelligibility for listeners, however care is required to ensure that the frequency response of the channel is relatively flat. Otherwise the actual loss of word-recognition may be substantially higher than is generally believed in the field. P56

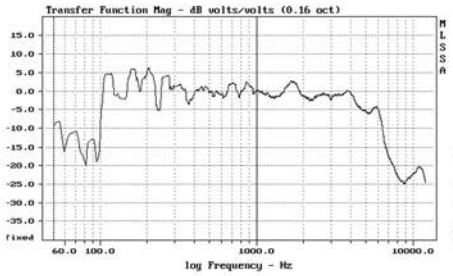


APPENDIX
FREQUENCY RESPONSES OF FILTER SCENARIOS

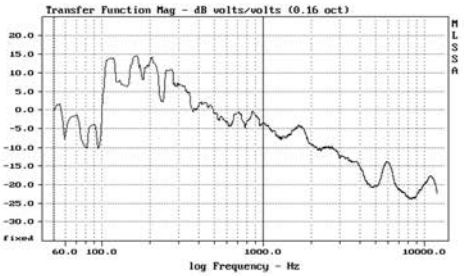
Anechoic response of lsp



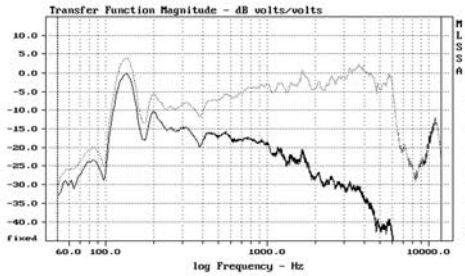
Reverberant response of speaker



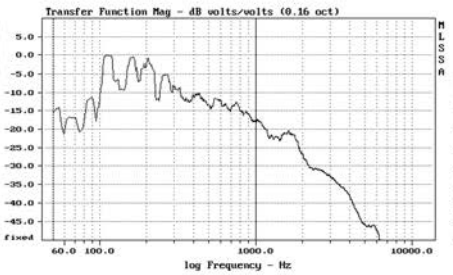
Response of lsp with tonal filter



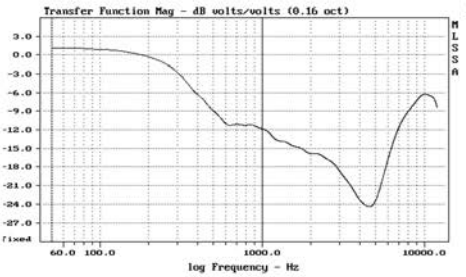
Anechoic response of lsp with speech filter



Reverb. response. of lsp with speech filter



Filter response

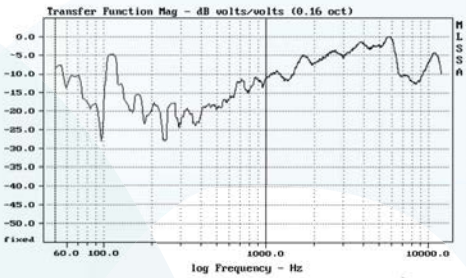


Scenario 1

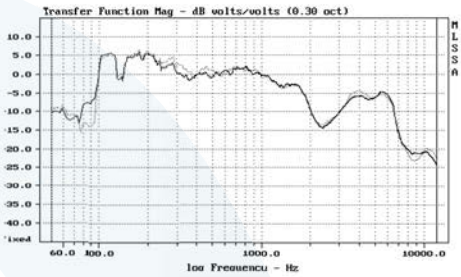
Scenario 2

Scenario 3

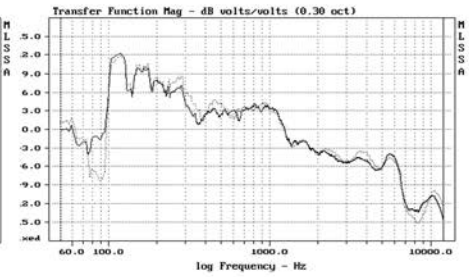
Response of lsp with tonal filter



Response of lsp with tonal filter



Response of lsp with tonal filter



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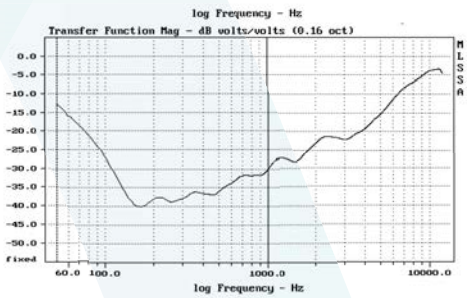

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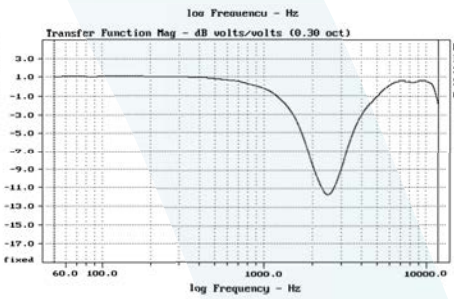

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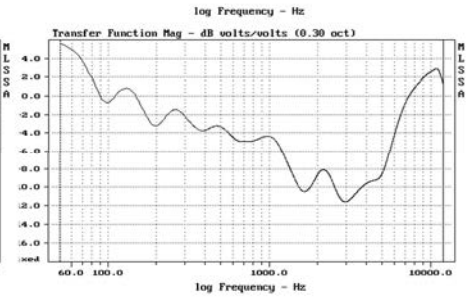
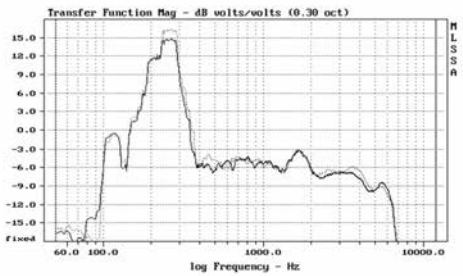


Scenario 4

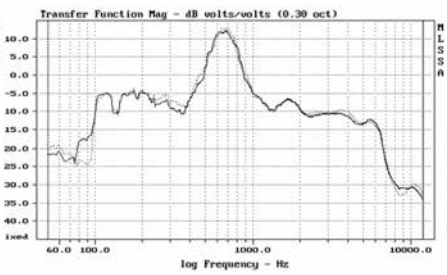
Scenario 5

Scenario 6

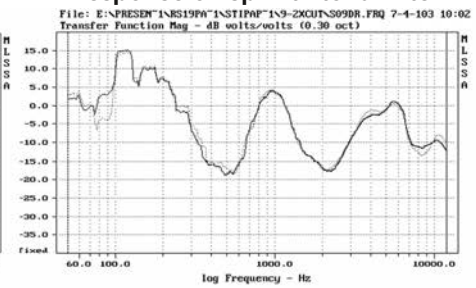
Response of lsp with tonal filter



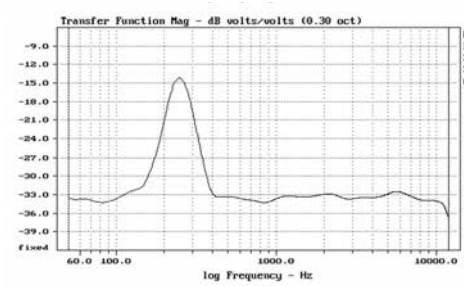
Response of lsp with tonal filter



Response of lsp with tonal filter

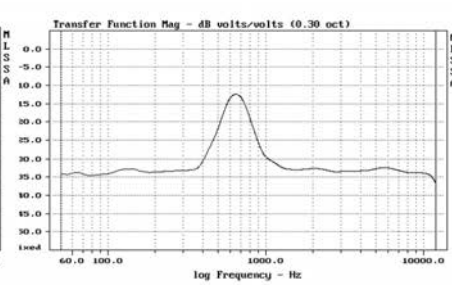


Filter response



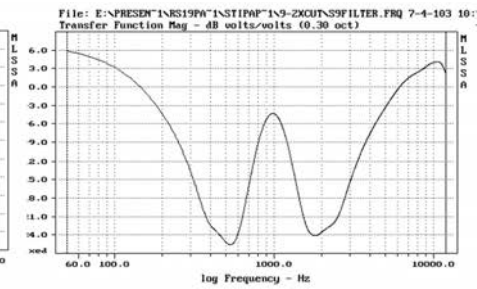
Scenario 7

Filter response



Scenario 8

Filter response



Scenario 9

Register now for Inter-noise 2022

The 51st International Congress and Exposition on Noise Control Engineering will be held at the Scottish Event Campus (SEC) in Glasgow on 21-24 August 2022.

This major international conference on noise control engineering attracts scientists, engineers and consultants from around the world. More than 1,000 abstracts have been submitted from all around the globe: 380 from Europe, over 100 from China, 150 from Asia Pacific and 100 from the Americas, as well as many more.

A huge thank you to the IOA membership as 210 abstracts have been submitted from the UK and Ireland!

Of the 1,000 abstracts submitted, over 800 presenters are intending to attend the conference in Glasgow in person. Inter-Noise 2022 organisers

are excited to provide an opportunity, after a difficult couple of years, to get together with international delegates, exhibitors, and sponsors, face-to-face in Glasgow.

Sustainability

The congress theme, *Noise Control in a More Sustainable Future* covers many aspects of sustainability in the programme:

- modern construction methods and embodied carbon;
- sell and buy quiet;
- acoustics and educating the next generations;
- acoustics supporting sustainable economies; and
- acoustics and UN sustainability goals.

Inter-Noise 2022 is working towards a sustainable agenda, to manage the social, economic and environmental impacts of the congress.

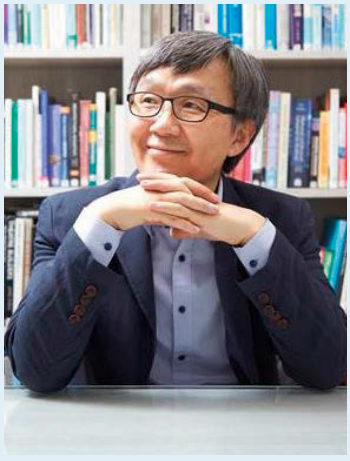
Keynote speaker spotlight

Professor Maria Heckl

Left: Professor Maria Heckl's presentation is *Sustainable Combustion Technologies Need Acoustics Research*

Right: Professor Jin Yong Jeon's presentation is *Soundscape and Digital Therapeutics: Psycho-physiological Restoration*

Professor Jin Yong Jeon



Find out about keynote speakers here **https://internoise2022.org/keynote-speakers/**

Technical programme

The technical programme, offering at least 14 parallel sessions will cover the main topics ranging from aircraft noise to underwater, ship and offshore acoustics. Included is the topic: **Profession**, **Training and Outreach**, which will be of special interest to young researchers, engineers and consultants who are at the early stage of their careers. Find out about the main topics here **https://internoise2022.org/main-topics/**

Virtual option

Should you be unable to travel to Glasgow, we are also offering the option to join virtually, with four rooms of the programme available via livestream and the rest of the programme available to view online after the conference has ended.

Students/early career delegates

We have reduced registration fees for students who may not wish to present a paper as yet but would like to mingle with people active in their area of research. We are also organising various social events for early career delegates. Join us at the breakfast networking event on Monday 22 August and the early career social event on the evening of Tuesday 23 August.

Register now to take advantage of the early bird registration rate!
https://internoise2022.org/registration/

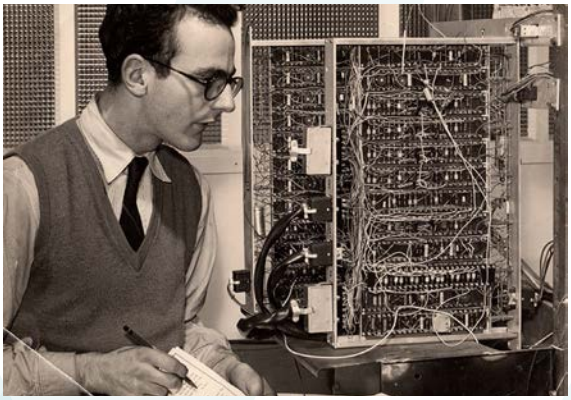
Registration Fees

Registration Fees are in GBP and include VAT @ 20%

REGISTRATION TYPE	DEADLINE	COST
Delegate Early Bird	by 8th July 2022	£488
Delegate Standard	from 9th July 2022	£535
Delegate Onsite	from 21st August 2022	£595
Student Early Bird	by 8th July 2022	£93
Student Standard	from 9th July 2022	£108
Student Onsite	from 21st August 2022	£130

Alan Dudley Wallis

(1935 – 2022) – Living a life less ordinary



Dudley was instrumental in the early years of Cirrus Research and the development of many of the key projects it is still known for today.

Left: Dudley 'fixing' the germanium transistor core store 'read' amplifier at GEC in early 1958

Dudley's love of electronics came out of necessity from learning how to fix a bicycle lamp at the age of seven during WWII.

Even at such an early age, this made him realise that technology was what he wanted to do; not only that, but "do it" by designing products himself with his own company. Was that a ridiculous dream for a seven-year-old? Having never deviated from that path, and becoming owner-director of two 'brand' instrument companies as well as a producer operation, Contract Production Ltd, Dudley's career proves dreams can come true.

From humble beginnings in a South Yorkshire mining community and after stints in the RAF, GEC, and Marconi, Dudley joined Dawe – one of the world's top three manufacturers of sound measurement products (at the time). At Dawe, he discovered that the production of sound level meters posed all kinds of technical challenges. This led Dudley to develop several key innovations that were, in the end, an aid in the development of sound meters in his own company, such as the quasi rms circuit used in many future sound level meters.

Dudley's first company, Custom Electronic Associates Ltd, was formed on 21st June 1971. That took over the assets of his 1969 'garage-based' business, Castle Associates, which was sold to the other business partners. The "little spin-off" from that, Cirrus Research, became the main company in the Cirrus Research family from 1980.

In that first start-up designing a new meter was the easy part, selling it was a different matter. But with nothing to lose, Dudley designed and built a prototype meter in his garage using a new idea for a low current circuit and included A-frequency weighting as an integrated part of the amplifier. This was followed by his new quasi-rms rectifier that used a new type of diode.

Success grew from there. This had been hard-fought at times as life threw obstacles in the way and when finances were challenging, feeding his family became his key motivation. Dudley pioneered the use of integrated circuitry in sound measurement instruments in place of discrete transistors. Other key innovations included developing the first sound level meter to be styled with coloured scales and fitted into moulded cases, and developing the world's first true linear scaled meter. And in the 1980s, designing the first L_{eq} meter to meet the new international standard as well as a series of Class 1 sound meters; he and three other British engineers were responsible for much of the IEC's noise measurement standard IEC 61672.

During the 1990s, Cirrus Research was exporting its meters to over 50 countries, recognised by gaining the Queen's Award for Export Achievement. In 1995, under Dudley's stewardship, the rule book on noise dosimetry was torn up with the development of the world's first truly wireless noise dosimeter, the doseBadge, a completely new design for a personal noise measurement instrument, different from anything that had come before or after.

Below: Dudley as a 34-year old corporate 'salaryman' at a Lucas/Dawe board reception a few days before he started his own business

Dudley's role in the IOA

In 1989 the IOA was in what the then Secretary, Cathy Mackenzie, later called the "starvation phase" of its history. Although membership of the IOA had been growing, it had in effect been operating at a loss. The incoming President, Chris Rice, convened a sub-committee to propose ways of resolving the issues. It was during these sub-committee meetings that the support offered by the non-academic members was most helpful, not least that given by Dudley, who, in confidence to the President, offered to underwrite any failed attempt to rectify a short-term deficit in the financial situation should this arise. The IOA moved from Edinburgh to St Albans resulting in a small surplus, and with additional effort, principally by Dudley, supplementary income was gained by reorganising the member structure, introducing both key sponsor and sponsor grades and allowing advertising in the Acoustics Bulletin; all resulting in a reliable income from commercialisation that would previously never have been considered. This move almost certainly guaranteed the survival of the IOA and continues to provide security of income to this day.

Dudley retired from day-to-day involvement with Cirrus Research in 1996. So, did seven-year old Dudley's dreams come true? They most certainly did, far beyond anything he ever imagined.

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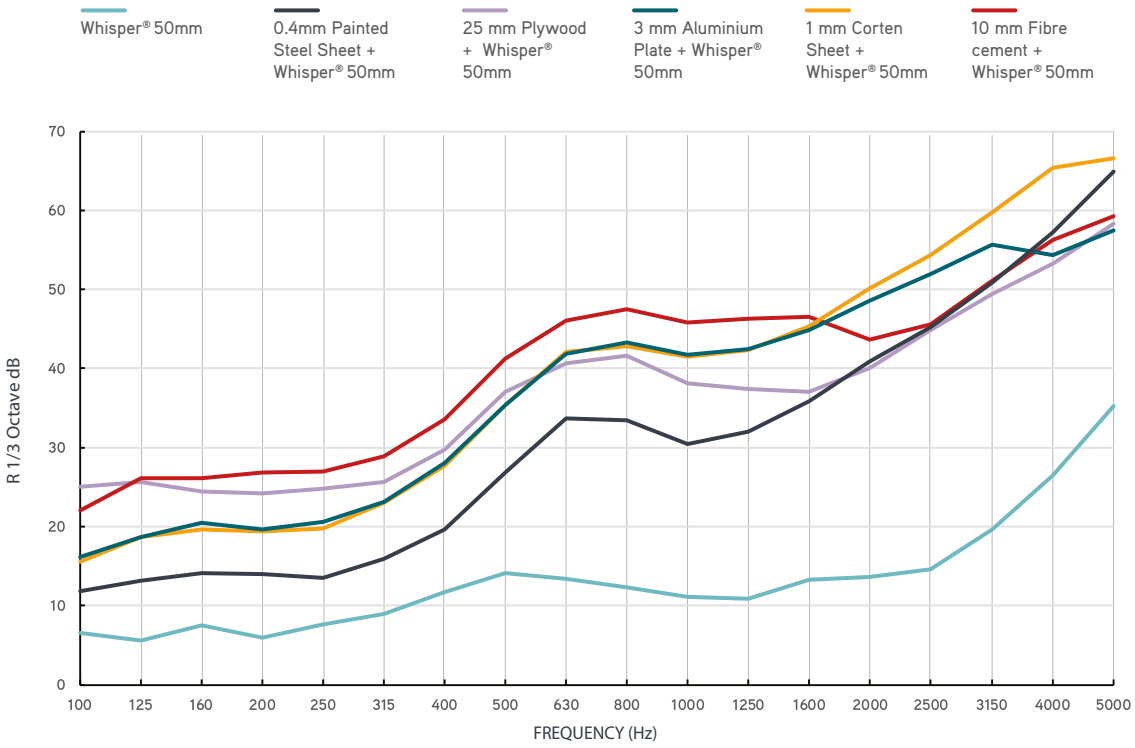

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IOA Royal Charter application

In 2020, the IOA Executive made the decision to apply for a Royal Charter. The chair of the group tasked with the application, Russell Richardson, provides some background on the application process and gives an update on progress to date.

Institute of Acoustics

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16 March 2022

The Privy Council Office,
2, Carlton Gardens,
London,
SW1Y 5AA

We write as agreed, this letter of intent to seek permission to petition for a Royal Charter of incorporation.

The Institute of Acoustics (IOA)

Why are we applying for the Award of Chartered Status?

The Institute is a Charitable body (267026) with a mission to promote and advance the art, science and technology of acoustics in all their aspects.

As an organisation we have promoted excellence through education, training and regulation of membership standards and ethics for nearly 50 years. We believe that the grant of Chartered status would recognise the public interest in the Institute's continuing demand for excellence from its members to provide a productive environment for cross-fertilisation of ideas and initiatives.

The range of interests of members within the world of acoustics embraces aspects as diverse as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, underwater acoustics, together with a variety of environmental aspects.

The Institute of Acoustics requires its members to conduct themselves so as to safeguard the public interest in matters of safety, health and the environment, exercise their professional skill and judgement to the best of their ability, discharge their professional responsibilities with integrity, honesty and diligence and treat all persons fairly and with respect.

The Institute will rank alongside other chartered bodies and attract a widening pool of talented individuals, aspiring to ever higher standards of expertise and professionalism. Chartered status is a public endorsement of the value of the service given by members for the public good.

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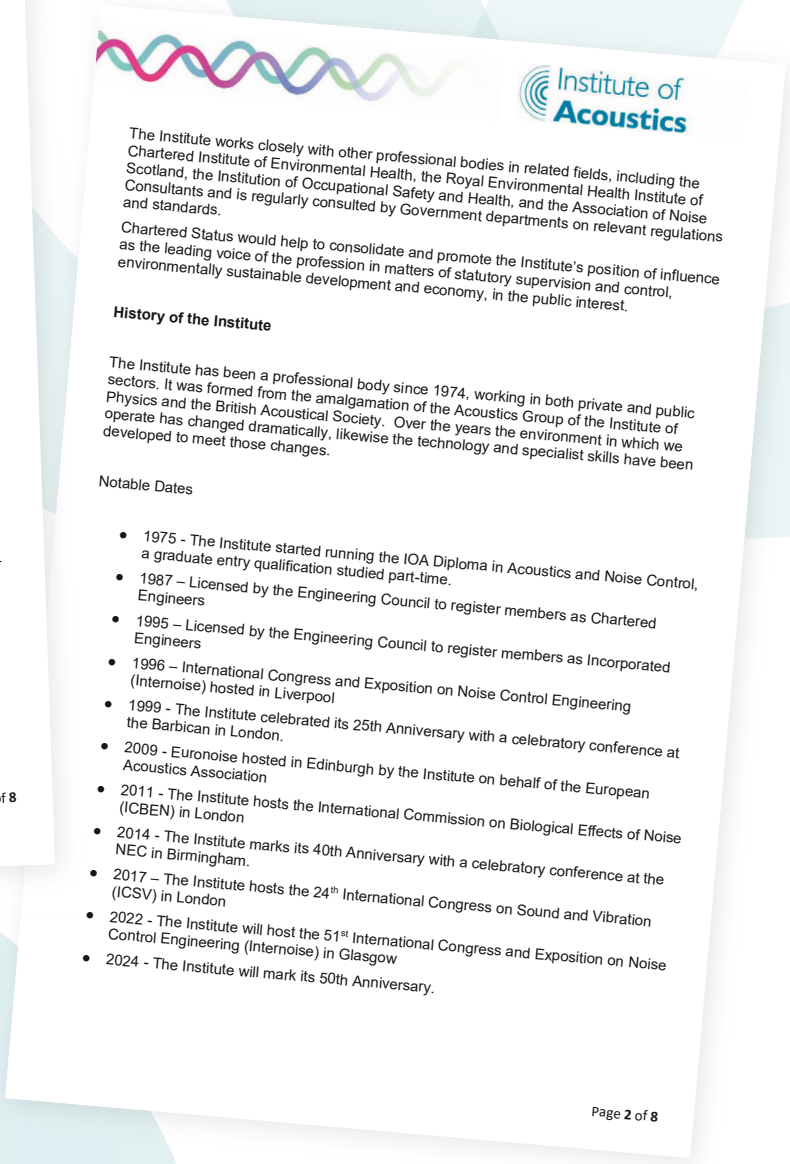

Institute of Acoustics

The Institute works closely with other professional bodies in related fields, including the Chartered Institute of Environmental Health, the Royal Environmental Health Institute of Scotland, the Institution of Occupational Safety and Health, and the Association of Noise Consultants and is regularly consulted by Government departments on relevant regulations and standards.

Chartered Status would help to consolidate and promote the Institute's position of influence as the leading voice of the profession in matters of statutory supervision and control, environmentally sustainable development and economy, in the public interest.

History of the Institute

The Institute has been a professional body since 1974, working in both private and public sectors. It was formed from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society. Over the years the environment in which we operate has changed dramatically, likewise the technology and specialist skills have been developed to meet those changes.

Notable Dates

- 1975 - The Institute started running the IOA Diploma in Acoustics and Noise Control, a graduate entry qualification studied part-time.
- 1987 – Licensed by the Engineering Council to register members as Chartered Engineers
- 1995 – Licensed by the Engineering Council to register members as Incorporated Engineers
- 1996 – International Congress and Exposition on Noise Control Engineering (Internoise) hosted in Liverpool
- 1999 - The Institute celebrated its 25th Anniversary with a celebratory conference at the Barbican in London.
- 2009 - Euronoise hosted in Edinburgh by the Institute on behalf of the European Acoustics Association
- 2011 - The Institute hosts the International Commission on Biological Effects of Noise (ICBEN) in London
- 2014 - The Institute marks its 40th Anniversary with a celebratory conference at the NEC in Birmingham.
- 2017 – The Institute hosts the 24th International Congress on Sound and Vibration (ICSV) in London
- 2022 - The Institute will host the 51st International Congress and Exposition on Noise Control Engineering (Internoise) in Glasgow
- 2024 - The Institute will mark its 50th Anniversary.

The first question most members ask when the subject is raised is what is a Royal Charter?
The Privy Council Office provides the following description:

Incorporation by Charter is a prestigious way of acquiring legal personality and reflects the high status of the body. The grant of a Charter comes from the Royal prerogative, that is to say, the grant is made by the Sovereign on the advice of the Privy Council.

The application is a two-stage process. Initially, a Letter of Intent is submitted to The Privy Council Office, detailing the history and achievements of the Institute, its educational role and its dealings with Government and the wider international community. Critically, evidence is required of the extent to which the Institute is pre-eminent in its field and how its activities benefit society. In this respect we are grateful for the support of numerous other professional bodies. The Letter of Intent was submitted to The Privy Council Office in March and is published in full here. We await a response to that and, should that be acceptable, we will be invited to submit a Petition to The Sovereign in Council, which constitutes the formal application. P64

Institute of Acoustics

Role of the Institute

1. To assess the initial and continuing competence of those seeking admission to the Institute, and to require them to abide by the Institute's Code of professional conduct while practising their profession.
2. To hold, promote or support conferences, lectures, symposia for the discussion, promotion or advancement of the art, science and technology of acoustics. Branch meetings are open to members and non-members alike at no cost.
3. To stimulate interest in, and advance the study of, the art, science and technology of acoustics in all their aspects.
4. To encourage theoretical, experimental and applied research directed towards the advancement of the art, science and technology of acoustics.
5. To promote, assist and advise on elementary and advanced education in the art, science and technology of acoustics.
6. To co-operate with any national or international bodies, societies, organisations, associations, companies or persons whose objects are to advance the study and understanding of the art, science and technology of acoustics, or include the advancement and application of such study and understanding.

Membership of the Institute

The Institute currently has approximately 3400 members. Membership grades include Student, Technician, Affiliate, Associate, Member, Fellow and Honorary Fellow.

Institute members contribute to, and volunteer on, British and international standards and outreach participating in STEM festivals and school partnerships and have close links with other international acoustics institutes and associations.

Management Organisation of the Institute

The Institute is constituted under a governance model with a member-elected Council, chaired by the President, which determines the strategic aims and objectives of the Institute that are to take place over a rolling two year period.

The Institute's Executive Committee, formed of the Honorary Officers (President, President Elect, Immediate Past-President, Hon. Secretary and Hon. Treasurer) and the Chief Executive, with the assistance of permanent staff at HQ, is responsible for delivering these aims and objectives.

An active structure of specialist groups and regional branches throughout the UK and overseas (Ireland and the Middle East) assist the Institute in delivering regular and localised events which can be included as CPD and support for members.

Page **3** of **8**

Institute of Acoustics

Finances

The Institute is financed from two principal sources: annual corporate membership income and fees for the provision of education services (please see further details of the IOA education programmes herein). Further income can be generated through events, although the Institute aims to run most events at cost in order to make them as accessible as possible to both members and non-members.

The Institute's finances are very stable, with membership being maintained at similar levels over many years and both the short courses and longer Diploma programmes being well-subscribed on an ongoing basis.

Our reserves are maintained at a minimum level in accordance with our Reserves Policy, enabling us to plan on a long-term basis and, where necessary, to respond to more immediate requirements, as appropriate, in pursuit of the charity's mission and objectives.

Qualifications required for membership of the Institute

Membership of the Institute is open to persons who satisfy the Council as being suitably qualified academically in acoustics or have an appropriate period of experience in acoustics in lieu of such qualification.

Historically, membership of the Institute would have been open to professionals holding a degree in acoustics as this was the traditional route into the field. In more recent years, it has been possible for applicants to provide evidence of their suitability for membership through professional skills and experience over a number of years. In the case of the lowest level of Corporate membership, for example, a candidate is required to show a minimum of seven years of responsible work which demands a knowledge of acoustics or its application. The study of other acoustics courses, for example, the Institute's own Diploma in Acoustics and Noise Control, can also be used as part of a mix of experience and non-degree academic study.

Educational Role

The Institute has an active, volunteer led, STEM committee that brings together STEM enthusiasts from all corners of the industry to improve our outreach and arrange attendance at a wide variety of STEM related events. Many of the Institute's members are STEM ambassadors and the IOA has also recently created a film and supporting booklet on careers in STEM.

For a number of years, the IOA has been a sponsor of Edinburgh Science, which delivers a programme of STEM Outreach in Scotland and Sheffield.

In addition to the careers fairs, members of the Institute have been supported when undertaking virtual outreach activities, such as for a TeenTech at Home Innovation Session, or through the STEM Ambassadors Programme. The Institute is also in contact with and provides activities and career related content for the STEMHub.

For the International Year Of Sound, which was planned for 2020, but was extended into 2021 due to the pandemic, the Institute organised a competition for schools, related to sound

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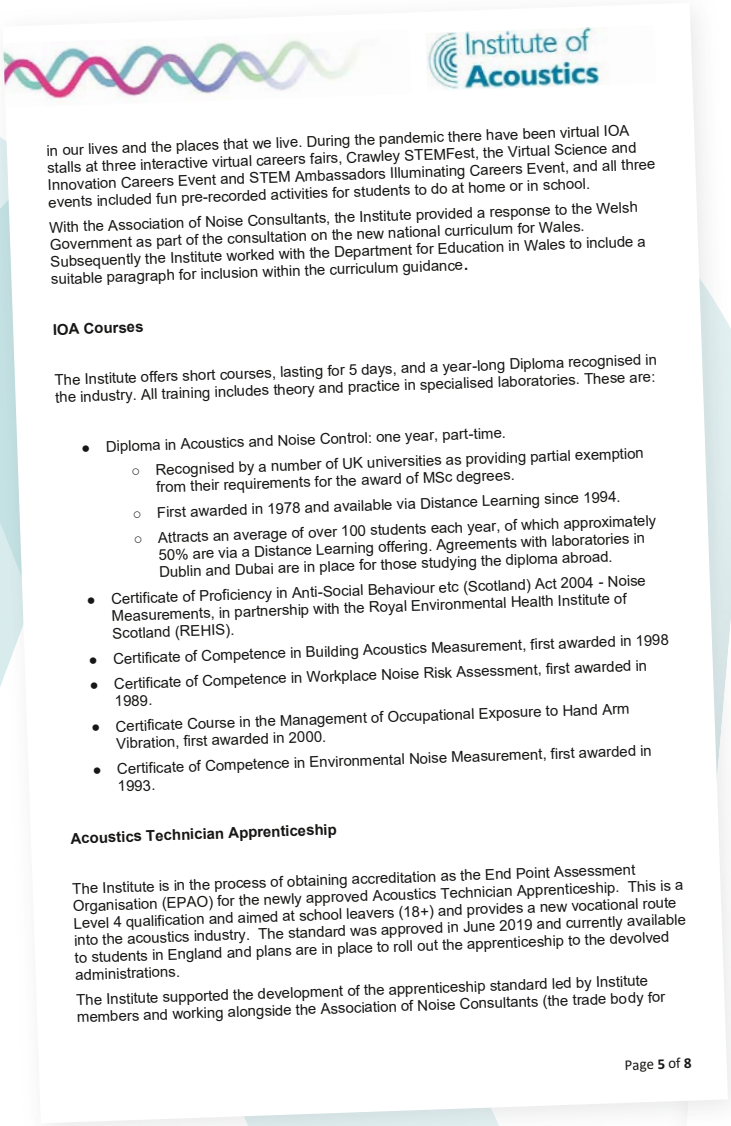

in our lives and the places that we live. During the pandemic there have been virtual IOA stalls at three interactive virtual careers fairs, Crawley STEMFest, the Virtual Science and Innovation Careers Event and STEM Ambassadors Illuminating Careers Event, and all three events included fun pre-recorded activities for students to do at home or in school.

With the Association of Noise Consultants, the Institute provided a response to the Welsh Government as part of the consultation on the new national curriculum for Wales. Subsequently the Institute worked with the Department for Education in Wales to include a suitable paragraph for inclusion within the curriculum guidance.

IOA Courses

The Institute offers short courses, lasting for 5 days, and a year-long Diploma recognised in the industry. All training includes theory and practice in specialised laboratories. These are:

- Diploma in Acoustics and Noise Control: one year, part-time.
  - Recognised by a number of UK universities as providing partial exemption from their requirements for the award of MSc degrees.
  - First awarded in 1978 and available via Distance Learning since 1994.
  - Attracts an average of over 100 students each year, of which approximately 50% are via a Distance Learning offering. Agreements with laboratories in Dublin and Dubai are in place for those studying the diploma abroad.
- Certificate of Proficiency in Anti-Social Behaviour etc (Scotland) Act 2004 - Noise Measurements, in partnership with the Royal Environmental Health Institute of Scotland (REHIS).
- Certificate of Competence in Building Acoustics Measurement, first awarded in 1998
- Certificate of Competence in Workplace Noise Risk Assessment, first awarded in 1989.
- Certificate Course in the Management of Occupational Exposure to Hand Arm Vibration, first awarded in 2000.
- Certificate of Competence in Environmental Noise Measurement, first awarded in 1993.

Acoustics Technician Apprenticeship

The Institute is in the process of obtaining accreditation as the End Point Assessment Organisation (EPAO) for the newly approved Acoustics Technician Apprenticeship. This is a Level 4 qualification and aimed at school leavers (18+) and provides a new vocational route into the acoustics industry. The standard was approved in June 2019 and currently available to students in England and plans are in place to roll out the apprenticeship to the devolved administrations.

The Institute supported the development of the apprenticeship standard led by Institute members and working alongside the Association of Noise Consultants (the trade body for

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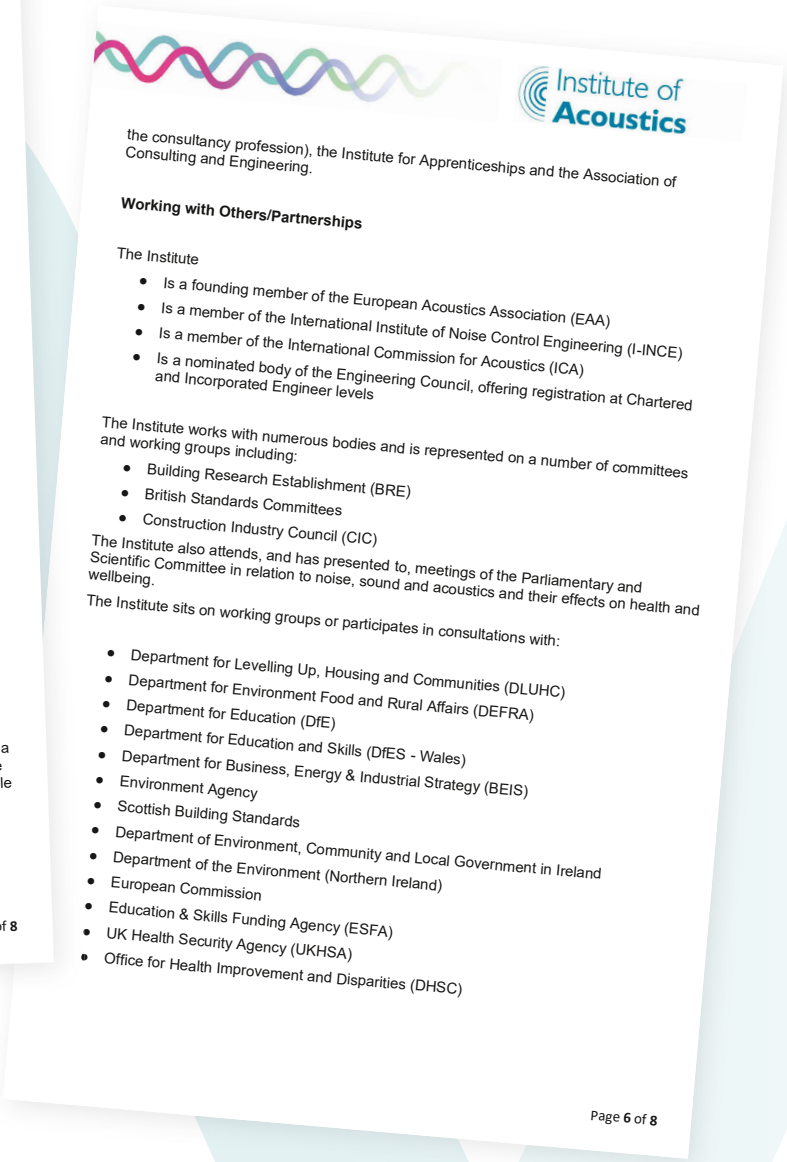

the consultancy profession), the Institute for Apprenticeships and the Association of Consulting and Engineering.

Working with Others/Partnerships

The Institute

- Is a founding member of the European Acoustics Association (EAA)
- Is a member of the International Institute of Noise Control Engineering (I-INCE)
- Is a member of the International Commission for Acoustics (ICA)
- Is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels

The Institute works with numerous bodies and is represented on a number of committees and working groups including:

- Building Research Establishment (BRE)
- British Standards Committees
- Construction Industry Council (CIC)

The Institute also attends, and has presented to, meetings of the Parliamentary and Scientific Committee in relation to noise, sound and acoustics and their effects on health and wellbeing.

The Institute sits on working groups or participates in consultations with:

- Department for Levelling Up, Housing and Communities (DLUHC)
- Department for Environment Food and Rural Affairs (DEFRA)
- Department for Education (DfE)
- Department for Education and Skills (DfES - Wales)
- Department for Business, Energy & Industrial Strategy (BEIS)
- Environment Agency
- Scottish Building Standards
- Department of Environment, Community and Local Government in Ireland
- Department of the Environment (Northern Ireland)
- European Commission
- Education & Skills Funding Agency (ESFA)
- UK Health Security Agency (UKHSA)
- Office for Health Improvement and Disparities (DHSC)

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Since 1155, when the first Royal Charter was granted to the Worshipful Company of Weavers, around 1,000 Charters have been granted, with around 750 still in existence. Charters are granted rarely these days so it is not a forgone conclusion, although we are very optimistic that our case is strong. We have taken advice from an external advisor who has worked successfully with other bodies to obtain Charters and he is confident that we have a convincing case.

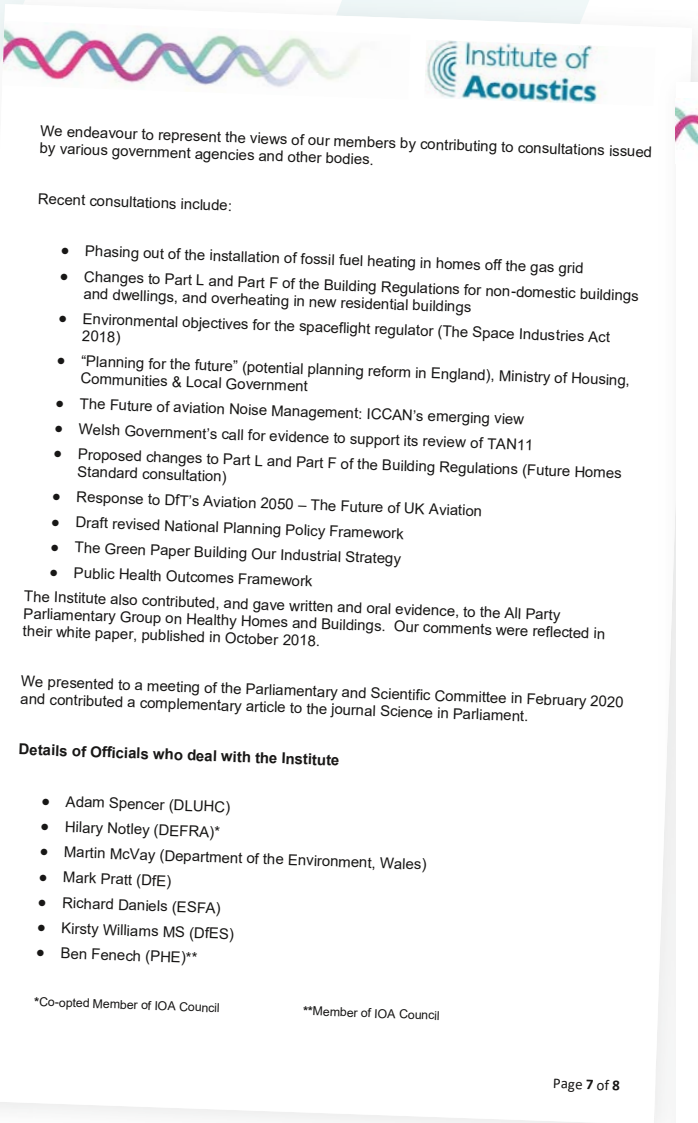
The benefits of being granted a Royal Charter

The principal benefit is the prestige that the Charter gives the Institute, recognising its distinguished role in acoustics in the United Kingdom. The criteria by which this role is judged are those related to benefit to society and the Institute's role in providing education, as well as the more obvious technical excellence as a learned society.

Which changes will members see?

In general day to day operation, there will be little change. Behind the scenes, as the Charter would incur a change in legal status, it will be necessary for some of the Institute's administrative documents, such as the Articles of Association, to be amended. Given the current documents were last reviewed in 2005, we see this as an opportunity for the documents to be updated to reflect the Institute as it currently operates. We would be able to change our name to be the Chartered Institute of Acoustics should we wish, but this is not a requirement. We would not to be allowed to use the 'Royal' prefix. One for the future, perhaps...

The members of the group looking into the Royal Charter submission are Russell Richardson, Fiona Rogerson, Chris Turner and Reena Mahtani.



Institute of Acoustics

We endeavour to represent the views of our members by contributing to consultations issued by various government agencies and other bodies.

Recent consultations include:

- Phasing out of the installation of fossil fuel heating in homes off the gas grid
- Changes to Part L and Part F of the Building Regulations for non-domestic buildings and dwellings, and overheating in new residential buildings
- Environmental objectives for the spaceflight regulator (The Space Industries Act 2018)
- "Planning for the future" (potential planning reform in England), Ministry of Housing, Communities & Local Government
- The Future of aviation Noise Management: ICCAN's emerging view
- Welsh Government's call for evidence to support its review of TAN11
- Proposed changes to Part L and Part F of the Building Regulations (Future Homes Standard consultation)
- Response to DfT's Aviation 2050 – The Future of UK Aviation
- Draft revised National Planning Policy Framework
- The Green Paper Building Our Industrial Strategy
- Public Health Outcomes Framework

The Institute also contributed, and gave written and oral evidence, to the All Party Parliamentary Group on Healthy Homes and Buildings. Our comments were reflected in their white paper, published in October 2018.

We presented to a meeting of the Parliamentary and Scientific Committee in February 2020 and contributed a complementary article to the journal Science in Parliament.

Details of Officials who deal with the Institute

- Adam Spencer (DLUHC)
- Hilary Notley (DEFRA)*
- Martin McVay (Department of the Environment, Wales)
- Mark Pratt (DfE)
- Richard Daniels (ESFA)
- Kirsty Williams MS (DfES)
- Ben Fenech (PHE)**

*Co-opted Member of IOA Council **Member of IOA Council

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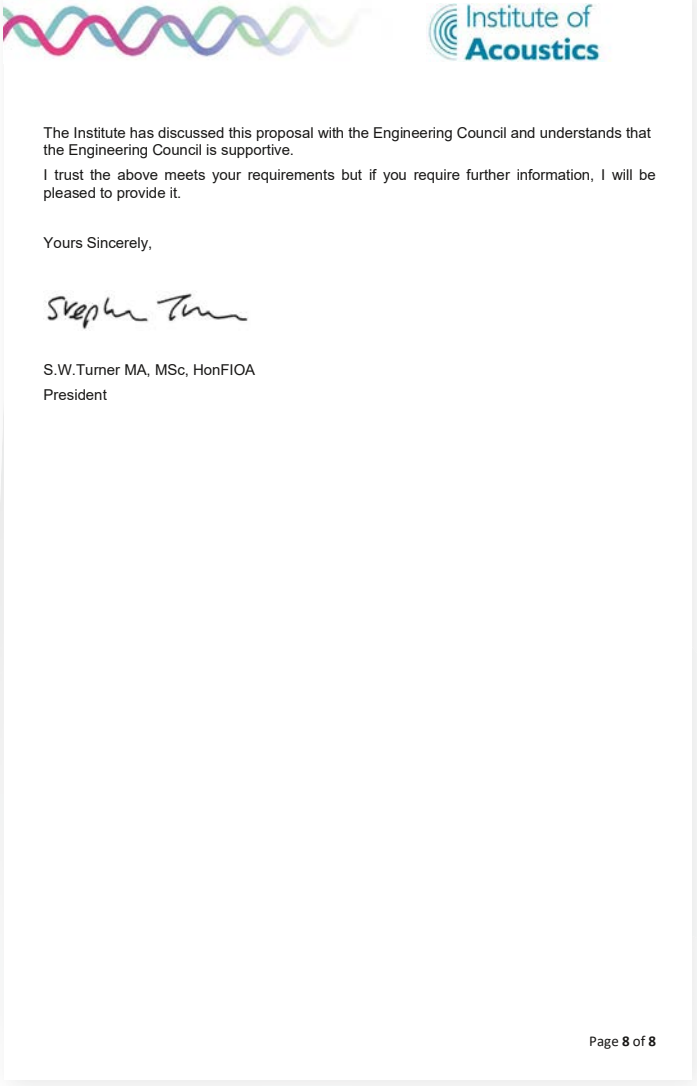

Institute of Acoustics

The Institute has discussed this proposal with the Engineering Council and understands that the Engineering Council is supportive.

I trust the above meets your requirements but if you require further information, I will be pleased to provide it.

Yours Sincerely,

S.W.Turner MA, MSc, HonFIOA

President

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Engineering Integrity Society Instrumentation, Analysis and Testing Exhibition

The Engineering Integrity Society's Instrumentation, Analysis and Testing Exhibition will be held on 17 May 2022 in Hall 3 at the Silverstone Circuit overlooking the racetrack. The event has been running for over 30 years and has grown significantly.

The event is aimed at companies and individuals with an interest in the field of engineering involving measurement, analysis, testing and prediction. It covers many sectors including automotive, aerospace, motorsport, rail, off-highway, mechanical handling, civil engineering, industrial and power generation. Acoustics engineers will be able to see the latest acoustic transducers as well as hardware and software for digital signal processing and analysis.

Attendance is free and visitors receive complimentary refreshments and free parking. In addition, all visitors have the chance to win a Silverstone driving experience.

Seminars

A key part of the day is a series of mini seminars and this year's theme is *Instrumentation and Measurement in the Future Digital World*. With presentations throughout the day from well-respected engineers across several different sectors, a wide range of topics will be covered.

The Instrumentation, Analysis and Testing Exhibition attracts visitors from all over the UK and is seen by many as the go-to event for testing and analysis technologies. For more information or to register your attendance, please contact the EIS Marketing & Events Manager (Sara Atkin): **info@e-i-s.org.uk** or visit **www.e-i-s.org.uk**

BRANCH NEWS

Southern Branch

Designing soundscapes for urban spaces

By David Yates, Syntegra Consulting

On Friday 18 March 2022, the Southern Branch welcomed Professor Jian Kang of University College London to present on *A framework and potentials for designing soundscapes in urban open public spaces.*

86 people attended online and the presentation focused on a methodology for moving beyond noise reduction techniques to soundscape creation and, specifically, considered that soundscape research will bring a step change in environmental acoustics by considering environmental sounds as a 'resource' rather than a 'waste'.

It was noted that this will support the design and implementation of the urban sound environment to promote health, attract investment, convey cultural uniqueness and enhance quality of life.

The framework presented a range of considerations including the level, spectrum and physical characteristics of each sound source type, to the effect of the space the source type is in and psychological expectations of the users in that space. It was developed by considering research from the UK, EU and China.

The type of sounds considered are divided into two areas 'active sounds' (e.g. group dancing, music) and 'passive sounds' (e.g. water fountains) and looked at designable factors such as the spectrum of the sound, dynamic processes and acoustic zones and scales to ensure a suitable aural space for each zone.

An image source method technique was used to create a noise map for a new fountain installation outside Sheffield Town Hall. Psychoacoustic effects and environmental effects were then discussed to demonstrate different preferences of different demographics, including expectations in different countries. All of this information was used to create a *sound map* of the installation containing greater details than a typical noise map.

Finally, some case study examples of different water installations and the soundscapes created around Sheffield were presented along with some audio recordings to demonstrate the results achieved using the methods.

Immediately prior to the meeting, the Southern Branch held its AGM during which long-standing committee member, James Jiang, stepped down and a number of members were re-elected. The Co-Chairmen for the next three years are Daniel Saunders (Clarke Saunders Associates) and David Yates (Syntegra Consulting) and the Secretary, Reena Mahtani (Sandy Brown) was re-elected to continue in her position.

Send your Branch reports for the next issue to editor, Nicky Rogers, at **nickyr@warnersgroup.co.uk** by 9 June 2022 latest please.

How writing a specification correctly can reduce the risk to your project

Specifications are passed down a lengthy chain. In the process of this journey, the intent behind the original specification can be lost, resulting in suboptimal solutions that entail a risk to your project. This risk can be avoided simply by getting the specification right. Here, Adam Fox, Director at Mason UK, offers three key principles for writing a good specification.

Above: Mason UK spring hangers

At its heart, a specification is a document that both defines a problem, offers a solution, then establishes a set of criteria whose satisfaction entails the successful implementation of that solution. This definition is a useful way of thinking about some common pitfalls that can emerge when writing a specification, so I'll return to it shortly.

For now, let's begin with why this matters so much. Part of the reason a specification is such a crucial document is because of its finality. As an acoustic consultant, once you produce this document and hand it over to the contractor then that may well be the last you see of it.

If a subcontractor further along the chain picks a suboptimal solution to save on cost or time to install correctly, or if an irresponsible supplier recommends a product that will not deliver the outcome, the acoustic consultant who wrote the specification may not know. There is a risk to the project and the end customer who will incur cost to resolve in the future.

The consultant might have written the document setting out the correct solution, but their intention has been lost in the chain. How does this happen or, more importantly, how can you prevent this from happening when you write your specification?

Having been called upon to provide retrofits where things have sometimes gone wrong, I've often pondered whether a more tightly written specification would have reduced the risks and if so, what general principles might govern the writing of a document like that? It is a tricky one to pin down, but here are three key things I think might help lower the risk to your project:

1) Make sure you answer the *how* question

Let's return to the definition offered at the outset. The specification should define a problem and a solution, but here's the important part – it needs to outline the criteria that determine whether that solution has been implemented correctly and in full. Take, for example, the following scenario: P68

An acoustic consultant is called in to identify a source of noise and vibration in an office building. They identify that the culprit is a pump on the roof of the structure. The problem, therefore, is the pump, and the solution is straightforward: you need to isolate it.

However, in this example you are missing the third component in our definition. Specifically, *how* do you isolate it? You need to identify the right engineering principles and incorporate these into the criteria. For example, you might specify the frequency and what other properties the isolator should have as a starting point. Now, you are not only offering a solution, but providing clear instructions as to *how* that solution is implemented.

2) The beauty is in the detail

This leads to the next important point. If you've read this far, it will come as no surprise that the next key ingredient in a good specification is the level of detail. It sounds so simple, but it's worth dwelling on why this is so important. Remember that the purpose of all this is to limit the risk to your project and that the specification document needs to have a degree of finality about it. It cannot leave any questions unanswered, so you need sufficient detail.

Of course, you don't want detail for its own sake. There is no point, for example, in specifying what colour paint should be used on an isolator, when the goal is to set out the correct engineering principles. However, that caveat aside, more detail is generally going to strengthen or tighten your specification.

Let's take an example to further illustrate why this is so important. Let's say acoustic hangers are specified for a project. The specification might require spring hangers which offer a natural frequency below 8Hz. There are many products on the market that could tick this box, but not all of them are designed correctly.

In this instance, additional detail might include the misalignment capability of the hanger. For example, with minimal misalignment capability, the rod will make contact with the bracket, creating a transmission path and an acoustic breach. If the specification did not include details about the necessary misalignment capability, the contractor might simply pick the cheapest hanger that can meet the natural frequency requirement, without realising that this product will inevitably fail to isolate sources of vibration.

3) Place the onus on the supplier

The specification should include enough design features that the consultant can walk away and forget about it, knowing there is little risk to the project. However, there may be situations where, if the supplier doesn't request the right information, then there is the risk of the wrong type of product being specified.

Ideally, the specification should be written so that the acoustic products will be fit-for-purpose and not all products are designed the same. For example, you would not specify the same size acoustic hanger for a small pipe versus a much larger pipe. The supplier should be proactive and ask questions about load requirements so that the specification can be met. Yet if a supplier were to simply pick larger hangers without caring about the outcome, the contractor is unlikely to know or understand the risks this might introduce.

At this stage in the project, the consultant who originally wrote the specification may no longer be involved. So how do you prevent scenarios like the one described above? A good supplier should willingly supply documentation that shows evidence that the specification has been complied with.

If you make sure you are addressing the *how* question and doing so with the appropriate level of *detail* in your criteria, you will have a tight specification. If you go to the additional length of requiring the contractor or supplier to provide *evidence* that the specification has been met, you ensure that your original intention is not lost along the way. Although it might entail slightly higher up-front costs, the risk to your project will be reduced and the whole life costs to the end user will likely be lower too.

For more guidance on how to write a specification, visit **www.mason-uk.co.uk**

Jason Clouston becomes Head of Acoustics at Scotch Partners

Jason Clouston has become Head of Acoustics at Scotch Partners after seven years with the practice.

The acoustics team comprises five staff and was created by John Lloyd in 2013. After almost 10 years leading the team, John is reducing his working hours; paving the way for Jason to take the reins.

"It's been an absolute pleasure contributing to the success of Scotch. We started as a small company

10 years ago and are now over 40 staff," Jason said.

"We are adjusting to the difference in size, but I see maintaining our identity as key to the next 10 years. Engineering consultancy is technical by nature, but it is nothing without the people behind it."

With more than 18 years' experience as an acoustic consultant, Jason has been responsible for the acoustic design of a wide range of projects across market sectors of varying size and complexity.

Sto acoustic ceiling system brings calm to refurbished museum

An acoustic ceiling system provided by Sto has created a quiet and calm environment for a museum in Hampshire. The StoSilent Distance system has been installed in Petersfield Museum, which has been created by the conversion and refurbishment of Victorian premises that previously housed a police station and court house.

"The StoSilent Distance system is well-suited to this type of refurbishment project," comments Sto's Acoustics Project Manager, James Gosling. "It delivers outstanding acoustic performance, but also offers flexibility as it can be used to create large seamless ceilings, sharp joints and creases, or curved ceilings and vaults. This gives architects and designers great freedom while still allowing them to accommodate the existing structures found on a refurbishment project such as this."

The Sto system was specified for the building by Hampshire County Council Property Services, as part of a project to create a series of new, welcoming spaces at the museum. "This is just the latest in a long line of projects where our StoSilent acoustic solutions have been installed in museums. A room's acoustic performance can influence our sense of well-being, and if that performance is poor, noise from speech, movement and everyday activity can create an unpleasant environment where sounds are unclear, communication is difficult, and concentration is impossible. The need for acoustically absorptive measures is therefore clear and the StoSilent Distance system can provide both outstanding acoustic performance and the sort of unobtrusive visual presence which is essential for this type of building." adds James.

Installed on this project by specialist applicators, The Broadsword Group, the StoSilent Distance system can function as a suspended ceiling, or as a wall-covering over a cavity. It features a metal profile sub-construction fitted with acoustic panels, which are manufactured from expanded glass granulate, making them lightweight and easy to handle, and allowing them to be adjusted to suit any room shape and create a smooth, seamless surface. Different system variants are offered to suit different types of application.

The boards were finished with StoSilent Décor M, a spray-applied acoustic plaster which can be tinted to match a range of shades from the StoColor system. This solvent and plasticiser-free plaster creates a classic fine stipple finish. It is also Natureplus approved and easy to refurbish.

Below: The StoSilent Distance acoustic ceiling system has been installed in the new Petersfield Museum to provide a quiet and calm environment *(©Tina Knowles Photography)*

Institute Sponsor Members

Council of the Institute of Acoustics is pleased to acknowledge the valuable support of these organisations

Founding Key Sponsors

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Applications for Sponsor Membership of the Institute should be sent to Membership at the Milton Keynes office. Details can be found on the IOA website.
Members are reminded that **ONLY** Sponsor Members are entitled to use the **Sponsor IOA logo** in their publications, whether paper or electronic (including web pages).

Committee meetings 2022

DAY	DATE	TIME	MEETING
Thursday	12 May	10.30	CCHAV Examiners
Thursday	12 May	13.30	CCHAV Committee
Thursday	19 May	10.30	Membership
Thursday	26 May	10.30	Executive
Wednesday	**15 June**	**10.30**	**Council**
Tuesday	21 June	10.30	ASBA (Edinburgh)
Wednesday	6 July	11.00	Research Co-ordination (London)
Tuesday	12 July	10.30	Distance Learning Tutors WG
Tuesday	12 July	13.30	Education
Wednesday	13 July	09.30	CCBAM
Wednesday	13 July	10.30	CCENM Examiners
Wednesday	13 July	13.30	CCENM Committee
Tuesday	26 July	10.30	Engineering
Wednesday	27 July	10.30	Engineering
Thursday	28 July	10.30	Meetings
Thursday	4 August	10.30	Diploma Moderators Meeting
Thursday	11 August	10.30	Membership
Thursday	25 August	11:00	Publications
Wednesday	7 September	10.30	Executive
Wednesday	**15 September**	**10.30**	**Council**
Tuesday	27 September	11.00	CPD Committee

Institute Council

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ST Acoustics

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Institute of Acoustics

ANV Measurement Systems

The Environmental Instrumentation Experts

Svan nviro

NOISE VIBRATION WEATHER DUST

Contact Support

Dedicated support gets you the help you need fast

- Available for purchase & hire
- A truly web-based solution
- No software required
- Fully certified and site proven hardware

Svan Leq | Svan VDV | Svan PPV | Svan Met | Svan PM10

New Features!

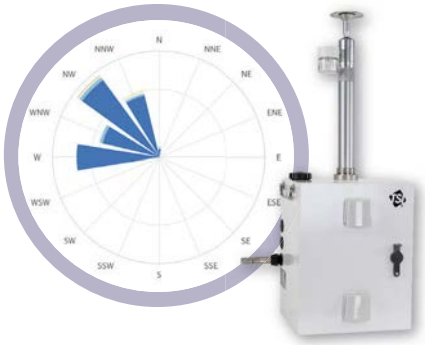
Just a few examples of the many features that have been recently introduced

AUDIO

- Triggered when individual limits are exceeded
- Separate audio-only trigger option available
- Audio-on-demand function for recalling any audio within the previous 24-hours
- Control .wav recording on the meter remotely

POLLUTION ROSES

- Daily, weekly and monthly pollution roses

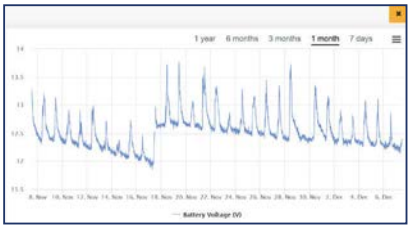


POWER

Monitor the power consumption and battery status of each position.

New PowerSave option:

- Units buffer and upload data once per hour
- Easy-to-use scheduler can be used to control when PowerSave is enabled
- Up to 50 hours with a single 12Ah battery and 2 weeks with a 100Ah battery
- Solar options available to power noise, vibration, weather and dust 24/7/365



Existing customers Contact us now to begin enjoying these new features free of charge

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