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(R) PURCHASE OF EQUIPMENT AND CONSULTANCY SERVICES RELATING TO INDUSTRIAL NOISE*.

ID/HOK/76/005.

HONG KONG.

Technical report

Prepared for the Government of Hong Kong by the
United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Bryan H. Miles, industrial noise consultant

United Nations Industrial Development Organization
Vienna

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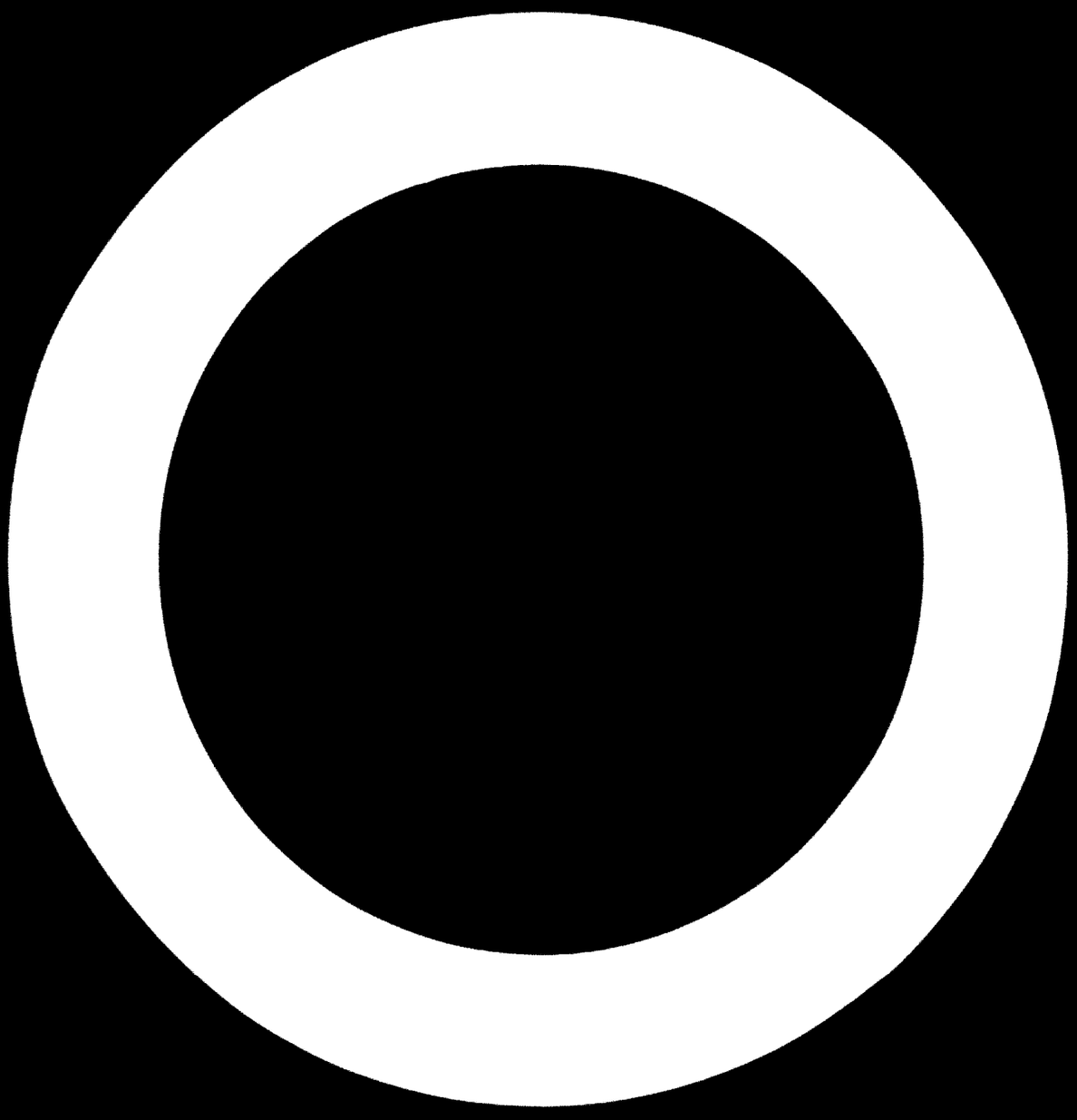


1. SUMMARY

1.1 The project covers the conservation of workers hearing by reduction of exposure to noise and is of two years duration. The UNDP input consists of equipment for the Noise Control Laboratory and the assignment of an industrial noise consultant for the first three months of the project.

1.2 It briefly outlines the work that was done in setting up the Noise Control Laboratory. Assesses the situation and makes recommendations for Noise Legislation, training, further equipment and organization. Also included are references to assist in the continuation of the programme by local staff.

2. INTRODUCTION

2.1 The project document assigned to the Industrial Noise Consultant appointed by UNIDO the task of covering Part II B, the Immediate Objectives:

(i) Identify industrial noise problem
(ii) Conservation of hearing of workers
(iii) Drafting of legislation and measures for industrial noise control.

2.2 The original project was laid out in 1976 assuming a starting date in 1977. It was finally agreed in 1978 and started in 1979.

2.3 Consequently adjustments were necessarily made to accomodate the current situation and the objectives reached were:

(i) Assess the industrial noise problem and the degree of hazard
(ii) Advise on appropriate means to reduce exposure to noise e.g. publicity, persuasion or legislation
(iii) If legislation is advised draft suitable regulations
(iv) Set up the laboratory and staff to carry out noise control measures.

2.4 At the host Department's request and to further assist the hearing conservation programme, by making people more aware, some public relations were also carried out. These consisted of visits, discussions, interviews with press and radio, an article and a formal lecture. Appendix IV gives examples to indicate the extent of this part of the project.

3. FINDINGS

3.1 An initial assessment of Hong Kong industry was made by visiting some 30 factories of varying and similar industries of different sizes and quality of working conditions.

3.2 The latest results of the Noise Survey being carried out by the Factory Inspectorate were studied. These results are very detailed and cover random sample visits to 394 establishments in "possible noisy industries." It had originally been intended to continue the survey until some time in April to present the results in May, however, the results so far obtained were collated for my benefit and, in my opinion, already show the extent of the problem so there is no longer need to continue. The survey clearly indicated that about 40,000 Hong Kong workers are exposed to Leq = 90 dB(A) all of the time and a further 60,000 exposed for some of the time. These results are attached to this report as appendix I for completeness but only in reduced form since they are available already to the Labour Department.

3.3 Despite the current extensive publicity campaign throughout industry in general, there seemed to be a lack of awareness of safety and health matters. It did not appear to be deliberate callous attitude, there was often a desire to have good standards and surprise expressed when omissions were pointed out.

3.4 Much of the industry is extremely efficient, which often means low noise levels. Garment factories are, in general, very clean, with good working conditions using modern, fast, new machines which, in consequence, are also quiet.

3.5 However, there are problem pockets, textile weaving, for instance, is carried out in both modern conditions and bad conditions. While both are noisy the larger concerns are, for economic reasons, changing to shutteless looms. Although these new looms will alleviate the problem in these factories the old looms will be sold for use elsewhere so that the problem will still exist but in a different place. This problem of old machinery is also very

evident in metal working. The old machines are badly maintained and run at fast speeds. Apparently if these extremes cause complete failure, similar ones can easily be found for replacement. Noise conditions in some of these factories is way above normal standards of similar factories experienced elsewhere.

3.6 The organization, type and location of much of Hong Kong industry gives advantages and disadvantages. Large heavy industry is negligible so no problem. Small firms are split into units so there is a natural separation one from the other attenuating noise by the boundary walls. On the other hand, if there is a noisy process within one of these units the reverberation set up in consequence of these close boundary walls, considerably increases the noise levels.

4. RECOMMENDATIONS

(a) Legislation

4(a)-1 In order to properly carry out a programme for the conservation of workers hearing it is felt it will be necessary to introduce legislation which can be used, when required, to compel reductions in noise exposure. Such legislation is, therefore, recommended. The complete consideration, intent, draft legislation and method of enforcement are attached to this report as Appendix II.

(b) Training

4(b)-1 Enforcement of noise legislation is fundamentally different from anything else in occupatal hygiene - in fact it is exactly opposite.

4(b)-2 In other fields it is generally very difficult to measure levels to determine if a hazard exists - with noise it is relatively easy. In other fields solutions to problems are relatively easy and absolute limits can be set, with noise, solutions are generally very difficult indeed and levels above limits must still be tolerated.

4(b)-3 So a specific expertise is needed in order to support enforcement. A good, basic groundwork for initial support has been laid with the three industrial hygienists during this stage of the project but if standards are to be gradually improved as provided for in the legislation appendix II proposals, then more detailed knowledge and wider experience may be required. In the list of useful references, appendix III, are given the names of organizations within the U.K. which may run suitable courses. It would be advantageous, if time permits and dates coincide, to attend more than one to get a varying emphasis. Courses at the Universities may tend to give an indepth coverage of overall principles whereas courses run by the Health and Safety Executive would emphasize enforcement and those run by Consultants solutions to specific problems.

4(b)-5 Alternatively, one of the Factory Inspectors is at present spending one year on a full time post graduate course at Southampton University, ISVR, on Sound and Vibration. Should he be successful in obtaining either a Diploma or M.Sc. he could join the Industrial Hygiene support team. It would then only be a question of obtaining practical, on the job, experience.

(c) Equipment

4(c)-1 Included in the equipment supplied is a Precision Grade Sound Level Meter complete with 1/1 and 1/3 octave filters. There is no tripod for the meter. Although it can be hand held, using a tripod gives better accuracy, is essential for repositioning and is considerably easier when combining the meter with the tape recorder because both are extremely heavy. There is no need to purchase a "B and K" tripod (the make of the meter) any sturdy photographic tripod with pan head will do. The Senior Industrial Health Officer was advised of this so it is possible one has already been obtained, if not immediate purchase is recommended.

4(c)-2 All sound level meters require constant calibration. The type of calibrator obtained for use with the Precision meter is not normally considered consistently accurate enough for that type of meter since its specification is lower than that of the meter. A pistonphone is recommended for these meters and if one more obtained could also be used for cross-checking all other calibrators in the department. The pistonphone needed to match this meter is a "B and K" type 4220. Early purchase is recommended.

4(c)-3 Although this project only covers work with the Industrial Hygienists it has been noticed that the Factory Inspectorate have six sound level meters and only one calibrator. Good practice requires calibration just before and immediately after each reading. The calibrators to match their meters are "B and K type 4230" and five are needed. Early purohase is recommended.

4(c)-4 Four modern limit levels are based on the concept of Equivalent Continuous Sound Level (Leq). With the equipment at present available to the Noise Control Laboratory it is possible to obtain this value, but it is fairly time consuming and, of course, cannot be read at all by the Factory Inspectors who would have problems getting accurate readings of Leq with their existing sound level meters if the noise is non-continuous. Modern Integrating Sound Level Meters give this value immediately as a direct reading. It is recommended that at least one such meter be made available fairly soon for the Laboratory and further

ones for the Factory Inspectorate before legislation is introduced.

4(c)-5 Noise control, in the early stages, will be done by simply applying various reduction techniques already learned and developing them to other situations. However, if it is decided to go into more sophisticated work there would be a need for noise analysis. For this work noise analyser and a graphic level recorder are required. In addition to analysis this equipment could be used to obtain reverberation times - needed to correctly specify sound absorbing materials - a facility not available at the moment. To do this a source of impulsive sound (starting pistol) is also needed. Purchase of these three items, noise analyzer, graphic level recorder and starting pistol are not recommended at the moment but should be kept in mind as being possibly required in the future.

4(c)-6 The audiometer and its ancillaries of artificial ear, pressure microphone, and calibration facility is now functioning. However, there is no booth in which to do it Although audiometry is often done without a booth most international standards now specify one. The role audiometry is to play in any hearing conservation programme is not clear. Its only value in such a programme is to make individuals aware of the hazard so that in future they will take care. This problem will again be referred to in (e) - the Function of the Noise Control Laboratory. Whether or not audiometry is to be used in the conservation programme some way, for research or in assessing workmen's compensation a proper acoustic booth is recommended.

4(c)-7 The acoustic booth selected by the Labour Department is a Model AR 9S manufactured by Tractor Incorporated of the United States. It is proposed to partition off an area for its location. Consequently a design study was carried out to determine the suitability of the resultant sound pressure levels. This design study is included in appendix III and shows a possibility of some excess in the region of 500 Hz. It is recommended this be checked after installation.

4(c)-8 The correct structure for the partition could have considerable influence in making noise in that region more acceptable. This has been discussed and the principle design features recommended are shown in a sketch design in appendix III.

4(c)-9 Included in the References, appendix III, are addresses of suppliers of all the above equipment. With the exception of the calibrators which must match existing meters, the final decision regarding which particular make is selected must be left to local staff with their experience of available back-up services offered by suppliers. The preferred ones are indicated but this extremely important factor in Hong Kong has not been taken into account and should be considered carefully before selection is made.

(d) Protectors

4(d)-1 Although personal wear hearing protectors are often mentioned as the last resort when all other means of reduction of noise exposure have been attempted, there is no doubt that at the present time they have a large part to play in any hearing conservation programme related to industry.

4(d)-2 However, all hearing protectors are frequency selective. This means it is quite possible to have ones which are not adequate for a particular situation or, conversely, have ones which over protect. It is important that hearing protectors be "matched" to the noise. With the hot, humid climate of Hong Kong this could be particularly significant. To encourage people to wear them it is obviously better to select ones as comfortable and light as possible yet still give adequate protection than heavy weight uncomfortable ones when they are not necessary.

4(d)-3 Selection is made by subtracting protector attenuation characteristics from the noise levels. It is, therefore, most important to use the best available data on the protector characteristics when making the calculations. The most resent and comprehensive method of obtaining these is by BS 5108:1974 "Method of measurement of attenuation of hearing protectors at threshold". The Occupational Hygienists with their 1/1 octave Band analyser are quite competent to do this.

4(d)-4 With one exception (para.4(d)-6 below refers) only protectors whose characteristics have been tested to BS 5108:74 are recommended.

4(d)-5 A list of some of the protectors which have been tested to this standard together with their 'Assumed Protection' is given in appendix III. These are listed because all have Hong Kong agencies whose addresses are also given in the appendix.

4(d)-6 The one exception to this must be the American Optical muff, model 1675A, at present used by the Labour Department. It has also been featured in the extensive publicity to encourage protection use. Values resulting from tests to ASAZ 24.22-1957 are available but none from tests to BS 5108:74. Since it is obviously a very good muff it is unlikely the manufacturer would resist having them tested. They may have been already. It is recommended the supplier be contacted with a request for the information.

(e) Organization, Methods and Function of the Noise Control Laboratory

4(e)-1 The Industrial Hygienists and the Factory Inspectors are in two separate Divisions of the Labour Department. Since they are not under single control the two distinct roles each has to play should be carefully defined. The Enforcers (the Factory Inspectors) should come to the Industrial Hygienists for specialist support when considering legal action. There is a danger here that in building on their existing expertise there will be a temptation to do the work themselves. Resources are limited so any tendence towards duplication of effort should be resisted.

4(e)-2 Equally, the Industrial Hygienists come under an Industrial Health Officer, who also controls the medical aspects of workmen's compensation. This, therefore, is where the audiometric facility has a part to play should it be decided to award compensation for deafness.

4(e)-3 To use audiometry as a tool for assessment (i.e. measure the noise at the workplace and means the degree of deafness to obtain co-relation is definitely not recommended. Such work has already been

done in depth, in the US test S24 x 1 and later in the UK the Burns-Robinson report. It has been estimated that to use larger samples than either of these, including preliminary screening, one would need something in excess of 25,000 subjects. The order of magnitude of such a project, which, after all, would only be the quest for more exactly relationships and not be cost effective, would probably be beyond the resources of all the doctors in Hong Kong combined.

4(e)-4 There may be a temptation to use audiometry to investigate impactive noises - as is being done elsewhere in Hong Kong. This work has also been carried out in depth by Taylor/Pelmear who are believed internationaly to have laid to rest any residual doubt about biological effects of impact.

4(e)-5 Working to Industrial Health Officers, the Industrial Hygienists are used in other fields of industrial hygiene to assess risk by reading levels of pollution. As discussed earlier in 4(b)-2 reading noise levels for hazard assessment is relatively straight forward and can easily be left to the Factory Inspectorate.

4(e)-6 <u>It is recommended</u> that the Industrial Hygienists be given three distinct but very much related duties.

(i) On request from the Factory Inspectorate, when considering legal sanction or in an effort to assist a proprietor attempting to improve working conditions, they should investigate and report with explicite recommendations of the proposed action; should it be Noise Reduction, Hazard Making, Protection, any one or combination of two or three. They should indicate how this is to be achieved and be prepared to back their judgement should it be challenged.

(ii) To be able properly to carry out their first duty they will need to build on knowledge gained from this first part of the project by carrying out specific investigations of their own. Using their own experience or on advice from the Factory Inspectorate the areas for investigation should be carefully selected to give maximum reduction of exposure. When complete the results of their conclusions should be passed to the Factory

Inspectorate the areas for investigation should be carefully selected to give maximum reduction of exposure. When complete the results of their conclusions should be passed to the Factory Inspectorate who would then enforce those solutions on industry should they decide it is right to do so at that particular time and economic situation.

(iii) The third duty is harder to define because it becomes one of study. A list of useful books and journals is given in appendix III which should help to keep them up to date with progress elsewhere where larger resources are available. Hopefully, they will then avoid the temptation, similar to that in audiology, to carry out their own research investigations when it has already been done in far greater depth elsewhere or, if it has not, has probably been considered and rejected as not warranted.

(f) Noise Specialist

4(f)-1 Much of the report so far, particularly the work required of the laboratory argues a strong case for a Noise Specialist. There is no doubt that such a specialist would be kept very busy full time and probably call for additional help.

4(f)-2 However, there are no specialists working in this branch at the moment so to appoint one would be a new departure from existing practice.

4(f)-3 If these new specialist posts were established it is unlikely that the first one should be given to noise. Other areas of health and safety where life and limb are at stake should, quite rightly, be given first priority.

4(f)-4 Therefore, it is not possible at this stage to give a definite recommendation for the appointment of a full time noise specialist but future experience may show this is the only way to be properly effective.

(g) Further Assistance

4(g)-1 It is likely that at some future advanced stage of the project further outside assistance would be helpful.

4(g)-2 Detailed discussion of the final version of Noise Regulations, their timing, possible effectiveness and problems of enforcement would be advantageous. The organization and Noise Control Laboratory could be assessed as a functioning unit, advised on any modifications, if required, and training needs reviewed in the light of experience.

4(g)-3 The time needed by a consultant to complete such a task is estimated to be between two and four weeks.

4(g)-4 Should it be desired it is probable that a further application to UNIDO for the necessary funds would be favourably received.

Appendix I

NOISE SURVEY

This appendix contains summary sheets worked out from the detailed Factory Inspectorate Noise Survey carried out between November 1978 and February 1979. They show statistical probability of noise exposure to where Leq_8 = 90 dB(A) for all the time and also for some of the time.

Rounding the summary figures to the nearest thousand it is assumed that the number of persons in Hong Kong industry exposed to a potential noise hazard is:

Exposed to Leq_8 = 90 dB(A) for all of the time 40,000

Exposed to Leq_8 = 90 dB(A) for some of the time 60,000

TYPES AND NUMBER OF NOISY INDUSTRIES AND ESTIMATED NUMBER OF EMPLOYEES IN HONG KONG AS AT 15th JUNE 1978

International Standard Industrial Classification	Industry	Number of Establishments	Number of employees (operatives only)	Probable Number of operatives exposed to	
				90 dB(A) or mo for a certain time	Leq (8 hrs) = 90 dB(A) or more
3116	Grain mill products	147	1,179	235	100
	Manufacture of Textiles				
3219	Cotton teasing, cotton waste and laminated cloth	67	647	435	320
3250-3252	Spinning - cotton, wool and synthetic fibres	63	19,129	8,400	3,440
3259	Yarn doubling, winding and braid twisting	238	1,287	450	440
3260-3269	Weaving - cotton, wool, silk, tapes and labels and others	550	25,278	17,050	16,890
3270-3272, 3274	Knitting and hoisery	1,462	20,771	560	560
3280	Bleaching and dyeing	303	9,074	600	250
3291	Finishing - calendering, napping and yarn sizeing	92	1,797	260	180
3311	Saw mills	202	1,419	810	460
3313, 3315 and 3321	Wooden articles, cases and	1,913	10,400	1,750	230

International Standard Industrial Classification	Industry	Number of Establishments	Number of Employees (operatives only)	Probable Number of operatives exposed to	
				90 dB(A) or more for a certain time	Leq (8 hrs) = 90 dB(A) or more
3421-3429	Printing industries	2,048	17,930	120	120
3561-3569	Manufacture of plastic products	4,244	79,165	2,490	2,260
3710-3723	Basic metal industries (mainly steel rolling industry)	333	3,568	470	320
	Manufacture of fabricated metal products				
3802	Nails, screws and hinges	209	2,302	695	700
3803	Tin cans and hollow wares	140	1,490	115	40
3812-3813	Furniture, fixture, window and doors	845	4,498	700	150
3814	Aluminium ware	98	2,543	350	290
3816	Torches	45	4,374	520	280
3817	Wrist watch bands	327	6,056	330	140
3818	Electroplating, buffing and polishing	588	4,690	2,420	760
3801,3804,3810 3811,3815,3819	Other miscellaneous items	4,295	42,471	7,135	2,970
	Power press operation in metal trade			9,254 ***	
3833	Electrical appliances and houseware	296	9,782	410	260
3836	Dry batteries	12	2,254	14	10

International Standard Industrial Classification	Industry	Number of Establishments	Number of Employees (operatives only)	Probable Number of operatives exposed to	
				90 dB(A) or more for a certain time	Leq (8 hrs) = 90 dB(A) or more
3840-3841	Ship building and repairing	281	7,849	730**	470**
3846	Ship breaking	1	221	45**	30**
2901	Stone Quarrying	9*	500**	300**	150**
-	Marble works	23*	200**	100**	40**
-	Mirror and glass panes	43*	400**	200**	100**
-	Building and Civil Engineering Industry	2,000**	59,127***		
	Shotfiring operation			302***	302***
	Drilling and boring operation			712***	712***
	Plant and equipment operation (e.g. bulldozer, excavators, crane, piling etc.)			1,732***	1,732***
	Total in possible noisy industries	20,974	340,401	59,794	39,706
	Total in the whole industries	40,182	766,258	8%	5%
	Total random sample for survey	394	34,363		

Note: Except explained below, figures for number of establishments and total employees were quoted from Statistics by Census and Statistics Dept. as at 15th June 1978.

Figures marked * were quoted from Labour Department register

Figures marked ** were quoted from 4th Manpower Survey for Metal Industry and for Building and Civil Engineering Industry

Figures marked *** were estimated ones

Figures for probable number of employees exposed to noise were estimated by projection based on the recent noise survey results

Appendix II

L E G I S L A T I O N

CONSIDERATIONS

1. In deciding whether or not there should be specific industrial noise legislation in Hong Kong, and when it should be enacted, consideration must be given to three questions:

(a) Does a noise hazard exist and to what extent?
(b) Where is it's priority in the general health of the workers?
(c) Can it be enforced?

2. There is no doubt that there is a severe problem caused by industrial and other noise sources. That there is already a general awareness of this shown by the appointment of a noise adviser under the Environmental Branch of the Government Secretariat. The activities of this section will increase and there is an intention to enact legislation. To cope with this the Urban Services Department is also increasingly active in the field of noise. All this activity is confined to noise outside factories and not directly related to this question.

3. Based, to some extent, on my own assessment but even more on the comprehensive survey carried out by the Factory Inspectorate - see appendix I - it is my opinion that inside the factories and on construction sites there is also a severe noise problem and that hazard exists.

4. The fact must be faced that the general standards of safety in many industries is low and present laws regarding safety measures to be taken are completely ignored everyday. In consequence the accident rate is high. When life and limb are in danger noise becomes a low priority.

5. However, for the first time accident figures are dropping, so, since the economy is expanding, it indicates that present policies of expansion of the inspectorate and enforcement of the industrial health and safety law begin to improve the situation.

6. Expansion of the enforcing authority over the whole field, and in industrial hygiene in particular means that they would be able to start by halting a worsening situation and attacking the bad cases before getting any overall improvement.

7. With an industry made up of some 40,000 small establishments employing an average of 20 people each, any attempts at persuasion or reliance on voluntary efforts are likely to meet absolutely minimal success and the situation will continue to deteriorate. To be able to effect any improvement the inspectors and the hygienists need the support of law.

8. I, therefore, recommend noise legislation.

INTENT

9. In drafting these proposals for Noise Regulations it has been the intent to layout a simple framework which is operable in the present industrial conditions and will still be viable in the future as improvements in standards are needed to improve the working environment.

10. Industrial development is important and must not be impaired. There exists a total commitment to economic considerations by both employers and employees. Strict limit values rigidly enforced would not be acceptable to either side of industry at the present time.

11. However, while in no way can the aim be perfectioned, it is hoped that these regulations would lead to significant improvements where the noise hazard is very bad.

LIMIT LEVEL

12. The foregoing lays out an argument for quoting a level in excess of 90 dB(A). However, 90 dB(A), while by no means "safe" is one used in many countries and internationally. Even lower levels are used by some, usually for specific procedures. I do not know of any legislation quoting a higher figure. I believe, therefore, that it would be

politically unacceptable to quote in regulations a level higher than 90 dB(A).

13. In practice it is very difficult to get an accurate measurement of actual exposure. Although meters read correctly what is fed into them, it is often difficult to determine that is an exact workplace when a person is moving about. These difficulties are added to when the noise is non-continuous and, perhaps, completely un-periodic. So, inevitably, an estimate has to be made. The enforcing authorities would take this into account leaving a margin to ensure that 90db(A) had been exceeded so that the real level when the regulations would be enforced is a few decibels higher. This does not conflict with the opinion expressed in paragraph 3 that desirable improvements will be made.

14. Consideration has also been given to regulations with no specific level quoted. There is precedence for this in existing Hong Kong factory law. Regulation 33, ventilation, uses "effective ..... provisions .... circulation of fresh air", regulation 34, lighting, uses "sufficient", regulation 3 , overcrowded as to cause risk .....", regulation 38, drinking water, "adequate supply". In no case are specific numbers used.

15. While this approach may be correct in these fields, I believe with noise a specific quoted level is better. It can be used as a target for employees and enforcing authorities.

THE REGULATIONS

16. My proposals, therefore are as follows:

(1) In every industrial undertaking where, on any day any person is exposed continuously for 8 hours to a sound level exceeding 90 dB(A), or subject to an equivalent or greater exposure to sound:

(a) measures shall be taken so far as reasonably practicable to reduce the noise; and

(b) exposed persons shall be warned of the noise hazard; and

(c) suitable and effective ear protectors shall be made available to every such person.

COMMENTS

(1) In every industrial undertaking .....

17. "Industrial undertaking" is defined in Chapter 59 of the Factories and Industrial Undertakings Ordinance which means the regulations apply to all industries as is required.

18. All eight existing regulations covering industrial hygiene, use "registrable workplace" whose definition in Chapter 59 does not include construction sites, whereas "industrial undertaking" does as well as including places covered by "registrable workplace." While it is correct that regulations covering such things as ventilation, lighting and floor drainage should not apply to construction sites I feel it is important that noise should.

.... where on any day .....

19. Apart from exceptional accidental circumstances, noise induced hearing loss is caused by prolonged exposure. The basis for calculating the degree of deafness expected from particular levels is usually based on a working lifetime or 40 years However, this is a completely unenforceable concept. The longest time practical for enforcement purposes is one day.

..... a person is exposed continuously for 8 hours .....

20. Mostly 8 hour shifts in Hong Kong. Variations are covered by the end of the sentence.

..... to a sound level of 90dB(A) or subject to an equivalent or greater exposure to sound:

21. Comments regarding the selection of this figure are in paragraphs 4-15.

22. This is the use of "equivalent continuous sound level" symbolised by Leq. A well founded and internationally acceptable concept based on an equivalent dose of sound energy. It will allow for fluctuating noise. A straight 90dB(A) sound level limit would make the regulations effective with a single hammer blow, slamming a door or even shouting.

23. There are then three actions which must take place when the Leq equals 90dB(A) level is exceeded.

(a) measures shall be taken so far as is reasonably practicable .....

24. Of the eight existing hygiene regulations similar requirements occur in two, Regulation 33 ventilation and regulation 34 lighting. Both use similar work but leave out the word "reasonable".

25. However, regulations in other fields, construction (Regulation 40(1) - Barriers; Abrasive wheels Regulation 9(a) Guarding) - use "reasonably practicable".

26. There seems to be an inconsistency. Without the word "reasonable" it could be argued that "practicable" means anything that <u>can</u> be done without taking into account any other measures such as

costs, amount of risk or the communities need for having particular work done because one thing that can b done is to close a job down completely.

27. This point may be completely fallacious if case law exists either in United Kingdom or Hong Kong, but I am aware of none. The only case law I am aware of which applies is for the phrases "best practicable means" which occurs in legislation covering environmental (nuisance) noise and alkalii contamination, and "reasonably practicability" which is used in industrial health and safety legislation. Case law on both phrases have decided all circumstances are taken into account when reaching a decision so that costs and desirability can be balanced against risks and measures for protection being used.

28. This will allow the enforcing authorities to use discretion. In the early days they may well decide that it is not reasonable to insist on any reduction.

29. Soon afterward they could insist on the attenuation of unnecessary noise caused wilfully or through carelessness such as steel side plate covers being left to vibrate through not being fixed properly or silencers not being refitted to engines after maintenance.

30. For the next stage they could look at low cost reduction methods and bring the regulation into force where it costs, say 1% - 3% of the price of a machine.

31. At the same time they may look at similar or identical processes or industries where one uses methods which are much quieter than the other and yet still remains viable. They could argue that it is therefore reasonable and practicable for the noisy one to adopt similar methods.

32. They may also decide to take action against specific obvious circumstances. For instance there is much plastics industry in Hong Kong. Injection moulding of plastics is, in itself, quite quiet but two processes used in these factories are sometimes noisy and lead to a whole area being unnecessarily put at hazard. These are component blow-off and plastics granulation. Silencing of both these processes has been accomplished already and the various methods should now be within the competence of the local staff. This would lead to a complete industry being attenuated.

33. The rate of progress along these lines towards even quieter industry can be locally determined still using this regulation as it is decided it is not only practicable but <u>is</u> reasonable to demand improvement.

..... to reduce the noise,

34. The need for action under (a) ends here. There is no continuation to reduce the noise to the greatest extent reasonably practicable because this would mean that exceeding 90dB(A) would trigger a requirement to reduce down to 80 dB(A), 70dB(A) or even lower. I do not believe Hong Kong will be ready for this for some time for the reasons stated in paragraph 3.

..... and .....

35. The use of the word "and" between these three requirements is quite deliberate to eliminate any question of an option. The simpliest, cheapest way to reduce exposure is to insist on all employees wearing protectors and then argue that since they are no longer at hazard, it is not reasonable to spend money on reduction.

(b) exposed persons shall be warned of the noise hasard;

36. This could mean anything from a simple word during a discussion an odd notice, a complete lecture about the effect of deafness in later life or the marking and demarcation of hazard zones wherein protective measures must be taken.

37. It is important that exposed people are aware of the potential problems. The degree of warning can be decided by prevailing local enforcing authority.

..... and .....

38. Once again there is no option.

(c) suitable and effective .....

39. Both words are used to describe the protectors to be used because it is quite easy to get a very "effective" protector which is too heavy, uncomfortable or cannot be worn with other protective equipment and is, therefore, quite unsuitable. On the other hand "suitable" protectors must be able to reduce the exposure below 90dB(A). Since they are frequency sensitive they must be matched to the particular noise.

..... ear protectors shall be made available to every such person.

40. It is my opinion that it would be incorrect here to demand, by law, the mandatory use of ear protectors. Climate and other adverse working condition could make wearing them quite intolerable. However, if a worker decides, after being warned under (b) that he wants protectors then they must be supplied to him as a right.

ENFORCEMENT (e) Taking Readings

41. In order to enforce these regulations it would be obviously necessary to read the noise. The enforcing authorities have right of entry and powers to inspect and examine under section 4 of the Factories and Industrial Undertakings Ordinance. Under regulation 20 the power is given to take samples but this also puts a duty on an inspector to give one sample to the proprietor. With noise samples this is not possible.

42. It was considered adding to the Noise Regulations the powers to take measurements but has been omitted in the interest of simple, short regulations since it may not be necessary.

43. Other hygiene regulation, ventilation (33), lighting (34) have no specific enforceable values quoted but, at the same time, probably require measurements to be taken for comparison with recommended standards should a case need to be argued in court.

44. It is also possible that "powers to ..... examine" under the ordinance cover measurement but I am aware of no case law. If none exists and rights are challenged it would be preferable to add this right to measure to the original Factories and Industrial Undertakings Chapter 50 Ordinance S. 4(1)(a) "to enter, inspect, examine and measure .....". This would then overcome similar problems which may occur in other fields such as radiation, electricity and heat without confining the right to measure simply to noise.

ENFORCEMENT (b) Giving time to improve

45. Hearing loss due to industrial noise is (except in very exceptional cases) due to prolonging exposure. A gradual improvement is all that can be expected anywhere, particularly in Hong Kong. Industries must be given time to make these improvements. Legislation in Hong Kong follows closely that for U.K. but the Factories and Industrial Undertakings Ordinance does not contain provisions, as in H.K., for issue of prohibition and improvement notices.

46. Improvement notices have been used very successfully in the field of noise when it is stipulated that certain measures or improvements must be made within a specific time.

47. However, Hong Kong legislation does require that industrial undertakings be registered (or provisionally registered) which must be renewed every two years (or one year for provisional). They can be refused or cancelled or have conditions attached.

48. Existing legislation, therefore, already gives the powers to demand specific improvements over a particular time scale so there is no need for this to be included in noise regulations.

Appendix III

EQUIPMENT

Items of equipment mentioned in the project report together with their manufacturer and local supplier are listed below.

Item	Manufacturer	Supplier
1. PISTONPHONE Type 4220	Bruel and Kjaer, Naerum, Denmark	The Radio People Ltd., Chatham Road, Kowloon, Hong Kong.
2. CALIBRATOR Type 4230	- " -	- " -
3. INTEGRATED SOUND LEVEL METERS		
(a) Type 2228	Bruel and Kjaer, Naerum, Denmark	The Radio People Ltd., Chatham Road, Kowloon, Hong Kong.
(b) Type CEL-193*	Computer Engineering, Hitchen, Herts, England.	Harvey Main and Co. Ltd., Asian House, Hennessy Rd., Hong Kong.
(c) Type CRL 1-13	Cirrus Research Ltd. Soar Borough, Yorks, England.	Hong Kong Scientific Co., Nathan Road, Kowloon, H.K.
(d) Type CS 195C	Castle Associates Scarborough, Yorks, England.	Hong Kong Scientific Co., Nathan Road, Kowloon, H.K.
4. NOISE ANALYSERS (a) Type 2010	Bruel and Kjaer, Naerum, Denmark.	The Radio People Ltd., Chatham Road, Kowloon, Hong Kong.
(b) Type S.A. 59*	Rion Trading Co., Tokyo, Japan.	Gilman and Co. Ltd., Elisabeth House, Gloucester Road, Hong Kong.

Item	Manufacturer	Supplier
5. GRAPHIC LEVEL RECORDERS		
(a) Type 2307	Bruel and Kjaer, Naerum, Denmark.	The Radio People Ltd., Chatham Road, Kowloon, Hong Kong.
(b) Type LR.04 *	Rion Trading Co., Tokyo, Japan	Gilman and Co. Ltd., Elizabeth House, Gloucester Road, Hong Kong.
6. AUDIOMETRIC BOOTHS		
(a) Type AR 98*	Tractor Instruments Austin, Texas, USA.	Direct.
(b) Type AB-200	Eckal Industries Inc., Cambridge, Mass, USA.	Direct.
(c) Type PAC 250	Precision Acoustics Inc., New York, USA.	Direct.

* These are the items that would possibly be selected for recommendation elsewhere, where each product is known to have a tried and proven back-up service. This is a very important consideration in Hong Kong and should be taken into account by local staff before any decision to purchase is made.

COURSES

Courses which include Noise Control are run in the United Kingdom by the following establishments. Details of contents and times of courses should be obtained directly by writing to the Training Officer or Course Organiser.

1. Health and Safety Executive
   Chapel St., Edgware Road,
   London W2, England.

2. Institute of Sound and Vibration Research
The University
Southampton, England.

3. Rupert Taylor Associates
Hereford Road, Westbourne Grove,
London W2, England.

4. Sheffield University (Acoustics Dept.)
Sheffield, Yorks,
England.

5. Sound Research Laboratories
Holbrook Hall, Sudbury
Suffolk, England.

6. The Industrial Centre
Salford University
Manchester, England.

HEARING PROTECTORS

The following Hong Kong agencies include among their suppliers manufacturers of hearing protectors which have been tested in accordance with BS 5108:74 as recommended in 1(d)-4.

The attenuation figures recommended for use with all these muffs when calculating assumed protection and resultant exposure level are given on page 6.

(i) Arnold and Co. Ltd.
9 Ice House Street, Holland House
(MSA "Comfo 500") Foam Seal Muffs)
(MSA "V51-R" Ear Plugs)

(ii) Frank and Co.
6B Hang Lung House,
184/192 Queens Road.
(Welsh "4530" Foam Seal Muffs)

(iii) Gilman and Co. Ltd.
P.O. Box 56, Elizabeth House,
250 Gloucester Road.
(Amplivox "Sonoguard" Liquid Seal Muffs)

		(Amplivox "Supamuff" Foam Seal Muffs)
		(Auralguard III Liquid Seal Muffs)
		(Ultramuff 2 Foam Seal Muffs)
(iv)	Hutchison Engineering Ltd., The Chinese General Chamber of Commerce Bldg., Connaught Road.	(Itex Foam Seal Muffs)
(v)	Safety International Ltd. Lee Hing Building 58 Des Voeux Road.	(E.A.R. Ear Plugs)
(vi)	Swiss Far-East Trading Co. 18 Scenic Villa Drive, G.P.O. Box 4011, Victoria Road.	(Bilsom "Yellow" Liquid Seal Muffs)
		(Bilsom "Blue" Foam Seal Muffs)
		(Bilsom "Prop" Ear Plugs)

Also mentioned in recommendation 4(d)-6, with a specific reservation:

(vii)	American Optical Co. Watsons Estate, Block B, North Point.	(Model 1675A "Super Comfort" Foam Seal Muffs)

Hearing Protectors

Attenuation figures are given for Hearing Protectors listed as available in Hong Kong. All the values are taken from tests carried out to BS 5108:74 in accordance with recommendation 4(d)-4.

From basic data* the values given have been rounded down from Standard Deviation subtracted from Mean, so may be used directly for "Assumed Protection".

Attenuation, in dB, of Hearing Protectors

Centre Frequency Hz	63	125	250	500	1K	2K	3.15K	4K	6.3K	8K
1. Mines Safety Appliances "Comfo" 500 foam seal muffs	4	4	7	8	18	25	31	34	30	29
2. Mine Safety Applicances "V51 - R" Ear Plugs	14	12	11	12	15	21	27	22	17	20
3. Welsh "4530" Foam Seal Muffs	4	3	10	20	27	26	32	31	28	28
4. Amplivox "Sonoguard" Liquid Seal Muff	11	13	19	27	35	33	39	35	23	26
5. Amplivox "Supamuff" foam Seal Muffs	5	2	4	11	19	22	30	28	24	27
6. Auralguard III Liquid Seal Muffs	-	9	13	19	28	31	39	35	25	27
7. Ultramuff 2, Foam Seal Muffs	-	4	11	18	26	27	27	28	27	23
8. Itex Foam Seal Muff	9	8	9	16	25	29	32	34	27	26
9. E.A.R. Ear Plugs	14	18	19	21	26	27	38	38	39	38
10. Bilsom "Yellow" Seal Muffs	9	9	14	18	27	31	36	33	23	24
11. Bilsom "Blue" foam Seal Muffs	5	4	10	17	24	26	33	31	23	24

Centre Frequency H_z	63	125	250	500	1K	2K	3.15K	4K	63K	8K
12. Bilsom "Prop" Ear Plugs	1	1	3	6	10	14	21	21	27	30

* A.M. Marin. Ann, Occup. Hyg. Vol. 20. p 229-246 1977

SUITABILITY AND LOCATION OF AUDIOMETRIC BOOTH

If audiometry is to be carried out a booth should be used. A model AR-98 was recommended in para. 4. The manufactures specification together with some assumed figures were used in the design study on page 8 to check its suitability for use where it is intended to locate it.

It shows there could be a problem in the region of 500 Hz but no allowance was made in the study for additional transmission loss gained by adding partitions to make a separate testing room area in which the audiometric booth will be placed.

Since building layout modifications are to be made anyway, it is advisable to construct the room to be particularly effective in attenuation at the affending frequence (500 Hz).

Details of construction are not yet available. However, the principles involved have been discussed with the local staff and the main criteria shown diagramatically on page 38.

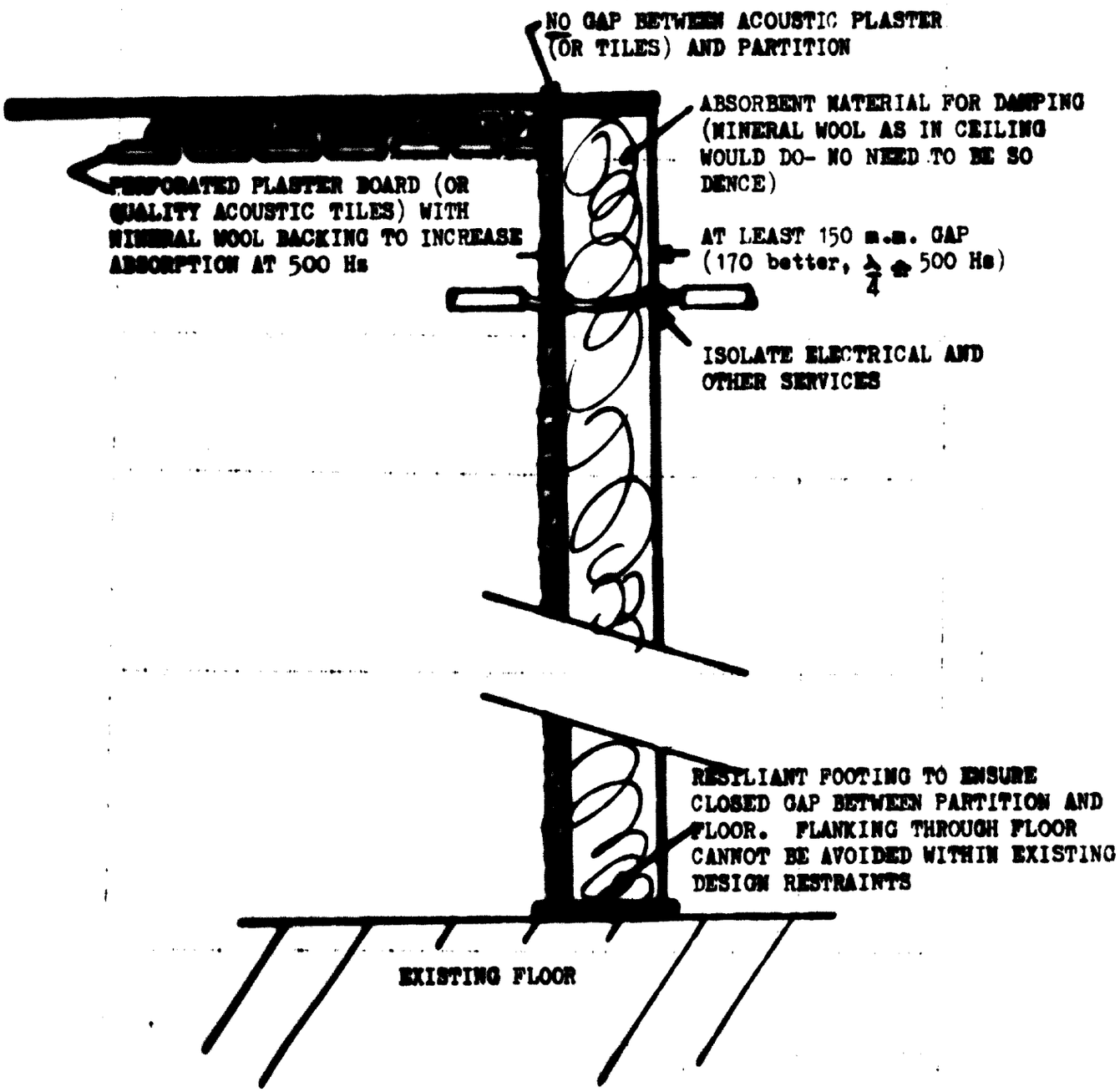
[redacted] STUDY USING TRACTOR INCORPORATED SPECIFICATION FOR THEIR AR 9S AUDIOMETRIC BOOTH

[redacted] CENTER FREQ. Hz	(A) [redacted] (HIGHEST) READING IN ROOM, WILL BE MUCH LOWER AFTER TREATED PARTITION WALL ADDED	(B) REDUCTION DUE TO AR 9S BOOTH	(C) RESULTANT IN BOOTH (A) - (B)	(D) MAXIMUM DESIRABLE IN BOOTH, NO ALLOWANCE FOR HEADSET	(E) ASSUMED ATTENUATION OF EAR PHONES	(F) MAXIMUM S.P.L. (D)+(E)	(G) COMPARE (C)-(F) SHOULD BE NEGATIVE	REMARKS
[redacted]	66	5(Assumed)	61	76	0	76	-15	OK
[redacted]	64	10(Assumed)	54	61	1	62	- 8	OK
[redacted]	57	15(Assumed)	42	46	2	48	- 6	OK
[redacted]	56	32(Manuf. Spec.)	24	31	5	36	-12	OK
[redacted]	58	38(Manuf. Spec.)	20	7	7	14	+ 6	Check after installation. If necessary modify as discussed
1K	54	46(Manuf. Spec.)	8	1	15	16	- 8	OK
2K	54	49(Manuf. Spec.)	5	4	25	29	-24	OK
4K	57	50(Manuf. Spec.)	7	6	31	37	-30	OK
8K	40	54(Manuf. Spec.)	0	-	-	-	-	OK
16K	32	60 (Assumed)	0	-	-	-	-	OK
31.5 K	18	60 (Assumed)	0	-	-	-	-	OK

AUDIOMETRY TEST AREA

Some design considerations for partition room construction.

1. Quality of construction is important. Avoid gaps.
2. If light weight use large gap.
3. Try to avoid wood. Wrong selection could lead to coincidence effect at critical frequency.
4. Plaster board would be a lot better.
5. Steel best of all.



BOOKS AND JOURNALS

The following could form the basis of a useful reference library and a means of keeping in touch with latest developments.

BOOK TITLE	AUTHOR	PUBLISHER
1. ACOUSTIC NOISE MEASUREMENTS	Jens Trompe Broch	Bruel and Kjaer
2. BUILDING ACOUSTICS	Day, Ford and Lord	Elsevier
3. HANDBOOK OF NOISE CONTROL	Harris C.M.	McGraw-Hill
4. HEARING AND NOISE IN INDUSTRY	Burns and Robinson	HMSO
5. INDUSTRIAL NOISE CONTROL HANDBOOK	Cheremisinoff P.	Ann Arbor Sciomi
6. INDUSTRIAL NOISE MANUAL	-	American Industrial Hygiene Ass..
7. MACHINERY ACOUSTICS	Diehl	John Wiley
8. NOISE	Taylor R.	Pelican
9. NOISE AND MAN	Burns W.	Murray
10. NOISE AND VIBRATION IN THE WORKING ENVIRONMENT	-	International Labour Organization
11. NOISE REDUCTION	Reynolds P.	International Wrought Copper Council
12. OCCUPATIONAL HEARING LOSS	Robinson D.	HMSO
13. PRACTICAL GUIDE TO NOISE CONTROL	Sharland I.	Woods of Colchester

JOURNALS	PUBLISHER
1. APPLIED ACOUSTICS	Applied Science Publishers Ltd. Ripple Road, Barking, Essex, England.
2. JOURNAL OF SOUND AND VIBRATION	Academic Press Inc. (London) Ltd. 24-28 Oval Road, London NW1 7DX, England.
3. JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA	American Institute of Physics 335 East 45th St. New York, NY 10017, USA
4. NOISE AND VIBRATION BULLETIN	Multi-Science Publishing Co. Ltd. The Old Mill, Dorset Place London E15 1DJ England.

JOURNALS	PUBLISHER
5. NOISE CONTROL AND VIBRATION ISOLATION	Trade and Technical Press Ltd., Drown House, Morden Surrey SM4 5EW England
6. NOISE CONTROL ENGINEERING	Institute of Noise Control Engineering P.O. Box 3206, Arlington Branch, Poughkeepsie, New York 12603, USA.
7. SOUND AND VIBRATION	Acoustical Publications Inc., 27101E Oviatt Road, Bay Village, Ohio, OH4140, USA.

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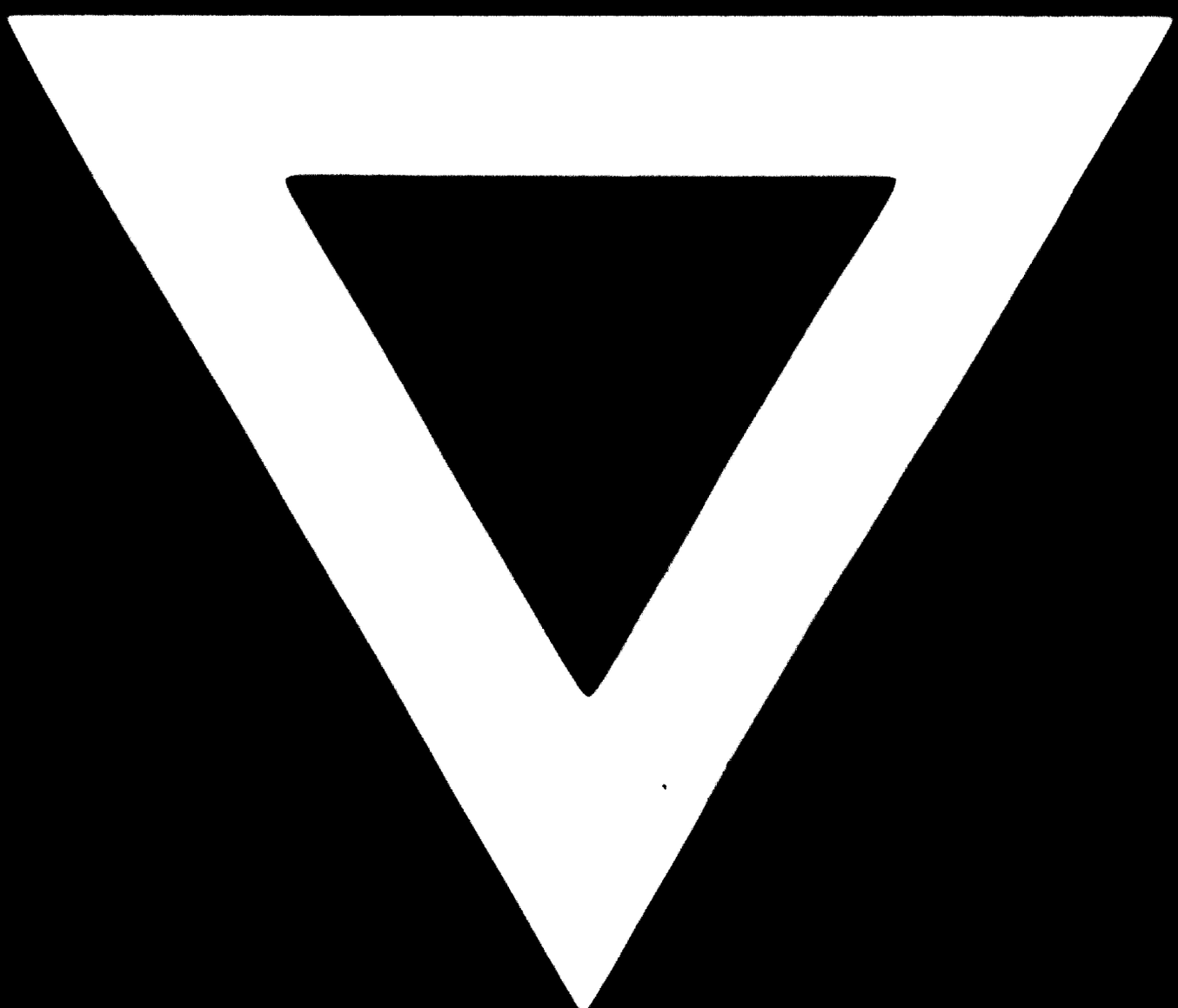

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