NOISE/NEWS INTERNATIONAL

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A quarterly Internet news magazine published by I-INCE and INCE/USA

- **Are electric cars too quiet, or are our city streets too noisy?**
- **Acoustical engineering community loses three leaders of the profession**
- **UK study relates classroom acoustics to learning**
- **Meet the Danish and Solvenian acoustical societies**

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Features

Departments

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NOISE/NEWS INTERNATIONAL

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I-INCE

The International Institute of Noise Control Engineering (I-INCE) is a worldwide consortium of societies concerned with noise control and acoustics. I-INCE, chartered in Zürich, Switzerland, is the sponsor of the INTER-NOISE Series of International Congresses on Noise Control Engineering, and, with the Institute of Noise Control Engineering of the USA, publishes this quarterly magazine and its Internet supplement. I-INCE has an active program of technical initiatives, which are described in the Internet supplement to NNI. I-INCE currently has 46 Member Societies in 39 countries.

INCE/USA

The Institute of Noise Control Engineering of the USA (INCE/USA) is a non-profit professional organization incorporated in Washington, D.C., USA. The primary purpose of the Institute is to promote engineering solutions to environmental noise problems. INCE/USA publishes the technical journal, *Noise Control Engineering Journal*, and, with I-INCE publishes this quarterly magazine and its Internet supplement. INCE/USA sponsors the NOISE-CON series of national conferences on noise control engineering and the INTER-NOISE Congress when it is held in North America. INCE/USA Members are professionals in the field of noise control engineering, and many offer consulting services in noise control. Any persons interested in noise control may become an Associate of INCE/USA and receive both this magazine and *Noise Control Engineering Journal*.

NNI and its Internet Supplement

www.noisenewsinternational.net

The primary change in this PDF-only volume of *NNI* is the ability to have "hot links" to references, articles, abstracts, advertisers, and other sources of additional information. In some cases, the full URL will be given in the text. In other cases, a light blue highlight of the text will indicate the presence of a link. At the end of each feature or department, a light blue back to toc will take the reader back to the table of contents of the issue.

- The Internet supplement contains additional information that will be of interest to readers of *NNI*. This includes:
- The current issue of *NNI* available for free download
- *NNI* archives in PDF format beginning in 1993
- A searchable PDF of annual index pages
- A PDF of the current *NNI* conference calendar and a link to conference calendars for worldwide meetings
- Links to I-INCE technical activities and I-INCE Technical Reports

Expanding Horizons of I-INCE Technical Activities

As most of you know, I-INCE is the sponsor of the INTER-NOISE series of congresses that are held annually in leading cities of the world. This of course requires the coordination of the technical program and careful planning. I-INCE undertakes technical initiatives on critically-important issues of international concern and this initiative has resulted in several reports and a number of active technical groups. Over the last 3 years, I-INCE has allocated funds to assist young scientists/engineers in attending the INTER-NOISE Congresses. Further, I-INCE has now also established a symposium series to meet the expanding needs of the field of noise control engineering. Some of the activities are discussed below.

The principal technical activities are carried out by Technical Study Groups (TSGs), as authorized by the I-INCE General Assembly on recommendation of the I-INCE Board of Directors. The Technical Study Groups tend to address one specific problem in the area of noise control. For instance, Technical Study Group 1 is finalizing its report on "Noise of Recreational Activities in Outdoor Areas". Technical Study Group 9 continues to study "Metrics for Environmental Noise Assessment and Control". A new Technical Study Group is forming to study the issue of "Buy Quiet" programs. Previous groups have written authoritative reports on topics ranging from "Technical Assessment of Upper Limits on Noise in the Workplace," "Assessment of the Effectiveness of Noise Walls," "Noise Emissions of Road Vehicles: Effects of Regulations," "A Global Approach to Noise Control Policy," "Survey of Legislation, Regulations, and Guidelines for Control of Community Noise," to "Guidelines for Community Noise Impact Assessment and Mitigation." Readers of the NNI are encouraged to download one or more of these reports from the I-INCE's website (www.i-ince.org) under "Technical Activities."

The Future Congress Technical Planning (FCTP) sessions are held at each INTER-NOISE congress. The principal task of the FCTP is to assist the organizing committees of future congresses with planning for structured sessions as well as poster sessions. The primary efforts focus on the next congress, but ideas may be considered for up to the next three congresses. The FCTP may offer advice on other aspects including the maximum number of parallel sessions, special sessions on selected topics of contemporary interest, suggestions for key speakers, etc. About one-third of INTER-NOISE congress's papers come from ideas offered or sessions organized at the FCTP meetings.

Effective INTER-NOISE 2010 in Lisbon, Portugal, the I-INCE began a grant program for young professionals and scientists (typically within 10 years of the beginning of their careers) to attend the conference (each grant is worth 500 Euro). The applicants are asked to submit an extended abstract of their paper as well as some other data, and winners are chosen from the best of the submissions. In 2010, 13 grants were given out of 29 applicants. Twelve young scientists received grants for INTER-NOISE 2011 out of 47 applications, and for INTER-NOISE 2012, 18 will receive the grant out of 47 applications.

All young scientist applicants are invited to the Young Professionals workshop for networking opportunities and technical presentations by experts in the industry. Winning applicants were presented with certificates recognizing their accomplishments. Attendees of the Young Professionals Workshop at INTER-NOISE 2010 were treated to talks on a variety of topics, including "Reducing Road Noise with Quieter Pavement," "Industrial Noise Control," and "Control of Structure-borne Sound in Wood Frame Floors." At Inter-Noise 2011, attendees of were advised on the following mentorship topics: "How to Publish" and "How to Formulate Research Problems" and "How to Network". This will be a subject of feature article in the Sept. 2012 issue of NNI.

The I-INCE also held a symposium for "Buy-Quiet" in Paris (5-6 July 2011) since this concept may offer a significant improvement in the acquisition of low-noise machines, as well as an effective management of occupational noise risks. The extension of the "Buy-Quiet" concept to consumer products should lead to an increased awareness by the public in the choice and availability of quieter products. Finally, I-INCE is assuming leadership role in formulating global noise policies; this includes an ongoing collaboration with CAETS (International Council of Academies of Engineering and Technological Sciences).

If you are interested in participating in any of the technical activities, please contact me at singh.3@osu.edu.

Guest Editor

Rajendra Singh
VP, Technical Activities, I-INCE

Big Shoes to Fill

Jim Thompson

As was announced in the March edition, George Maling is stepping down as the Managing Editor of Noise/News International (NNI). George has been the editor beginning with Noise/News which became Noise/New International. From 1971 George has done an outstanding job with this publication and the members of I-INCE and INCE/USA owe him a large debt of gratitude for all his hard work and the excellent results.

Through numerous presidents of the two organizations and countless public debates about noise control, George has been there to provide useful information and articles for consideration by the community. Not to take anything away from those who have contributed greatly to these organizations, George is INCE/USA. So much of what this organization is can be traced back to George. To say that George will be missed is an understatement. His is a legacy that we should all aspire to live up to.

Now we are in transition from George's editorship, and I have the honor of trying to carry on George's "baby," NNI. I am very aware of the tremendous job that George has done. Unquestionably, I have very big shoes to fill.

I have just finished as serving as INCE/USA President. With this background, I do not take this job lightly. In fact, I believe the role of Managing Editor may be a greater challenge than serving as President. As President, I had a lot of support from other officers and the Board of Directors. Now, my safety net is much less apparent. That's why I am especially grateful that George has offered to continue lending a hand with NNI, and I know I can count on his able assistance and sound judgment.

My best, I hope, will be good enough to meet your approval, NNI's reader. I can only hope that I can do nearly as well as George. With the help of our new Editorial Assistant, Earl Bohn, I will do my best to live up to George's high standards. I fully expect that Earl and I will frequently ask WWGD (what would George do)? Fortunately, George will still be available to help us out.

I am very thankful for this opportunity and hope that we can provide value to I-INCE and INCE/USA members. I also need to ask your help. Please give us input and provide suggestions for how we can do better. How can NNI better serve you?

Wish us luck and here we go with our first issue.

The Danish Acoustical Society

The Danish Acoustical Society was founded in 1955 by a group of professionals that included Prof. Dr. Tech. Fritz Ingerslev and Dr. Tech. Per V. Brüel.

DAS grew to include more than 300 member professionals, including more than 20 sustaining members. Since its 50th anniversary in 2005, DAS has grown by more than 20 percent, indicating the continued strength of the acoustics profession in Denmark.

Seventy percent of the members are associated with industry, 20 percent national and local institutions, and 10 percent higher education. To encourage new members and to promote lifelong affiliation with the group, the DAS offers complimentary one-year membership to graduate students.

While membership and leadership have changed over time, the society's mission has been constant: to promote and propagate knowledge of acoustics and its practical application throughout Denmark, and to establish national and international contact between people interested in acoustics, in particular cooperation with Scandinavian, European, and international organizations. DAS has played an important role in organizing several major acoustic meetings, the latest one being Forum Acousticum in Aalborg from June 27 to July 1, 2011, an event which DAS was proud to host for more than 600 participants.

DAS advances its mission in five focus areas: building and room acoustics, electro-acoustics, environmental acoustics, machinery acoustics, and psychoacoustics. Technical committees organize activities in each are, and DAS is especially interested in connecting scientists and practitioners within the focus areas. A major undertaking is the annual DAS "Day of Acoustics" that draws speakers from various technical disciplines.

DAS assists in reviewing new acoustical standards from the Danish standards organizations (including ISO) and provides input to the Danish Environmental Protection Agency on new acoustical guidelines. Beyond Denmark, DAS contributes board members to both I-INCE and ICA.

Leadership of the society rests with a six-member board: Birgit Rasmussen (Danish Building Research Institute), president, and board members Claus Møller Petersen (Grontmij - Acoustica), Douglas Manvell (Brüel & Kjær), Ann Lin Enggård (Moe & Brødsgaard), Dorte Hammershøi (Aalborg University) and Thomas Ulrich Christiansen (Danish Technical University). The society is supported by a part-time treasurer and secretary. The Society's web address www.d-a-s.dk contains information on meetings, hearings of proposals for new standards, and links to courses in acoustics as well as links to sponsor's websites (including job notices) and websites of other acoustical organizations. DAS can be contacted at email das@d-a-s.dk.

DAS is affiliated to the European Acoustics Association (EAA) and the International Institute of Noise Control Engineering, and DAS members receive publications from these two organisations (e.g. Acta Acustica) at no extra charge. Members of DAS are also admitted to the Nordic Acoustical Association (NAA). The NAA activities include organizing the Baltic-Nordic Acoustical Meetings (B-NAM) held every other year in either Denmark, Finland, Sweden, Norway, or Iceland. This year's B-NAM regional conference is hosted by DAS and held in Hans Christian Andersen's enchanting birthplace of Odense on 18–20 June 2012 (for more information see www.bnam2012.com).

The Slovenian Acoustical Society Profile

The Slovenian Acoustical Society (Slovensko društvo za akustiko SDA) was founded in 1997 in Ljubljana by 50 sound, noise and vibration professionals led by Mirko Čudina, its first and current president.

The SDA is a non-profit scientific society dedicated to helping Slovenian engineers respond to the increasing demands for control of environmental noise and noisy products. Membership has grown to 85 individuals and seven liaisons representing the scientific disciplines of physics, mechanical, architectural, electrical and environmental engineering, medicine, psychology, and musical and speech acoustics.

Among the most prominent and active of Slovenia's professional societies, SDA maintains strong ties with the university and industrial communities in Slovenia and abroad. SDA is a member of I-INCE, EAA, IIAV, ICA and AAAA. The activities comprise education, lectures, seminars, workshops, publications, legislative and regulatory affairs.

SDA produces a congress on sound, noise and vibration every two years. The first two congresses drew national and international participants to Portorož, Slovenia, in 1998 and 2000. The second congress saw three regional presidents, professors Mirko Čudina of SDA, Bojan Ivančević and Ewald Benes of the SDA, Acoustical

Society of Croatia (HAD) and Austrian Acoustics Association (AAA) found the Alps-Adria Acoustics Association (AAAA).

Čudina was elected as the first president of AAAA, which has organized congresses at Portorož, Slovenia, in 2003, Opatia, Croatia, in 2005, and Graz, Austria, in 2007.

A joint AAAA-EAA EUROREGIO congress in 2010 in Ljubljana included an integrated summer school that drew more than 170 young researchers to seven courses on soundscape, voice and musical acoustics, building acoustics, hydro-acoustics, numerical acoustics, psychoacoustics and ultrasound. Additional details can be found at http://www.fs.uni-lj.si/sda/euroregio.htm.

SDA also produced two- and four-day seminars for international participants in 2000 and 2009 on noise and vibration.

SDA has also organized five inter-laboratory comparison measurements in the last five years concerning site measurements of the airborne sound insulation, impact sound insulation of floors, environmental noise and sound power of noise sources.

Member Society Profile is a regular feature of *Noise News International*. If you would like to have your society featured, please contact Jim Thompson at nnieditor@noisenewsinternational.net

Adding noise to quiet electric and hybrid vehicles: An electric issue

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ABSTRACT

It has been suggested that hybrid and all-electric automobiles are so quiet at low speed in electric drive that they constitute a safety hazard for pedestrians and bicyclists. This trait has been especially troubling to vision-impaired people who rely on sound cues to avoid approaching vehicles. Assumptions have been made linking the quietness of such vehicles with fatalities and serious injuries.

The U.S. Pedestrian Safety Enhancement Act of 2010, requires the use of Audible Vehicle Alerting Systems (AVAS) in hybrid and all electric vehicles. Rules are now being developed and are expected to be issued by January 2014. Similar regulations are on being promulgated in Japan and the European Union. The UN/ECE is developing a Global Technical Regulation after extensive preparatory work. SAE International and ISO are developing a method of measuring the lowest accepted noise level for vehicles.

This article first notes firm evidence that the noise difference between electric-driven and ICE[1] vehicles exists only at speeds below about 20 km/h (13 mph); also that AVAS makes vehicles traveling at low speeds detectable from a longer distance, absent masking background noise. Some electric and hybrid cars on the market already have AVAS installed.

The author explores the assumptions related to the problem in regard to traffic safety and the harmful effects of noise on humans. One statistical study from the United States seems to suggest that vehicles driven in electric mode cause relatively more accidents involving pedestrians than do ICE vehicles. However, multiple studies in the U.S., Japan and Europe leave this causal relationship unconfirmed. Statistics about fatalities in vehicle/pedestrian collisions suggest that, at speeds where electric-driven vehicles give lower noise than ICE vehicles, the relative fatality risk is very close to zero and the risk of light or serious injuries is <5%.

The author then shows that quiet vehicles, very hard to hear when approaching at low speeds, existed in urban traffic already many years before hybrid cars became common, and if quietness would create accidents this should have been apparent already earlier and not be something occurring only when hybrid cars entered the market.

A number of non-acoustical ways to alert pedestrians, not the least blind people, of quiet vehicles near them are discussed and suggested in the article.

The article describes the intensive work to explore the problem as well as to develop and specify AVAS systems that has been made from 2008 until now. The most recent activities are reviewed. The author argues that the work to avoid really quiet vehicles has received an incredible interest and support and has been conducted at "racing" speeds; quite opposite to the attempts made to reduce the noise of vehicles. He also argues that it would be more beneficial to human health and safety to reduce the maximum noise of vehicles rather than increasing the minimum noise of them.

Consequently, the article ends with the recommendation to discontinue the work with AVAS, to limit rather than require the use of such systems, and instead focus on limitation of the worst masking noise emissions in urban areas.

1. A new problem identified: Hybrid and electric vehicles assumed to be too quiet

It has been suggested in later years that road vehicles, driven in electric mode, either hybrid electric vehicles (HEV) or all-electric vehicles (EV), are so quiet that they constitute a safety hazard for vulnerable road users (VRU) in traffic, especially to blind pedestrians. Following such fears, EVs and HEVs have sometimes in various documents and press articles been portrayed as "some kind of shark in the water" [1].

The "problem" seems to have been noted first in the United States in 2008 in meetings with the car industry and the US DoT following complaints by the National Federation of the Blind (NFB) against the growing trend for automobile manufacturers to design extremely quiet vehicles. Already in 2007, the SAE International started to work out a draft specification J2889-1 for the measurement of "minimum noise" of vehicles. Due to, among other

[a]ICE means internal combustion engine

things, pressure from the California Legislative Counsel in 2009 [2], in 2010 the Pedestrian Safety Enhancement Act was introduced in the US, and approved by the President in January 2011, requiring "means of alerting blind and other pedestrians of motor vehicle operation." This, in practice, requires the addition of artificial sound, also known as acoustic alerting systems, to EVs and HEVs [3].

The Japanese automotive industry, enjoying great commercial success with vehicles such as the Toyota Prius, seems to have reacted quickly to this potential threat to hybrid vehicles and already in 2009 had established own work towards Japanese standards for acoustic alerting systems for HEVs and EVs [4].

Internationally, a special informal group "Quiet Road Transport Vehicles (QRTV)" to deal with this "problem" was established within the UN/ECE/WP29/GRB in 2010 [5]. Japan had then already been working on guidelines for approaching vehicle alerting systems (AVAS), which later were essentially accepted also by the QRTV. Following the QRTV recommendations, the GRB (noise) group within the UN ECE [6] accepted them, which is now also part of a present proposal to the European Parliament regarding more stringent vehicle noise limits [7].

Concerning standardization, the SAE International draft specification J2889-1 for the measurement of "minimum noise" of vehicles is at the time of writing subject to a ballot [8]. In April 2010, work on "measurement of minimum noise emitted by road vehicles" was initiated also within the ISO, largely based on the SAE draft. The intention is to work out an ISO (international) standard ISO 16254 for measurement of "minimum noise" of a vehicle.

In this paper, the author presents a review and discussion of the problem, based on his earlier conference papers [9, 10], but with focus on the development during 2011–2012.

2. Racing activity for adding noise but not for reducing noise

Never before has the author in his 38 year career in transportation noise seen any subject being so quickly and non-critically accepted by the legislators, vehicle industry, university acoustics departments, acoustic consultancies and other research organizations, and as it appears almost in total agreement. This is in sharp contrast to when it comes to reducing vehicle noise. Vehicle noise standards in Europe and as specified by the UN ECE have been unchanged since 1996 and when now, after 16 years, somewhat lower limits are proposed, the industry and some MP's are hesitant [11]. One interpretation of this is that with regard to noise reduction, technical development of conventional vehicle technology has been extremely slow. In North America, there has been no significant lowering of vehicle noise limits in the past 25 years; i.e., there has been a standstill in vehicle noise reduction for a whole human generation.

On the other hand, the interest in adding sound to quiet vehicles is enormous. As an example, at the QRTV's 2nd meeting the number of members in this informal group was 33 and the meeting was attended by more than 50 people. The QRTV group held 9 meetings between February 2010 and December 2011 before its mandate expired and produced impressive work during this time [12]. Several large European research projects, funded by the European Commission and other European organizations already include the subject in their work program.

The author is amazed and wonders what was causing the unusual urgency: was it purely the care for pedestrians' safety and for the concerns of the blind, or was it something else that was pushing so hard?

3. Acronyms and other terminology

When working on this subject, the reader will find a multitude of acronyms, the meaning of some of which may not be obvious to everybody. This section presents the most important ones. The terms EV (all-electric vehicles) and HEV (hybrid electric vehicles) have already been introduced above. PHEVs are plug-in HEVs. These are mostly compared with their counterpart, the vehicles with internal combustion engine (ICE vehicles) which may be powered by gasoline, diesel or CNG. The safety problem affects vulnerable road users (VRU) and the special international task group working on the subject is called Quiet Road Transport Vehicles (QRTV). It is part of the Working Party on Noise (GRB), which is the subsidiary body of the World Forum for Harmonization of Vehicle Regulations (WP.29) which in turn is part of the Economic Commission for Europe (ECE) under the United Nations (UN). The GRB and WP.29, despite being part of the ECE, include not only Europeans but also representatives of industry and authorities in North America, Australia and Asia. The WP.29, namely, has a special task to develop Global Technical Regulations (GTR). A GTR is what might come out of the QRTV work.

The main work in U.S., except that of the vehicle industry which is made within the SAE International (previously known as the Society of Automobile Engineers), is made under direction of the National Highway Traffic Safety Administration (NHTSA) which is part of the U.S. Department of Transportation (DoT). In Japan, the responsible authority is the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and much of the

industry work is coordinated within Japan Automobile Standards Internationalization Center (JASIC) [13] and the Society of Automotive Engineers of Japan (JSAE).

The vehicles operating at exceptionally low noise levels are mostly called "quiet vehicles," but the British seem to prefer the term "near-silent vehicles." "Silent vehicles," which is used by a few, is not a relevant term here since "silence" means total absence of sound. The systems that are intended to save the world from the assumed pedestrian road massacres have been named Audible Vehicle Alerting Systems (AVAS), although some documents let the A stand for "Approaching" instead of "Audible." These are meant to add sound to the vehicles when sound would, otherwise, not reach a "minimum noise" level. Standards are being developed to measure and specify such "minimum noise" levels, i.e. the lowest noise that a vehicle is allowed to emit under some critical operation(s).

Please note that "noise" is "unwanted sound" and the distinction is not always clear. In this paper sound is used when it is generally intended to be perceived, else the term noise is used.

4. Noise emission properties of electric versus ICE vehicles

The very low noise emission from electric motors means that power unit noise is almost totally absent for EVs and HEVs in electric mode, and that only tire noise remains. There is some high-frequency noise from the electric systems but it may be difficult to hear for people with some impaired hearing. The effect will be that at low vehicle speeds, approximately up to 20 km/h (13 mph) for cars and up to 50–70 km/h (31–43 mph) for heavy vehicles, the acoustic environment will improve substantially.

This subject was the main issue in an earlier paper by the author [9]. It has been shown by many researchers, with consistent results, that it is only at speeds below approximately 20 km/h for cars when there is a significant difference in noise emission from ICE vehicles and vehicles driven in electric mode. The example shown in Fig. 1 is typical of most test results.

5. Distracted attention and traffic safety aspects

5.1 Traffic accidents due to lack of sound cues?

One of the more common causes of collisions in cities is pedestrians stepping onto the roadway without looking enough for oncoming vehicles. In the U.S., more than 11% of all traffic fatalities are with pedestrians and in Japan, this scenario accounts for about 30% of all fatal collisions [14]. In Europe it is 14% [15].

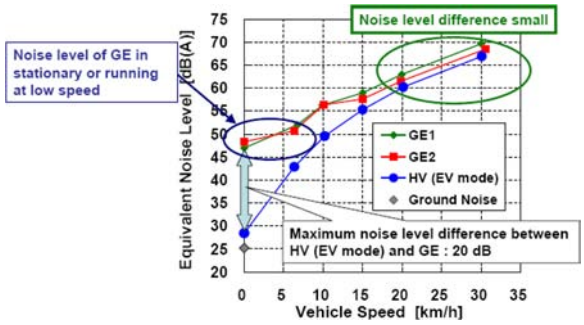

Fig. 1 – Equivalent A-weighted noise levels from an HEV car, compared to two ICE cars in Japan at low speeds. From [31].

It is widely claimed that electric vehicles (EV) or hybrid vehicles (HEV) driven in electric mode are not heard due to the power unit being exchanged from a combustion engine to one or more electric motors, and that this may cause collisions with pedestrians; especially visually impaired people. It has been proven many times and there is no doubt that acoustical cues are important in the interactions between road users of all kinds, and in particular among the visually impaired pedestrians. However, this does not mean that the lack of sound cues automatically lead to serious traffic accidents. There are many other things of importance and the lack of sound cues is associated only with very low speeds.

As yet, the lack of sound cues has never been identified in accident statistics as a major cause of accidents, at least as far as this author has found in literature searches and when asking colleagues specialized in traffic accident statistics. The only exception is a study presented by NHTSA, which concluded that [16]:

- "*This study found that HEVs have a higher incidence rate of pedestrian and bicyclist crashes than do ICE vehicles in certain vehicle maneuvers*";
- "*In situations where cars drive slowly (slowing down, stopping, backing up, parking maneuvers) hybrid cars were involved twice as much compared to conventional cars*."

When looking critically at these conclusions, one finds that the evidence of the conclusions is rather weak and that alternative causes for the findings are possible [9, 17]. An update of the NHTSA report when more data had been added became available in 2011, but the conclusions are essentially the same [18].

Other studies of statistics, in the Netherlands and Japan, have been unable to confirm this [17]. Another U.S. study of deaths and accidents of blind people involving a Toyota Prius (this car was especially studied as it dominated the U.S. HEV park) gave a different picture [19]:

- *No deaths of legally blind pedestrians 2002–2006 involved a Prius or any other hybrid vehicle (out of an average of five legally blind pedestrians per year killed in US motor vehicle accidents);*
- *For all U.S. pedestrian deaths, a Prius was no more likely to be involved in a pedestrian death than the average passenger vehicle.*

A study in the U.K. to explore the safety aspect of quiet vehicles was undertaken for vehicle accident statistics in the period 2005–2008 and showed that [20]:

- Relative to the number of registered vehicles, for the combined vehicle group of passenger cars, car-derived vans and vans < 3500 kg GVW, EV/HEV vehicles were 38% less likely to be involved in an accident than ICE vehicles;
- Relative to the number of registered vehicles, for the combined vehicle group of passenger cars, car-derived vans and vans < 3500 kg GVW, EV/HEV vehicles were 10% less likely to be involved in a collision with a pedestrian than ICE vehicles;
- Although the relative number of EV/HEV vehicles involved in accidents is smaller, proportionately more of these vehicles hit a pedestrian than ICE vehicles;
- The reason for the latter observation may be that these accident rates reflect different usage patterns of EV/HEV vs ICE vehicles;
- There were only two EV/HEV accidents (out of 497) involving a collision with a pedestrian who was disabled in some way (CF810) so it was not possible to make a judgment on the perceived risk to vision-impaired pedestrians.

There is no doubt that much more research on the traffic accident statistics is needed. It is indeed strange that such extensive activities as started on this subject are not based on any robust traffic accident data. As so many pedestrian accidents happen, and we have now had quiet vehicles for quite some time, if lack of sound were a problem, it should be relatively easy to identify this in current accident statistics.

The common procedure is that a problem is addressed and solved when the problem has been reliably identified. In this case, the safety problem seems to be more psychological than "real" and yet work is extremely intensive to solve the assumed problem. It seems that one has started in the "opposite end" to what is customary. If legislators and industry had acted with equal speed and efficiency when it comes to high noise emissions from vehicles, it would have been wonderful.

5.2 The special fears of the blind

Organizations such as the National Federation of the Blind (NFB) in U.S. [21] and the World Blind Union (WBU) have put pressure on the NHTSA and the QRTV in order to produce a solution to the problem that they identify as the lack of sound cues for this group of people who depend largely on sound cues. This group is not small, the WHO writes that it is estimated that there are 285 million people with some vision loss worldwide, and of them approximately 39 million are blind; 90% of them live in developing countries [22]. Some national organizations for the blind have also reacted. The WBU was rather critical to the guidelines for AVAS produced in 2011; the organization thought that the guidelines are not sufficiently strong or far-going [23].

There is of course no doubt that the blind perceive their situation as worrying when the sound cues are becoming less audible. Yet, this does not necessarily lead to accidents. As will be reported below, the situations where and when the EVs and HEVs may pose a problem due to weak sound are relatively few and not with very serious effects as seen in relation to the entire traffic work. This, in combination with the general habit of blind pedestrians to be careful in traffic, the white stick and possibilities in the low-speed situations for the drivers to react in time, will relieve the problem substantially. This then refers to the traffic accident problem, and not so much the psychological problem. The latter is more difficult to tackle.

As shown below, we have had numerous electric driven vehicles for a very long time and we have had relatively quiet ICE vehicles, some of which are almost equally quiet as EVs, for at least 15 years. For example this author, who is used to listen to sounds in traffic due to his profession, have had many encounters with quiet ICE cars cruising or coasting at 10–15 km/h in a variety of locations with no sound perceivable until the car is just a few meters away. Thus, the reaction of the blind organizations should have come much earlier, and be a result of many more encounters than from electric drive, if lack of sound were a "real" accident problem. As written above, a U.S. study of deaths in traffic over 4 years for blind people found no correlation with a Toyota Prius or any other hybrid vehicle.

However, at the time, it must be recognized without doubt that the problem is at least a psychological problem for the blind, since they see their possibilities to navigate safely as pedestrians in traffic relying on sound cues becoming reduced with the increasing number of EVs, HEVs and quiet ICE cars. This is especially serious in a situation as in the U.S. where the maximum noise level limits have not been reduced since the 1980s. One should, therefore, look for solutions to this problem for the blind, but the solutions might not necessarily be addition of artificial sound.

The author has searched very extensively on the Web (in English and Swedish) for reports about accidents where blind pedestrians have been seriously injured due to quietness of the car. No such case has been found to date (July 2012), whereas cases when pedestrians are killed due to distraction by using electronic devices in traffic (not involving quiet cars) are frequent.

5.3 Distraction due to use or misuse of sound

Especially for the blind people it must seem strange, if not stupid, that a large proportion of the seeing people deliberately choose to totally neglect sound cues from vehicles and from other pedestrians. More and more pedestrians and joggers, in many situations a majority of them, wear some kind of system producing music or speech in earphones, or they are using cell phones, which effectively obscure sounds of approaching vehicles. Figure 2 shows an example. It may sometimes be impossible even to hear warning sounds as was, e.g., an observation in the study in [24]. How many of us have not been insulted by fellow pedestrians whom we ask or tell something and they do not respond, as they do not hear it, since at closer sight they appear to wear earphones?

A study conducted by three U.S. universities in 2005 indicated that 48% of pedestrians using a cell

Fig. 2 – Lady crossing a street while listening to something in her earphones (Sydney, Australia). *Photo by the author*.

Fig. 3 – Lady crossing a street while "texting" (Braga, Portugal). *Photo by the author*.

phone stepped into a crosswalk in what the researchers defined as "unsafe" condition, compared to 25% not using cell phones [25].

Of course, these people have acceptable vision, but often they seem to fail concentration to the traffic as they talk or listen to whatever they use the electronic equipment for. The latest trend is to walk around and read and write text messages. It is not necessary to watch a pedestrian crosswalk many minutes until one will see a situation as the one in Fig. 3. This may well be the unsafest behavior of all.

In the Australian state of New South Wales, this is already identified as a serious problem. In the last 12 months 26 Sydney pedestrians died after being hit by vehicles, twice as many as the year before. Experts say that both drivers and people crossing roads are distracted by texting or listening to technology like iPods and mobile phones [26]. "Last week an 18-year-old woman listening to music on an iPod was hit this week as she crossed a road in Marrickville, Sydney. Maybe if she wasn't listening to an IPod she would have heard the horn of a car, the screech of tyres or other people warning her," it was reported [26].

The New York State "distracted walking legislation," first proposed in 2007, would keep pedestrians who are in crosswalks from using handheld cell phones, Blueberries, MP3 players such as iPods, PDAs and similar attention-grabbing devices. The proposal restricts the law to cities with a population of at least 1 million, meaning only Manhattan [27]. However, as far as this author could find, it has not yet materialized into a law.

Since the number of people choosing to neglect sound cues, as described above, may outnumber the blind by a factor 100, or probably more, this author wonders if not this would be a far greater accident cause than the missing acoustical cues for the blind. And, sadly, this is a self-chosen situation among seeing pedestrians.

6. Are quiet vehicles a new phenomenon in our society?

In a previous paper by this author on this subject [9], a number of vehicle types are described which have operated in traffic since many years ago and which produce no or very low propulsion noise (that list is supplemented here with newer findings by the author):

- Volvo and Scania supplied city busses for the Scandinavian market which met very stringent noise limits already in the early 1970s. These had encapsulated diesel engines at the very rear (Scania) or in the middle (Volvo) resulting in mainly tire noise being heard towards the front in cruising or coasting conditions.
- Also modern CNG-driven busses with rear engine used in some Swedish cities, are very quiet when approaching and also when leaving a bus stop; propulsion noise can hardly be heard towards the front. In 2008, 15% of all buses in Sweden were CNG-driven. In the Swedish city Malmoe, 10 quiet CNG busses were in operation already in 1993. Some drivers complained that they could not hear the engines. See Fig. 4.
- From 1996, new cars in Europe have had to meet the same noise level limits as today (74 dB(A) according to ISO 362). The spread in results has been and is dramatic; some have measured only 68 dB(A). The more fancy variants of these cars are usually designed with quiet (ICE) engines since this gives an impression of a luxury car and is a selling argument. In the U.S., such luxury cars and limousines have been common for many decades. This goes also for the U.K., Germany and Sweden, to name a few countries. It is undisputable that such cars are so quiet that it may be hard to hear other than tire/road noise from them when they approach a listener at cruising or coasting, even at very low speeds. They are at most marginally noisier than EVs having the same tires and tire loads.

Fig. 4 – CNG-driven bus in Gothenburg, Sweden, with engine at the rear and operating in crowded pedestrian-priority street. When starting from a bus stop this bus is almost impossible to hear at the front. *Photo by the author.*

Fig. 5 – Trolley bus in Seattle, WA, U.S., in 2008. *Photo by the author.*

- Bicycles may not be so much used in most U.S. cities but in some European cities (such as in the Netherlands, Denmark and Sweden) they are the dominating vehicle types for personal transportation. What you hear from them is weak tire noise and maybe sometimes chain noise and a bell, but they run very close to pedestrians, even among them, and at speeds up to 30 km/h. Collisions pedestrian-bicyclist at 20–30 km/h may be fatal. The recent trend is that some cities supply electric bicycles for rent.
- Segways have been used for a number of years (first version 2001, 2nd generation 2006) as a private electric vehicle capable of running at 20 km/h, used widely by police, lately also offered for touristic excursions in cities.
- Trackless trolley bus networks have existed or exist in e.g. Vancouver, San Francisco, Philadelphia, Zurich, Arnhem, Geneva, and three cities in Poland. In some cases such vehicle types have been used for several decades. They are essentially as quiet as a regular EV. See Figs. 5 and 6. Note that tire noise from heavy trucks and buses is sometimes no worse than from automobiles, depending on tire equipment fitted [28].
- On the 16th Street Mall in Denver, CO, the main shopping and entertainment street, partly only open for pedestrians and busses, hybrid busses which are very quiet have been operating for approximately a decade. No accidents due to the quietness had been reported, according to the Denver transit company in 2010, but the busses have bells that may be activated by the driver when needed, and often is so when starting from a stop.

Fig. 6 – Trolley bus pulling out soundless from a bus stop in Sopot, Poland in 2010, a system in operation for many years. *Photo by the author.*

In addition to those conditions, having existed for many years, it should be mentioned that modern hybrid-electric busses are increasingly used today in cities such as Gothenburg, San Francisco, New York City, Washington (DC), Toronto, Seattle, Boston, London, and Shanghai. For example, the Volvo hybrid bus has been a great success already and is sold worldwide.

Increasingly popular, particularly in densely populated urban areas, electric two-wheel vehicles is a category that includes Segways, electric bicycles, electric kick scooters, electric motorcycles, and electric scooters. Walmart sells a range of electric scooters that can run at up to 25 km/h.

None of these vehicle types, busses and electric two-wheelers, which run in quiet mode especially close to pedestrians, have been considered in the work so far by QRTV, although they are not formally excluded, as all attention has been focused on cars.

It is concluded that pedestrians and bicyclists have been exposed to numerous quiet vehicles (where no or very little propulsion noise can be heard) for many years; some very quiet vehicle types have been around even for decades.

Therefore, the potential problem of missing sound cues is not new and occurring only recently with the modern EVs and HEVs. It has existed for a long time and yet significant accident types caused by the quietness of vehicles have not been reported, as far as this author has found. Also, blind people have of course been exposed to this situation for a long time.

7. What driving conditions might be critical?

There is a wide consensus in the QRTV group, also supported by data in [9], that EVs and HEVs in general are significantly quieter than ICE (Light) vehicles only at the following driving conditions:

- At speeds below approx. 20 km/h while ICE vehicles would be using the lowest gear. This hardly ever includes decelerating and stopping at a traffic light, since first gear would not normally be engaged, but it does include the first few seconds of starting from standstill. Whenever 2nd or higher gear is used, tire and overall noise is approx. the same for EVs/HEVs as it is for ICE vehicles.
- When reversing, for example backing out from a parking lot.

It follows that if artificial sound is added with the aim to make EVs and HEVs equally recognizable in traffic as regular ICE vehicles, this sound shall be in operation only when driving 0–20 km/h and when reversing ("back-up").

It seems that the many proponents of adding extra sound to EVs and HEVs have not yet understood that the assumed safety problem would be potentially greater for trackless trolley busses and other heavy vehicles than for light vehicles, as the "loss" of sound in electric drive versus combustion is much bigger for the heavier vehicles, thus AVAS for these have not yet been proposed. If they will ever be proposed, the conditions would include cruising and coasting at speeds lower than 30–50 km/h and accelerations up to probably around 60 km/h, and this would normally mean a dramatically larger effect than for light vehicles, but it depends on how much of the "lost" sound that will be compensated for.

Note that at speeds lower than 20 km/h, stopping distance (reaction and braking times) is shorter than 6 m.

It follows that an accident involving a car-to-pedestrian collision would potentially happen more frequently for EV/HEVs without extra sound than for ICE vehicles only when the EV/HEV is starting or turning from standstill up to about 20 km/h. As stopping distance is less than 6 m in such cases, it means that the driver must be drunk, very distracted or extremely slow in detecting a (blind) pedestrian who is suddenly stepping out into the driving lane, normally displaying his white cane. One situation where the problem may be bigger is if the pedestrian stands hidden behind a large object as seen from the driver's position.

For such an accident to be more likely for EV/HEV without extra sound than for ICE vehicles, an additional condition is that the background noise must be low enough not to mask the ICE vehicle's propulsion noise at speeds lower than some 20 km/h. This requires background noise expressed as L_{Aeq} to be lower than approx. 60 dB (which follows from the normal noise levels emitted at such speeds). On a sidewalk in a city, this is rarely the case; one would rather have to be in a suburb or a semi-rural village [29].

Given the conditions mentioned in the previous two paragraphs, it should be obvious that in order for an accident to happen more frequently or more likely for EV/HEVs without extra sound than for similar ICE vehicles, quite rare conditions must coincide:

- blind or seriously distracted person standing on the roadside in a relatively quiet suburb or village;
- not hearing an electric-driven vehicle starting or turning from standstill;
- suddenly stepping out on the street or road;
- while at the same time the driver will not notice him within the first second(s) like a normal driver would, even though he is at or close to standstill and even though a blind person should show his white cane.

A potentially dangerous situation might be at an intersection where a pedestrian suddenly decides to step out in the street in exactly the same second as an EV/HEV driver starts to drive from standstill. However, this might equally well happen also in case of an ICE vehicle.

This author believes that occasions outlined above happen, but only extremely rarely, which may explain why this has not yet been identified as a significant type of accident for EV/HEVs in particular.

8. How common or serious are accidents at such low speeds?

Despite the quite unlikely case of a car-pedestrian collision at speeds below 20 km/h there will be cases when it happens. How serious would such collisions be? In an international literature review about fatality risk as a function of impact speed, it appeared that below 20 km/h the risk of a fatality is close to 0% [30].

When looking at risks of severe injury, at an impact speed of 20 km/h, the risk is $< 5\%$. If risks for a light injury as well as a severe injury are added, the risk is $< 25\%$ [31].

Consequently, making EV and HEV vehicles equally noisy as ICE vehicles, which would require AVAS only at speeds below about 20 km/h, would have no measurable effect on fatalities and a very limited effect on severe injuries, when a collision happens. Furthermore, several very unfortunate things must coincide for such a collision to happen, including illegal driving actions.

9. Perception of noise from EVs and HEVs versus ice vehicles

There have been numerous studies of how people perceive the noise from EV and HEV versus ICE vehicles. Generally, such studies have been made using a jury of observers who are asked to react when they can hear an approaching vehicle, while the distance to this vehicle is measured. Some studies have been made in laboratories; some have been made outdoors.

There is no point here in mentioning all the studies, since they give rather consistent results; only two of the better will be mentioned. In a German outdoor study using a jury of 12 visually impaired persons, at an approach speed of 10 km/h a Nissan Leaf was detected at distances of 4–7 m while a Lexus IS 250 was detected at 8–20 m (median values). At a speed of 20 km/h, Nissan Leaf was detected at approximately 20 m, while the Lexus was detected at 16–33 m [32]. Thus at 20 km/h there was no distinct difference between the EV and the ICE car, whereas at 10 km/h there was a significant difference. But remember that at 10 km/h (2.8 m/s), stopping distance (reaction time and braking) should be close to the closest detection distance for the EV, and a pedestrian should normally be able to step away from the approaching car before a collision occurs during the 1.5–2.5 s between detection and collision. Rather similar procedures were used in a Japanese study, except that they used more EVs and HEVs as test objects (including AVAS systems), and results were rather similar too [33].

Others have checked whether the use of AVAS will aid in early detection of vehicles running in electric mode. The answer is "yes," provided background noise is rather low and speeds are below 20 km/h [33, 34].

However, it has also been admitted that perception of quiet vehicles was poor already before the EVs and HEVs became common [35]. Thus, it is indeed a problem we have been facing for a long time and without concerns for safety until Americans started to react against the quietness of Japanese HEVs.

Consequently, AVAS will have a positive effect on the detection. But is it really needed and what are the consequences?

10. What is the problem with adding artificial sound?

So, what is the problem with adding some extra sound in forward driving at speeds below 20 km/h and when reversing? The answer is, in summary, that it neutralizes a substantial part of the noise reduction or annoyance reduction that may follow from the increasing use of EVs and HEVs.

To begin with reversing: this would hardly be a significant environmental nuisance if the sound is not of an intrusive kind (such as beeps, see below),

since reversing is only a very short driving operation. However, the problem is that the driver may be tempted to rely on such sound and refrain from the discomfort of looking backwards carefully, and vision- and hearing-impaired people as well as young children may then be hit. Some kind of radar would be better.

Regarding the addition of artificial sound to light EVs and HEVs, the present decisions and proposals in the work of Japan, ECE and the EU suggest that one shall find sounds that will increase the overall level of the vehicle just a little, and not up to the level of the ICE vehicle. But it depends on how it is made. The interesting metric is not the A-weighted sound in dB. It is the loudness that is of interest. etc. Further, it appears from the psychoacoustic studies that the extra sounds need not be particularly disturbing, and that they might be able to shut off. With this in mind the extra sounds do not necessarily neutralize the positive effect of much lower propulsion noise for EV/HEVs. If done in a proper way, the acoustic effect on the environment may be limited.

However, the safety effect may not be as expected. Firstly, it is argued above that car-pedestrian collisions at such low speeds must be very rare and will have relatively small consequences. Secondly, the existence of warning sounds will make some drivers feel more confident that they will not hit a pedestrian or bicyclist, and the attention to this potential danger might be lower than if they would be aware of the danger. Even if only relatively few drivers will react in this way it might be enough to offset the positive effect of the warning sound. An additional problem is that loudspeaker systems are rather sensitive to the harsh environments in the front of vehicles driving in snow and slush, sand and gravel and dirt water thrown up, while being exposed to temperatures in the range of perhaps − 30 to + 50°C over a year, which means that the risk of malfunctioning of the warning sounds is significant.

If heavy vehicles (trucks and busses) are exchanged from ICE types to EV/HEVs, there will be a substantial improvement in the acoustic environment since at low speeds tire noise (remaining for EV/HEVs) is much lower than propulsion noise [36]. For example, a potential noise reduction of 1 to 8 dB has been measured when comparing an electric to a medium-sized European ICE truck [26]. If compared to the noisier North American trucks, the potential noise reduction is even more dramatic. This would significantly reduce the background noise level in urban areas, and also the maximum levels, and consequently reduce the masking effects (see below).

The conclusions above for light vehicles would, therefore, not hold for heavy EV/HEVs. If these are equipped with extra sounds, they will most probably compensate for a big part of the much lower propulsion noise of these vehicles at low speeds, and thus mean a substantial extra load to the acoustic environment, compared to if extra sound is not generated.

Exchanging ICE types of heavy vehicles with EV/HEV types (without extra sound) in urban settings with average speeds at 50 km/h or lower, will substantially improve the overall noise exposure in the area. It will mean a global breakthrough in noise control, especially in countries having noisy trucks and busses today. This would be much needed in view of the recent WHO report about serious health effects of noise [37]. A couple of decibels of reduced noise exposure may lead to more saved healthy "life-years" than the few injuries from accidents which may perhaps occur due to the loss of sound cues at low speeds for the EV/HEVs. Adding AVAS sound may then cost more lives than it saves. These are just speculations, but it is important to explore these things before extra sound is added to the heavier EV/HEVs, although it may be there where it is most needed. The WHO report may assist in such investigations.

11. Importance of masking noise

Since even the low (tire) noise of EV/HEVs at speeds in the range of 5–20 km/h is well above the hearing threshold at low ambient levels, the problem of perception is that background noise is masking the tire noise. If background noise can be reduced by (say) 6 dB, the perception of 6 dB lower (tire) noise levels from EV/HEVs will be possible. Six dB corresponds to a doubling of distance for a point source, such as an approaching car, to give the same level as without the 6 dB reduction. That would also improve the health situation and reduce general noise annoyance in all areas of this type.

Therefore, it is strange that the focus of the worldwide work on this subject is only to add noise to the lower levels instead of reducing the higher levels of noise. This author thinks that it would be much better to reduce the higher noise levels, in order to reduce the masking effect, than to add extra noise to the low levels.

One way of achieving this is to encourage the introduction at a fairly large scale of heavy EV/HEVs in the urban areas, i.e. to use EV/HEV busses and distribution trucks which are run in electric mode preferably when they are close to pedestrians, bus stops and residential areas.

Another way is to reduce the maximum noise levels allowed at type approval for the vehicles that contribute the most to the general background noise; this would often but not always be caused by the heavy trucks and busses. The European Parliament is currently reviewing and modifying a

proposal from the European Commission which will require reduced vehicle noise limits in a few years [38]. In the U.S. such maximum limit changes for heavy vehicles could be especially effective, as the U.S. heavy vehicle standards are significantly weaker than corresponding ones in Europe and East Asia (it is not so easy to compare as measurement methods differ, but it is in the order of several dB for the heavy trucks and busses), and they have not been changed since the 1980s. This author thinks that the assumed problem of the quietness of light EVs and HEVs would be solved in the U.S. simply if the same new stringent noise levels for light and heavy vehicles are applied in the U.S. as those that are planned for Europe within a few years. It would also save a lot of lives by improved health due to lower community noise exposure. Not the least would it mean a general improvement of the auditory perception for the blind when masking sounds will be reduced substantially.

12. Present status of quiet vehicles rulemaking (JULY 2012)

Work has been and is going on in psychoacoustics at several places in the world to design suitable sounds. As examples of advanced work the following references are given [39, 40]. The subject quickly became a favorite subject in acoustical departments at many universities.

With the passage in the U.S. of the 2010 Pedestrian Safety Enhancement Act [3], and the endorsement of the President in January 2011, the U.S. vehicle safety authority is required to issue a formal regulation on this topic no later than January 2014. Before that they should collect comments and explore the consequences in an Environmental Impact Assessment, which is probably what goes on at this moment. The Act requires EVs and HEVs to use AVAS, without the possibility to switch them off, but no later than January 2015 the Secretary shall complete a study and report to Congress as to whether there exists a safety need to apply the motor vehicle safety standard also to conventional (ICE) motor vehicles.

The MLIT in Japan, following consultation with the industry and representatives of the blind, in 2010 issued guidelines for audible pedestrian warning systems, already in-force early in 2011 [41]. These guidelines are presented in Table 1. Note that in Japan AVAS stands for "Approaching Vehicle Audible Systems" rather than the term used in the proposed GTR which is "Audible Vehicle Alerting System." In principle, the terms refer to the same thing.

As reported above, the informal working group QRTV operated under the GRB and had nine meetings in 2010–2011. A few details of its very comprehensive work are worth mentioning.

At the third meeting of QRTV, held in Japan, some interesting observations were made. A Japanese report summarizing the meeting stated [42]:

"There were pros and cons for generating the sound at stable state or idle state, and we concluded to generate the sound only when the vehicle starts running as urgent short-term measure. The committee reached this conclusion because the majority of visually-impaired said that they noticed highest danger when the vehicle started moving.. . .The guideline only requires that the sound should be a continuous sound reminding of an approaching vehicle. . .. If certain technological evolutions are available, other solutions than sound based solutions would be assessed and probably adopted. The use of sound by the Guideline is short term strategy (1–2 years ahead)" [42].

At the GRB, the subject has now advanced to a level when a proposal for a Global Technical Regulation (GTR) is available, as developed by the QRTV [6] and to be discussed at the September 2012 meeting of GRB. This proposal is partly based on the previous Japanese guidelines that had already been submitted to GRB [41], but is substantially less specific in its performance specifications, yet contains quite exhaustive explanations and discussions.

To summarize the guidelines [6], the main issues are listed in Table 2. It is recommended that the UN GTR be written to apply, in principle, to all quiet vehicles regardless of their motive power. However, due to limited performance information for other vehicles than EV/HEV it is recommended that initial regulatory specifications be limited to EVs and HEVs, operating in their electric mode. It is stated that the QRTV spent considerable effort to align its recommendations with the anticipated rule related to the U.S. Pedestrian Safety Enhancement Act.

The QRTV did not believe that a specific alerting signal sound pressure level can be recommended, absent a clear specification for sound frequency and content. Since audibility depends to a great extent on the background noise in a specific situation, and this may vary from (say) 30 to 80 dB in an urban setting, the author thinks that it will be up to the vehicle manufacturer to decide on at which background noise levels the AVAS should be audible. Other uncertainties in the specifications is the speed range for which the AVAS should operate ("crossover" speeds up to 33 km/h are mentioned but it is not mentioned how this speed shall be determined). Also, whether or not a pause switch shall be allowed is suggested to be left to decide by the country applying the regulation.

Table 1 – The Japanese guidelines (not a complete list; major items are selected by the author).

The AVAS shall automatically generate a sound in the minimum range of vehicle speed from start up to approximately 20 km/h and during reversing (not necessary when operating an ICE engine)
The AVAS may have a switch to stop its operation temporarily ("pause switch")
The AVAS sound level may be attenuated during periods of vehicle operation
The sound to be generated by the AVAS should be easily indicative of vehicle behavior, for example, through the automatic variation of sound level or characteristics in synchronization with vehicle speed
The sound level to be generated by the AVAS should not exceed the approximate sound level of a similar vehicle of the same category equipped with an internal combustion engine and operating under the same conditions
The development of the AVAS shall give consideration to the overall community noise impact
The sound shall be continuous
The following and similar types of sounds are not acceptable:
(i) Siren, chime, bell and emergency vehicle sounds
(ii) Alarm sounds e.g. fire, theft, smoke alarms
(iii) Intermittent sound
The following and similar types of sounds should be avoided:
(iv) Melodious sounds, animal and insect sounds
(v) Sounds that confuse the identification of a vehicle and/or its operation (e.g. acceleration, deceleration etc.)

How the GTR proposal could be turned into meaningful uniform specifications and harmonized performance with such non-specific issues is questionable.

Note that neither the Japanese nor the GTR guidelines provide for a system which adjusts its sound level to the background noise. With due consideration to the environmental impact, it means that the AVAS will be effective only in "low-noise" situations. These are generally typical of low risk areas, where traffic is low. However, this is similar to the situation today for propulsion noise where ICE vehicles operate. But it means that AVAS is a solution that may be effective only in a very limited number of urban situations and not really where most pedestrian accidents occur.

In the proposal to the European Parliament from the Commission in 2011, it is stated that taking into account the discussions and the information provided in the UN ECE it is proposed to amend the current noise legislation with a new Annex harmonizing the performance of "Approaching Vehicle Audible Systems" (*here we have yet another interpretation of the AVAS acronym*) if they are fitted to a vehicle. The fitting of such systems, however, shall be voluntary and remain an option under the discretion of the vehicle manufacturers [38]. The current intention is just to harmonize the AVAS.

The specification appears in an Annex IX named "Annex IX: Measures ensuring the audibility of hybrid and electric vehicles" [38], and it seems to be essentially a copy of the Japanese proposal; see Table 1. It will not harmonize with the proposed GTR.

13. Some AVAS in use

Most EV/HEV vehicles available on the market already have AVAS mounted; in some cases these are retrofit systems. Here are but a few notes about this.

For the Toyota Prius, the AVAS is an optional speaker setup in the front of the car that makes a "futuristic" humming sound equivalent to that of a standard petrol-driven vehicle. The cost is reported to be approx USD 170, excluding installation. The speaker is activated when the car starts up but can be turned off at the touch of a button if the driver so desires [43]. A synthesized electric motor sound is emitted at speeds up to 25 km/h and rises and falls in pitch based on the vehicle's speed. The system would not be acceptable if the GTR proposal is turned into a regulation since it can be turned-off.

In the Nissan Leaf, the sound system includes a speaker under the hood and a synthesizer in the dash. The driver will be able to turn it off, but it comes on by default at start up. At speeds above 30 km/h, the system turns off. The sound is a sine wave sweeping from 2.5 kHz to 600 Hz. At start-up, the sound comes on at its loudest to warn the visually impaired and other pedestrians that a car is about to enter their vicinity. When the Leaf is reversing, the system produces an intermittent "beeping" sound, similar to the back-up warning systems on trucks [44]. The U.K. has temporarily banned Nissan LEAF vehicles from being sold [45] due to its backup warning sound since the warning violates British noise laws, which prohibits loud noises between the hours of 23:00 and 06:00. Nissan has then

Table 2 – The most essential recommendations from QRTV to be part of a Global Technical Regulation (GTR) (not a complete list; major items are selected by the author).

The GTR shall currently be applicable to all EVs and HEVs in electric mode, but at some later stage also to quiet vehicles with other motion systems than electric
GTR audibility requirements shall address at least the following "at risk" issues:
(a) Vehicles approaching at right angles to the direction of pedestrians intended movement
(b) Vehicles initiating movement from a driveway or in a parking lot
(c) Vehicle travelling at low speed in quiet areas
A specific alerting signal sound pressure level is not recommended
A specific crossover speed, at which the system shall be switched on and off is not specified
The alerting system should be automatically activated when the vehicle slows to or below the crossover speed
The alerting system will automatically deactivate at vehicle speeds in excess of the crossover speed
It is recommended that the sound generated by the alert device monotonically increase or decrease in frequency as a function of vehicle speed. Further, it is recommended that during acceleration or deceleration an increase or decrease of at least 8% be demonstrated between 10 and 20 km/h
It is recommended that the alerting system is operated during temporary stops of the vehicle
It is further recommended that the sound level be automatically attenuated during these periods to a level that is adequate to be heard by a pedestrian who is at the curb, immediately adjacent to the vehicle
It is recommended that the acoustic performance requirements give careful attention to their potential adverse environmental impact, particularly with respect to loudness and frequency content
The development of the AVAS shall give consideration to the overall community noise impact
The following operating frequency specifications should be considered:
(a) Frequency range of audible signal: between 50 Hz and 5 kHz
(b) The frequency content should include at least two 1/3 octave bands within that range
(c) In case the AVAS produces only two frequencies, these should differ by $\geq 15\%$
(d) An alerting signal's mid-frequencies (0.5–2 kHz), higher frequencies (2–5 kHz) support audibility and directional cues. Low frequencies (< 500 Hz) support earlier detection but in an urban environment are at risk of being masked.
The following sounds should be prohibited:
(a) Siren, horn, chime, bell and emergency vehicle sounds
(b) Alarm sounds e.g. fire, theft, smoke alarms
(c) Intermittent sound
(d) Melodious sounds, animal and insect sounds
(e) Sounds that confuse the identification of a vehicle and/or its operation (e.g. acceleration, deceleration etc.)

the intention of removing the warning sound entirely; states the company, "The audible system on the LEAF did not allow for [a timing dependent fix], so the beeping sound is being removed entirely before the cars can be driven on roads in Britain" [45].

The Chevrolet Volt EV has an AVAS that GM calls "pedestrian friendly alert" or "courtesy signal," which is manually activated by pushing a button on the blinker control stick. It is reported to sound like a soft horn [46]. The system would not be acceptable if the GTR proposal is turned into a regulation since it is normally used only when it is judged by the driver to be needed in order to alert a pedestrian or bicyclist.

14. Non-acoustical solutions to the problem

The author thinks that the acoustic solution in the form of a soft horn applied by GM Volt could be a reasonable compromise, to be applied only when the driver thinks that there is a danger ahead (but it must not be abused by telling pedestrians "keep out of the road, here I come"). Apart from this, non-acoustical solutions are preferred.

The QRTV group did not put much attention to alternative solutions. However, at least the Japanese are open to non-acoustical solutions [47].

In the author's previous paper, several non-acoustical systems for alerting pedestrians or drivers about a potential risk of collision are described [9]. This is not repeated here; nevertheless, a few potential solutions will be mentioned.

Professor Jim Kutsch, President of The Seeing Eye, Inc. (http://www.seeingeye.org/), blind himself (as his family) and an expert on seeing-eye dogs, has expressed in an interview that "We've added hybrid cars to our training program. You can't hear them when they are at a full stop. We now teach

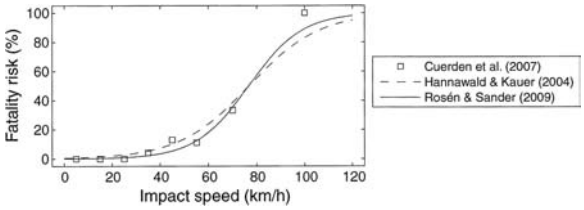

Fig. 7 – Fatality risk in pedestrian-to-vehicle collisions as a function of impact speed, as determined in three different studies. Diagram from [30].

dogs that a car is a car, whether it's making a noise or not" [48].

One may also consider making the white cane sticks more hi-tech with special warning indications, such as a blinking lamp when the cane is pointed straight out or when activated by the user.

An alternative way of improving pedestrian safety is to equip quiet vehicles with a chip (corresponding to RFID chips) which sends out a radio signal within a very limited range, which can be identified by a pedestrian if he/she has a receiving unit for such signals. It should be possible in such systems to distinguish between approaching and non-approaching vehicles, as well as displaying some kind of speed indication. This is in practice possible already today if the political will exists. This may be made useful also for hearing-impaired people as such signals may be sensed also as vibrations. Not the least, this may be effective even for pedestrians who have chosen to neglect ambient sound by using portable audio systems.

Several modern cars are already equipped with Autonomous Emergency Braking (AEB) systems, often in combination with pedestrian detection systems. EuroNCAP describes AEB Pedestrian systems which can detect pedestrians and other vulnerable road users like cyclists [49]. They invariably employ a camera combined with a radar—something called sensor fusion. New technologies are appearing on the market that use infrared which can also operate in very low light conditions. EuroNCAP lists two car manufacturers who have such systems fitted: Lexus and Volvo, where Volvo has it as standard equipment on most of its new models [49].

The latest BMW 3-Series has been commended for its pedestrian protection measures following a crash test in Europe, while Volvo has developed an airbag designed to save pedestrians [50].

Volvo's newest pedestrian detection system with AEB is presented in [51]; see illustration in Fig. 8. It reads "In an emergency situation the driver first receives an audible warning combined with a flashing light in the windscreen's head-up display. If the driver does not react to the warning and a collision is imminent, full braking power is automatically applied" [51].

In backing operations, a possibility is to equip vehicles with a simple radar device or an "Ultrasonic Auto Reverse Safety Device" that can detect moving objects behind the vehicle. Many vehicles are already equipped with "parking radars" to facilitate parking operations, and there are already relatively inexpensive products on the market that offer protection against backup on small children and other pedestrians.

15. Transfer of responsibility from driver to pedestrian

The traditional view is that it is the driver who has the main responsibility to avoid a collision with a pedestrian, probably also with a bicyclist. This is natural since the driver has a reasonable protection against injuries in his vehicle while the former are totally unprotected.

A driver being aware of that his vehicle emits dedicated sound that has the expressed intention to inform pedestrians that the vehicle is coming may be tempted to think that this moves some of the responsibility from him over to the pedestrian. This may create a situation which is even worse than with no warning signal, where it is obvious that the driver has the full responsibility. Especially, a vehicle backing out of a parking lot, where it is inconvenient and uncomfortable to look behind, may be an example of this.

A system where the pedestrian is informed about the presence of an EV/HEV by other means, without giving the driver any reason to rely on it, would be better. For example, this author would suggest that each EV/HEV is equipped with an RFID chip that can be recognized in a GPS system and that such a system is available to pedestrians, in particular optimized for blind people. If they wear such a system, there could be a warning issued

Fig. 8 – Illustration of Volvo's pedestrian detection system with AEB [51].

(a sound or vibration noticed only by the person who wears the device) when such a vehicle comes closer than x meter. The speed and direction may be calculated each second from the change over time in GPS position. It may mean some cost to the pedestrian; however, when such devices are produced in large numbers the cost will become reasonable. The system may be integrated into a cell phone, and it may be enough to buy an "app" for it. Cell phones that have an integrated or add-on GPS are already on the market; see for example www.maps-gps-info.com. Such systems will need development for this application; in terms of geographical coverage, precision (1 m would be desired) and speed. But development is fast and if the need is recognized, satisfactory systems should be available soon. For the blind, a system with spoken instructions or sound-coded signals should be developed.

With such a system, no responsibility should be transferred from the driver to the pedestrian, since the driver would never know which persons who have such systems.

16. CONCLUSIONS

The occurrence of electric driven vehicles on the market promises a unique breakthrough in reduction of urban community noise. The very low noise emission from electric motors means that power unit noise is almost totally absent for such vehicles and that only tire noise remains. The effect will be that at low vehicle speeds (approximately up to 20 km/h for cars and up to 50–70 km/h for heavy vehicles) the acoustic environment will improve substantially.

However, the supposed problem of quietness of vehicles operating in electric mode has resulted in concerted actions by a number of organizations at a pace which is unique within the subject of traffic noise, the justification for which is questionable. Firstly, the actions have not been based on robust evidence of serious traffic accidents; secondly, the problem (if any) seems to be potentially greater for other types of vehicles than for the cars which have been in focus so far and, thirdly, correspondingly quiet vehicles have been used for decades already without noticing a specific accident problem due to the quietness. The current concern seems to have been triggered by the occurrence of Japanese hybrid cars on the market and the relative success they enjoyed.

It is suggested in this article that the quietness of cars driven in electric mode may not be a major safety problem, as far as one can see at this moment, possibly with the exception of back-up operation. There is simply no robust and consistent traffic accident data that say that quietness of vehicles is a significant cause of accidents. On the one hand, we have the NHTSA report that suggests that more HEV than ICE vehicles are involved in pedestrian accidents; on the other hand, several other studies have failed to show such relations. It may be that the NHTSA report indicates a unique U.S. situation, or that there are biases in the data that may explain the relations in other ways than due to quietness. This matter needs more research.

Nevertheless, for the blind community the quietness of vehicles driven in electric mode must be recognized as a psychological problem, making the blind feel unsafe and experiencing more serious restrictions than earlier when the sound cues have been reduced. However, it must also be noted that this situation has existed for a long time due to several types of quiet vehicles operating in our traffic, and did not occur only due to HEVs becoming common on the market.

It is suggested in the article that reducing maximum noise level limits is a much better way for promoting health and safety than adding extra sound to the quietest vehicles. The problem is not that vehicles are getting too quiet; the problem is that background noise masks the noise of the quiet vehicles. Especially heavy vehicles, as well as motorcycles with illegal exhaust systems, give very high contributions to the masking by background noise.

The addition of AVAS to EVs and HEVs, or even to quiet ICE cars, may be directly counter-productive, as it is likely to provide only a marginal safety improvement (if any at all), which may easily be balanced-out by an increased feeling of safety for both pedestrians and drivers, transformation from responsible driving to a belief in AVAS, as well as the impaired health issues due to missing an opportunity to efficiently reduce noise exposure.

The perceived unsafety of the blind due to vehicle quietness should be addressed primarily by reducing the masking of sound cues by noisy vehicles, which would have other substantial benefits, and by other measures than the acoustical. Training of seeing-eye dogs to care about vehicles in the same way irrespective of sound level may be one; another one may be the collision-preventing systems rapidly being introduced on the market. One may also consider making the white cane sticks more hi-tech with special warning indications. For reversing quiet vehicles, rearview cameras and/or radars would be preferred. Also, informing and educating both drivers and pedestrians about the change in traffic acoustics due to the gradual introduction of EVs and HEVs would be useful.

When it comes to sound cues in traffic, the most effective measures for accident prevention would probably be to reduce distraction of pedestrians and bicyclists by limiting the use of portable audio

systems and cell phone talking as well as texting in traffic environments.

The current attempt to develop a Global Technical Regulation for AVAS seems difficult to implement in a practical and uniform way globally, at least in the way it was specified recently. The Japanese proposal seems to be easier to develop into a regulation, although also this is unnecessary according to this author.

The author suggests discontinuing the work with AVAS, limiting rather than requiring the use of such systems, and instead focusing on limitation of the worst masking noise emissions in urban areas. It may not be as exciting and fashionable to work with noise reduction as with sound production, but it would have more benefits to the safety and health of society.

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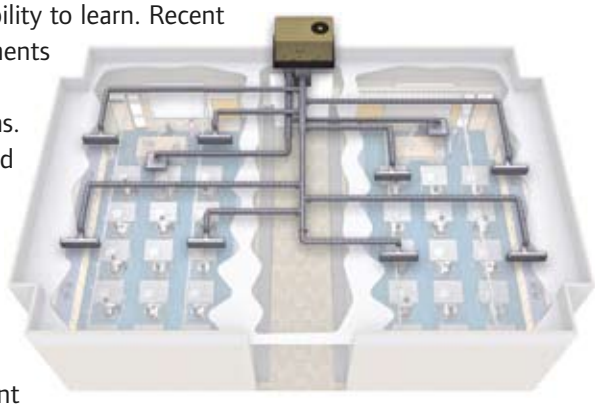

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European News

Bernard Berry, European Editor

Essex Study Links Lower Reverberation To Better Classroom Instruction and Learning

Acoustic Bulletin Quarterly, a publication of Saint-Gobain Ecophon AB, is shining the light of scientific achievement on noise control engineers with its coverage of a UK study that demonstrates the benefits of lower reverberation on instruction and learning in school classrooms.

The publication's latest edition prominently features the May 2012 release of the final report of the Essex Study, designed to point the way to standards of excellence as complements to established minimum acoustical design standards for schools. The study included six months of acoustic measurement plus commentary by school personnel regarding ten combinations of teachers and classrooms at the Sweyne Park secondary school in Rayleigh, Essex, east of London. The pupils involved were both hearing-impaired and unimpaired.

Classroom noise level measurements showed a much larger than expected reduction in approximated background noise as reverberation times decreased. This corresponded to a much improved signal-to-noise ratio with less vocal effort by teachers, consistent with interview findings suggesting that pupil behavior and comprehension increased as reverberation times decreased.

Acknowledging a century of awareness that noise in the classroom undermines learning and numerous studies of the detrimental effect over the last 50 years, the Essex Study claims to be "the most extensive systematic study to examine the impact of reducing reverberation in a working school environment."

"Despite the introduction of various guidelines over the years aimed at ensuring good speaking and listening conditions in schools, many schools continue to be built which are acoustically 'unfit for purpose' with high noise levels and reverberant conditions creating difficulties for both pupils and teachers," the study said.

The study was jointly funded by Essex County Council, the Federation of Property Services , and the National Deaf Children's Society. The final report was presented in Corby, UK.

Environmental Groups Want Lower Vehicle Noise Standards

Three environmental groups are urging the European Parliament and member states to support more stringent noise emission standards for all road vehicles.

The groups – Transport & Environment, the European Environmental Bureau, and the Health and Environment Alliance – have been pressing their point with the help of a video news release featuring claims that traffic noise is associated with 50,000 deaths and about 250,000 cases of heart disease per year.

The groups note that the European Commission put forward a proposal to update vehicle noise limits that would require cars and vans to be quieter by four decibels and lorries by three decibels within five years of the proposed law's enactment.

The environment committee of the European Parliament was expected to vote on the new rules in July. The three environmental groups say they want restrictions to be even tighter than those proposed – an extra two-decibel reduction for cars, vans, lorries and buses by 2020.

The groups acknowledge that counterarguments by vehicle manufacturers who favor less stringent standards for certain kinds of vehicles may be lessening Parliament's interest in enacting the most stringent standards.

Pan-American News

Paul Donovan, Pan-American Editor

Harvey Hubbard
Dead at Age 90

Engineer, research scientist and author Harvey Hubbard died peacefully at age 90 after long devotion to his faith, his family and to making life quieter in the proximity of large aircraft, sonic booms and wind turbines.

The Daily Press of Hampton Roads, Virginia, (www.dailypress.com) and The Virginia Pilot (www.pilotonline.com) carried reports of his passing on May 14, 2012 in Newport News, Virginia, where Hubbard lived as a retired aero-acoustician and noise control engineer of the National Aeronautics and Space Administration. He was buried May 19.

Sadie Miller Hubbard, his wife of 62 years, preceded him in death. Hubbard is survived by four married children and a sister.

As a longtime member, elder, and trustee of Hilton Presbyterian Church.

A Swanton, Vt., native educated in one-room schools and at the University of Vermont, Hubbard was a World War II veteran of the U.S. Army Air Corps and a retired lieutenant colonel of the U.S. Air Force Reserves.

He wrote more than 130 NASA documents, and journal articles and reference textbook chapters. Hubbard edited two volumes of *Aero-acoustics of Flight Vehicles, Theory and Practice*, for which the American Institute of Aeronautics and Astronautics honored him. He served on the editorial boards of the *Journal of Noise Control Engineering* and the *Journal of Sound and Vibration*.

NASA bestowed multiple honors on him for his many contributions to science, among them the Hubbard Criterion, the formula for predicting the effect of noise on physical structures.

Hubbard was a charter member, a president and a fellow of the Institute of Noise Control Engineering. He was a longtime member, a fellow and a president of the Acoustical Society of America, recipient of its first silver medal for noise control research and chairman of its Technical Council. He was the first American recipient of the Aero-acoustics Award of the American Institute of Aeronautics and Astronautics.

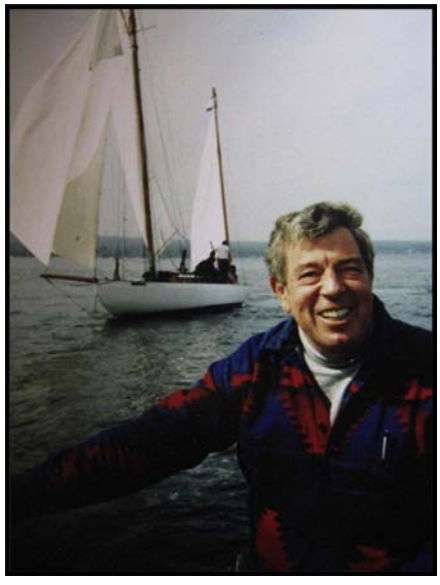
The family encourages friends to make memorial contributions to the Harvey and Sadie Hubbard Memorial Fund, Presbyterian Homes and Family Services, 150 Linden Avenue, Lynchburg, VA 24503 or Hilton Presbyterian Church, 34 Main Street, Newport News, VA 23601.

Ken Eldred, 1929 - 2012

Kenneth McKechnie passed away Jan. 30, 2012, at age 82 after a long career devoted to making residential neighborhoods and industrial centers quieter through practical applications of wide-ranging noise- and vibration-control principles. He earned international recognition and was considered by his peers to be among the best practitioners in the nation. He was born on November 25, 1929, in Springfield, Massachusetts.

Eldred received a general engineering degree from the Massachusetts Institute of Technology in 1950 and until 1954 served as director of shipboard vibration, noise control for submarine machinery and propellers, and underwater sound activities at the Boston Naval Shipyard Sound and Vibration Laboratory. He served as chief of the Physical Acoustics Section, Bio-Acoustics Branch, at the USAF Wright Air Development Center in Dayton, Ohio, where he worked closely with Dr. Henning von Gierke from 1954 to 1957.

From 1957 to 1963, Eldred served as vice president and consultant in acoustics and vibration at the Western Electro-Acoustics Laboratory, Los Angeles, California. In 1963 he was appointed director of research at Wyle Laboratories, El Segundo, California, newly formed to help meet intensifying requirements of the space program.



KENNETH McKECHNIE ELDRED
1929 – 2012

He joined the Cambridge, Massachusetts office of Bolt Beranek and Newman in 1973 and served as group vice president, principal consultant, and director while also consulting with clients including airport operators and the EPA Office of Noise Abatement and Control.

Eldred later formed Ken Eldred Engineering and for many years continued consulting with airport and industrial clients. His papers during this period included *Airport Noise: Solving a World Class Problem* and *Sound Exposure without Decibels*.

He helped found the Institute of Noise Control Engineering of the USA, serving as director, finance committee chair and president.

Eldred was a principal author of the 1974 landmark U.S. EPA report *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, or the *Levels Document*.

He was a member of the National Academy of Engineering, a fellow of the Institute of Noise Control Engineering, a director of the INCE Foundation, and a fellow of the Acoustical Society of America.

Eldred is survived by his wife, Barbara, daughter, Heidi McKechnie, and two granddaughters.

For Sale: Lab Built for Acoustics Pioneer Wallace Clement Sabine

A landmark building constructed in Geneva, Illinois, in 1918 as a laboratory for Wallace Clement Sabine, founder of the scientific discipline of architectural acoustics, has been put on sale by its current owners.

Fred Hackendahl, representing owner Riverbank Properties, LLC, said the offering comprises nearly 16,000 square feet of combined lab and office area in the original 1918 three-story building and a connected, free-standing addition erected in the 1960s. The structures stand on a lot of eight-tenths of an acre. They are occupied under a tenant lease by Riverbank Acoustical Laboratories, a unit of Alion Science and Technology Corp. The lease expires in 2013.

The property is a Geneva landmark subject to conditions of the National Register of Historic Places and the Illinois Historic Preservation Agency. Riverbank Properties has owned the property since 1999.

Sabine had been researching reverberation as a physics professor at Harvard University when he was invited to Geneva by George Fabyan, whose financial success in the cotton industry was directed toward his interests in military engineering, codes and ciphers, and acoustics, including an experimental acoustic levitation machine associated with the 16th-century philosopher, statesman and scientist Sir Francis Bacon.

Efforts to perfect Bacon's machine led Fabyan to contact Sabine.

Their meeting in 1913 produced no breakthroughs in acoustic levitation but did lead to collaboration on war research, including the use of cameras in airplanes for aerial reconnaissance, and the construction beginning in 1917, under Sabine's supervision, of a reverberation chamber that ranks among the most efficient in the world and remains in use today.

The precision with which sounds can be measured in the chamber allowed Sabine to calculate absorption coefficients that bear his name, the Sabine Formula. He died at age 50 in 1919.

Scantek Names Three to Technical Staff

Scantek, Inc. appointed three new members to its technical staff.

MAREK KOVACIK – Applications engineer who will oversee the sale and support of Scantek noise prediction software and sound analysis programs. Degree in audio arts and acoustics, Columbia College, Chicago. Background includes environmental and engineering acoustics and acoustics of performing spaces.

MATT GOLDEN – Head of testing & laboratory instruments who will operate the Norsonic Nor 848 Acoustic Camera, Nor 850 Distributed Multichannel System and other instruments for Scantek's acoustical labs. Ten years' experience in building acoustics and product development. Previously acoustical product engineering manager at Kinetics Noise Control.

STEVE MARSHALL – Manager of operations who will oversee instrumentation sales and marketing and lead initiatives in monitoring systems and consulting. Thirty-five years' experience in sound & vibration control in automotive, airspace and HVAC&R. INCE fellow and board certified member.

FAA Receives Study Analyzing Aircraft Noise Annoyance Metrics

The Federal Aviation Administration in June received a report that examines options for supplementing or replacing a common measure often used as the sole predictor of the annoyance that people experience in the presence of aircraft noise.

The measure in question is day-night average sound level, DNL. The report notes that annoyance is the primary effect that aircraft noise has on residential populations, yet DNL is not the only cause of annoyance and it is poorly understood by the public, hence the interest in possibly augmenting or replacing it.

Under the title *Technical Support for Day/Night Average Sound Level Replacement Metric Research,* authors Mestre, Shomer,

Fidell and Berry submitted their work under report number DOT/FAA/AEE/2011-02.

In its various sections, the report reviews basics of transportation noise regulatory policy, introduces the customary approach to measuring aircraft noise, and identifies the major limitations of DNL. It contains excerpts of a European analysis of similar matters.

The report also describes the logic for measurement of transportation noise, and the rationale necessary to predict noise effects from noise measurements. It contains information about limitations of the most commonly used frequency weighting for noise measurements and the unreliability of certain field measurements.

Regarding the challenges of communicating with the public about aircraft noise, the report recommends avoiding all use of acoustics profession jargon.

The report states that a different noise metric can serve as an improved predictor of aircraft noise impacts only if it differs from DNL by a statistical correlation smaller than about 0.7. Since nearly all aircraft noise metrics correlate very highly with DNL, most alternates are thus unlikely to support more accurate or precise predictions of noise impacts than DNL. The only noise metrics that do not correlate highly with DNL, time above and number above, share other limitations of their utility as predictors of noise effects.

The report includes a brief description of a systematic method for including non-acoustic influences on self-reports of annoyance. Such a community tolerance level is currently under consideration by ISO for adoption in a revised international standard for characterizing transportation noise impacts.

Eagan Joins ACC Board

The Airport Consultants Council announced the appointment of Mary Ellen Eagan, president of Harris Miller Miller & Hanson Inc. to its board of directors.

"As president of a mid-sized consulting firm, I look forward to contributing a different perspective to the board's discussions," said Eagan, whose roles on the board will encompass governance and strategic direction.

ACC is the international trade association that represents private businesses involved in the development and operations of airports and related facilities. It considers itself the only association focusing exclusively on the business interests of firms with airport-related technical expertise.

Asia-Pacific News

Marion Burgess, Asia-Pacific Editor

'Father of Acoustics' In China Dead at Age 97

Professor Dah-You Maa (Ma Dayou), who as a graduate student in the United States helped to advance room acoustic theory and later earned renoun as China's "father of acoustics," died peacefully in Beijing surrounded by family July 17, 2012, at age 97.

Maa was born in Beijing on March 1, 1915. Having earned a bachelor of science from Peking University in 1936, he began graduate studies in 1937 at the University of California, Los Angeles, and continued at Harvard University in 1938. He co-authored "Distribution of Eigentones in a Rectangular Chamber at Low Frequency Range" and "Analysis of Sound Decay in Rectangular Rooms." These two landmarks in room acoustic theory were both published in the Journal of the Acoustical Society of America in 1939, the year he earned his Master's, followed a year later by his Ph.D., also at Harvard.

Maa returned to China during World War II to teach at National Southwest Associated University in Kunming and in 1946 at age 31 founded the Engineering College at Peking University, as reported in an obituary posted at http://english.ioa.cas.cn/ns/es/201207/t20120717_89024.html. He helped to plan and later served as director of an acoustics research center within the Chinese Academy of Sciences.

As a professor of physics, electronics, electrical engineering and acoustics and as a visionary in research and development, Maa made significant contributions to speech analysis, synthesis and recognition technology, noise control, nonlinear acoustics and infrasonics. He conducted pioneering research regarding micro-perforated absorbers, active noise control in rooms, high-intensity standing waves, and turbulent jet noise.

Maa was a founding member of the Technical Committee on Acoustics in the Chinese Society of Physics, later the Acoustical Society of China. He founded IACAS in 1964 and served as Chairman from 1980 to 2007. He was elected a member of the New York Academy of Sciences in 1981.

Numerous prestigious awards came his way between a fellowship of Acoustical Society of America in 1943 and the 19th Honorary Fellow of ASA in 2012.

He was editor-in-chief of the Chinese-language ACTA ACUSTICA since its inception in 1965 and the English-language Chinese Journal of Acoustics since 1984.

He authored and co-authored more than 20 books and 200 papers. His "Theoretical Foundation of Modern Acoustics" was published in 2004 and became a standard university text in China.

Professor Maa is survived by his wife of 65 years, Rong Ho Wang, a physician, and their two children, Xiaofei and Xiaobin.

The funeral was scheduled for July 21 in Beijing. Condolences may be directed to Prof. Dah-You Maa's Funeral Committee, 21 Bei-Si-Huan-Xi Road, Haidian District, Beijing 100190, China, or in care of Yang Cheng, chengyang@mail.ioa.ac.cn or Jun Yang, jyang@mail.ioa.ac.cn. Tel: +86-10-82547851; +86-10-82547853; Fax: +86-10-82547890

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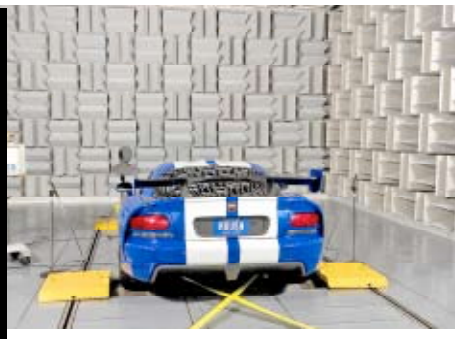

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Trane

USA: Trane
www.trane.com/acoustics

Future Meetings

NOISE-CON 13
The 2013 National Conference On Noise Control Engineering
Denver, CO
August 28-30

WTN 13
Wind Turbine Noise
Denver, CO
August 30-September 1

INTER-NOISE 13
The 2013 International Congress On Noise Control Engineering
Innsbruck Austria
September 15-18

Endevco Converter Series Adds 5mV/pC Gain Version

Meggitt Sensing Systems announced the addition of a 5 millivolt per picocoulomb version of its Endevco Model 2771C-XX series of ultra-low-noise remote charge converters.

The new feature was designed to produce more precise measurements from piezoelectric transducers in applications related to mechanical system health monitoring, nuclear power plant and regenerative energy processes and environmental testing.

The Model 2771C-XX now sells for a lower price and is offered as a lower-noise, drop-in replacement for legacy Endevco 2771B models or their equivalents.

Meggitt Says Its Endevco Model 7264 Reaches Best-Seller Status in its Class

Meggitt Sensing Systems said its Endevco® Model 7264 series has become its best-selling family of piezoresistive shock accelerometers.

The Model 7264 frequency response extends to DC, or steady-state acceleration, applicable for measuring long-duration transients as well as sudden impacts to structures and systems. Typical applications include testing related to automobile crashes, seat belts, ejection seats and circumstances involving minimal mass loading and broad frequency response.

Learn more at www.meggittsensingsystems.com.

Shunt vs. Dynamic Calibration Clarified

A common misunderstanding about the nature and purpose of accelerometer shunt calibration can obscure the authentic value that the procedure has in the preparation of test structures, Meggitt Sensing Systems explains in the July 2012 edition of its on-line publication Measurement News.

The publication offers the insight in response to a question about whether shunt calibration is 'true' calibration.

In contrast to dynamic calibration in which an accelerometer is stimulated mechanically by a known value under laboratory conditions, usually with a shaker, shunt calibration is passive. Connecting an accurate and stable fixed resistor across one of the accelerometer's bridge resistors will unbalance the bridge and electrically simulate a calculated percentage of transducer full-scale output, mimicking mechanical stimulation.

Shunt calibration is usually performed after the accelerometer is installed on a test structure and dynamic calibration is impractical. The procedure provides a valuable continuity check of the entire measurement chain, from transducer to data acquisition system, and can reliably verify signal conditioner gain settings.

Shunt calibration is described in further detail on an Endevco web page of Meggitt Sensing Systems.

Meggitt Issues Technical Paper To Guide Selection of Accelerometers

Assessing the nature of the measurements to be taken ranks among the first considerations in selecting the most appropriate accelerometer for any given application and circumstance.

Thus begins a straightforward, utilitarian narrative in a new Endevco technical paper, Steps to Selecting the Right Accelerometer, released by Meggitt Sensing Systems.

Endevco TP327 covers the main characteristics of the three most widely used technologies, piezoelectric, piezoresistive, and variable capacitance. The paper sets out the main categories of acceleration and the technologies associated with their measurement. It addresses considerations related to frequency response, axes, the accelerometer's weight, operating temperature and means of mounting, ground isolation, sensitivity, resolution, signal conditioning, and transverse sensitivity.

The paper is available for download on the Endevco website at http://www.endevco.com/news/newsletters/2012_07/tp327.pdf.

Scantek Product Gains Algorithms

Scantek, Inc. said Mediterranean Acoustics Research & Development has added ISO 9613-2:1996 algorithms to create a new version of its Olive Tree Lab-Terrain software.

OTL-Terrain is used to design noise barriers and map small to medium projects.

The product already had an acoustical calculation engine to simulate three-dimensional sound propagation. Enhancements include display of LpAfter and LpBefore curves, visibility tracing for reflection detection, better path detection, render modes in mapping views, and calculation of reflected diffracted paths.

Handbook Editor Jon Wilson to Teach Calibration Theory in San Juan Capistrano Sept. 18–20

Jon Wilson, editor-in-chief of Sensor Technology Handbook, will teach accelerometer calibration theory in San Juan Capistrano, California, Sept. 18 through Sept. 20 at the 2012 edition of this annual course produced by Meggitt Inc.

Accompanied by Endevco text and technical materials, the lectures and hands-on demonstrations will cover motion theory and measurement, shock calibration, electrodynamic shakers, accelerometer performance, signal conditioning, statistics, error analysis, accuracy and uncertainty, calibration standards and specifications. Registration limited to 50 persons. Contact Jessica Koble, Sales & Marketing Coordinator, +1 949 276 0413, jessica.koble@meggitt.com

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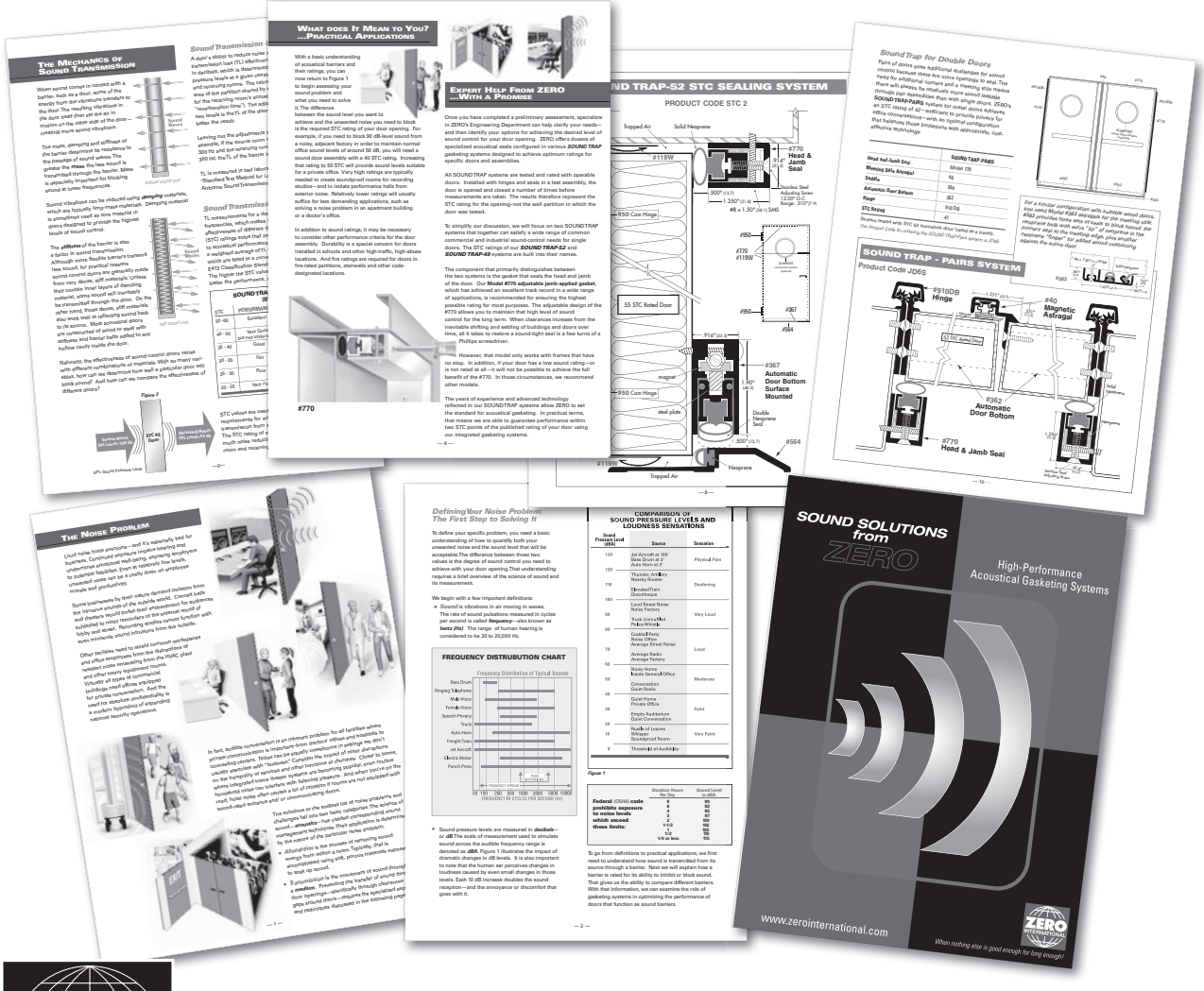
ZERO is a world-wide leader in high-performance acoustical control for doors, windows and walls. Nobody does sound control better — we use advanced technology and testing to master the challenges of creating an effective barrier and preventing gaps in that barrier for the life of the assembly. Our systems are rated for use in sound studios and recording facilities, music halls, etc — up to 55 STC. Let us help you close the door on noise — contact us for a copy of our 20 page Sound Control brochure, and our 72 page Product Catalog, or download from our website.



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Acknowledgements

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G.R.A.S. Sound and Vibration ..... Vedbaek, Denmark

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Conference Calendar

Below is a list of congresses and conferences sponsored by International INCE and INCE/USA. A list of all known conferences related to noise can be found by going to the International INCE page on the Internet, www.i-ince.org.

2012 August 19–22
INTER-NOISE 12
New York City, USA
Contact:
Institute of Noise Control Engineering-USA
Amy Herron, Conference Coordinator
INCE/USA Business Office
9100 Purdue Road. Suite 200
Indianapolis, IN 46268-3165
Telephone: +1 317 735 4063
E-mail: ibo@inceusa.org
http://www.internoise2012.com

2013 August 28-30
NOISE-CON 13
Denver, Colorado, USA
Contact:
Institute of Noise Control Engineering-USA
Amy Herron, Conference Coordinator
INCE/USA Business Office
9100 Purdue Road. Suite 200
Indianapolis, IN 46268-3165
Telephone: +1 317 735 4063
E-mail: ibo@inceusa.org
http://www.inceusa.org/nc13

2013 August 30-September 1
Wind Turbine Noise 2013
Denver, Colorado, USA
Contact:
Cathy Mackenzie
INCE/Europe,
Riverside House,
4 Oakland Vale,
New Brighton,
Merseyside CH45 1LQ, UK
Tel: +44 (0)151 638 0281
Fax:+44 (0)151 639 5212
E-mail: cathy@cmmsoffice.demon.co.uk
http://www.windturbinenoise2013.org

2013 September 15-18
INTER-NOISE 13
Innsbruck, Austria
Contact:
Austrian Noise Abatement Association
Dresdner Straße 45/3.19, 1200 Wien
Tel.: +43-664-1865630
Fax.: +43-2287-4963
E-Mail: internoise@oal.at
http://www.internoise2013.com/

Directory of Noise Control Services

Information on listings in the Directory of Noise Control Services is available from the INCE/USA Business Office, 9100 Purdue Road, Suite 200, Indianapolis, IN 46268-3165. Telephone: +1 317 735 4063: e-mail: ibo@inceusa.org. The price is USD 400 for 4 insertions.

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http://www.ngctestingservices.com

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Mark your calendar and plan to participate!

INTER-NOISE 2012

New York City, USA
August 19–22

INTER-NOISE 2012, the 41st International Congress and Exposition on Noise Control Engineering, will be held in New York City, USA, from 19-22 August 2012. The theme of the Congress is Quieting the World's Cities. The congress is being held in conjunction with the American Society of Mechanical Engineers Noise Control and Acoustics Division (ASME NCAD) annual meeting, is sponsored by the International Institute of Noise Control Engineering (I-INCE), and is being organized by the United States Institute of Noise Control Engineering (INCE-USA). The Acoustical Society of America (ASA) and SAE International are also co-sponsoring the event.

We anticipate a large, broad program of sessions on a variety of acoustics, vibration, and noise topics. We plan to hold special workshops highlighting city noise codes, and the New York City noise code in particular.

The INCE/USA Page at the Atlas Bookstore

www.atlasbooks.com/marktplc/00726.htm

INTER-NOISE 06 Proceedings

This searchable CD-ROM contains the 662 papers presented at INTER-NOISE 06, the 2006 Congress and Exposition on Noise Control Engineering. This, the 35th in a series of international congresses on noise control engineering was held held in Honolulu,Hawaii, USA on December 3-6, 2006. The theme of the congress was "Engineering a Quieter World."

The technical topics covered at INTER-NOISE 06 included:

- Aircraft and Airport Noise Control
- Community Noise
- Fan noise and aeroacoustics
- Highway, automobile and heavy vehicle noise
- Machinery noise
- Noise policy
- Product noise emissions
- Sound quality.

The NOISE-CON 2011 Proceedings Archive (1996-2011)

NOISE-CON 2011 was held jointly with the Transportation Research Board (TRB) ADC40 Committee on Transportation-Related Noise and Vibration on 25-27 July, 2011 at the Marriott Downtown Waterfront Hotel in Portland, Oregon. One hundred forty seven (147) technical presentations were given at the conference and of those, 132 were submitted as written papers that are included on this DVD.

This DVD contains the proceedings of ALL NOISE-CON conferences held since 1996. This includes the years 1996, 1998, 2000, 2001, 2003, 2004, 2005, 2007, 2008, and 2010. Also included are the proceedings of two sound quality symposia, 1998 and 2002. So, including the NOISE-CON 2011 papers, a total of 1621 technical papers are included on this DVD. All papers are in PDF format.