# ACOUSTICS AND AIR TESTING LABORATORY COMPANY LIMITED

***Acoustics and Air Testing Laboratory Company Limited (A&A) is located at 2/F., 190 Prince Edward Road West, Kowloon, Hong Kong. It was incorporated in June 1996 and registered as a private company limited by shares.***

***A&A is a unique independent testing laboratory in Hong Kong, equipped with sophisticated instruments according to international standards (ASTM, ISO) to provide a full range of Acoustics and Air testing services.***

***A&A has been accredited as HOKLAS laboratory by the HKAS Executive and has been assigned registration number 122.***

## *Laboratory Measurement*

- **HOKLAS Accredited** Sound Reduction Test according to BS EN ISO 140-3:1995 (BS 2750 Part 3:1995) and BS EN ISO 717-1:1996
- **HOKLAS Accredited** Airborne sound insulation of road traffic noise reducing devices and road barrier according to BS EN 1793-2:1998 and BS EN 1793-3:1998
- **HOKLAS Accredited** Sound Absorption Measurement according to ASTM C423-02
- Sound Transmission Loss Measurement according to ASTM E90

## *Field Measurement*

- **HOKLAS Accredited** Field measurement of room sound absorptions and/or room decay rate according to Annex X2 of ASTM C423-02.
- Noise Isolation Class Measurement
- Vibration Measurement
- Environmental Monitoring and Audit
- Handling Noise Abatement Notice
- Noise Exposure Assessment in Working Places

## *Acoustics Design with Computer Modeling*

- Room acoustics simulation for room acoustics, auditorium acoustics and industrial noise control.
- Sound insulation prediction for walls, floors, ceilings and windows.

## *Indoor Air Quality (IAQ) Measurement*

We can conduct the indoor air quality assessment according to the Draft Guidance Notes for the Management of Indoor Air Quality (IAQ) in Offices and Public Places was published on November of 1999 by the Indoor Air Quality Management Group of the Government of the HKSAR.

## *Laboratory Measurements:*

- **HOKLAS Accredited Sound Reduction Test according to BS EN ISO 140-3: 1995 (BS 2750 Part 3: 1995) and BS EN ISO 717-1:1996**
- **HOKLAS Accredited Airborne sound insulation of road traffic noise reducing devices and road barrier according to BS EN 1793-2:1998 and BS EN 1793-3: 1998**
- **HOKLAS Accredited Sound Absorption Measurement according to ASTM C423-02**
- **Sound Transmission Loss Measurement according to ASTM E90**

### *HOKLAS Accredited* Sound Reduction Test

When sound is incident upon a building element some of it will be reflected and some will be transmitted through the wall. The fraction of incident energy that is transmitted is called the transmission coefficient $t$ . The sound reduction index $R$ , is in turn defined in terms of the transmission coefficient, as follows:

$$R = -10\log_{10} t \quad \text{(dB)} \qquad \ldots(1)$$

The sound reduction index of a partition is measured in a laboratory by placing the element in an opening between two adjacent reverberant rooms designed for such tests. Noise is introduced into one of the rooms, referred to as the source room, and part of the sound energy is transmitted through the test element into the second room, referred to as the receiving room. The resulting mean space-average sound pressure levels between 100 Hz to 5000 Hz in one third octave band in the source $L_1$ and receiving rooms $L_2$ are measured.

The receiving room constant is determined by measurements of the reverberation decay. When measuring reverberation time in a room, the sound source is driven by a random noise generator in series with a bandpass filter. When the sound is turned off the room rate of decay is measured by the frequency analyser. The reverberation time, $T$ in each frequency band is determined as the reciprocal sound pressure level decay rate. The slope, generally measured as the best straight line fit to the recorded decay between 5dB and 35dB down from the initial steady-state level, is used to determine the decay rate.

Once found, the reverberation time $T$ is used in Equation (2) to calculate the room absorption.

$$A = 0.16V/T \qquad \ldots(2)$$

$A$ is the equivalent sound absorption area, in square metres;
$V$ is the receiving room volume, in cubic metres;
$T$ is the reverberation time in the receiving room, in seconds.

The noise reduction index is given by

$$R = L_1 - L_2 + 10\log(S/A) \qquad \ldots(3)$$

$S$ is the area of the test specimen, is square metres.

A single number descriptor, weighted sound reduction index Rw is used to facilitate comparison of the performance of different element. To determine the Rw for a particular element, a curve fitting technique is used to fit the calculated one-third octave sound reduction index.

Rw contours consist of a horizontal segment from 1250 to 3150 Hz, a middle segment increasing by 5 dB from 400 to 1250 Hz and a low frequency segment increasing by 18 dB from 100 to 400 Hz. The Rw rating of an element is determined by plotting the one-third octave band $R$ of the element and comparing it with the Rw contours. The Rw contour is shifted vertically until the $R$ curve falls mainly below the contour and the criteria that the sum of the deficiencies below the contour over the 16 one-third octave bands does not exceed 32 dB is met.

When the Rw contour is shifted to meet these criteria, the Rw rating is given by the value of the contour at 500 Hz.

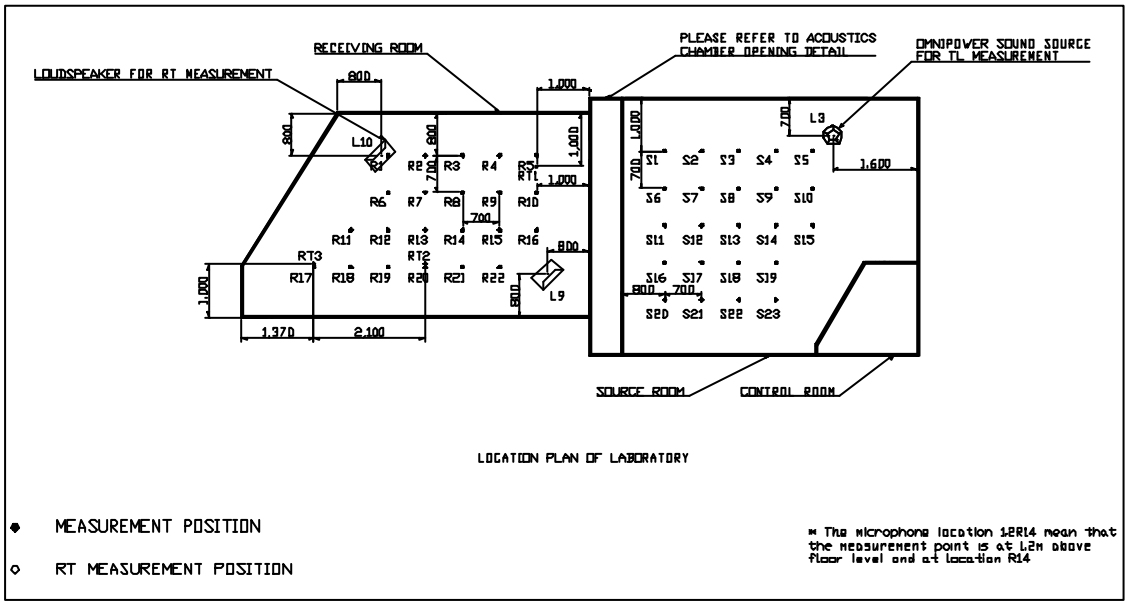
Our acoustics laboratory fulfills the requirement listed in ISO-140, and the experimental result of the building specimen is applicable to ISO 140-3, ASTM E-90 and BS 2750.

### *Acoustics Laboratory and Facility*

| Equipment | Fulfilled International Standard |
|---|---|
| Real- Time Frequency Analyzer | ✓ |
| Free- field Microphone | ✓ |
| Microphone Preamplifier | ✓ |
| Sound Level Calibrator | ✓ |
| OmniPower Sound Source | ✓ |

Our laboratory consists of 2 connecting reverberation rooms. The source and receiving are of $90m^3$ and $75m^3$. This was satisfied the requirement of ISO-140 and ASTM E-90 for sound insulation testing. The receiving room is built on an isolation box to ensure efficient vibration and sound isolation. The building specimen was installed in the $10m^2$ opening. The support frame for the specimen was fixed to a concrete platform, which was isolated from both source and receiving rooms. This is to reduce the transmission of structure-borne vibration from the structure of the source room.

To ensure the highest accuracy and precision of our measurement, our equipment is complied with the requirements of accuracy classes 0 or 1 defined in IEC 651 and IEC 804.



***Certify Your Buildings Specimen***

Once finished laboratory measurement, a detail report of the measurement, and a Certification that certified the Sound Reduction Index ($R_W$) of the tested buildings specimen will be issued. People can refer to this Certification to consult the acoustics performance of your building products. No more estimation, true data is here.

**(A+A)*L can also carry out the laboratory sound transmission measurement according to ASTM E90 for building materials to obtain a Sound Transmission Class (STC) of the material of product.**

## ***HOKLAS Accredited Airborne Sound Insulation of Road Traffic Noise Reducing Devices***

***Test Arrangement***

To determine the sound insulation performance of the roadside noise barrier when they are subjected to the conditions of the test specified in International Standard BS EN 1793-2: 1998 " Road traffic noise reducing devices – Test method for determining the acoustic performance – Part 2. Intrinsic characteristics of airborne sound insulation".

According to the BS EN 1793-2: 1998, the test arrangement shall be as described in EN ISO 140-3 for partition, with the following modifications.

The test specimen shall be mounted in the test opening and assembled in the same manner as the manufactured device is used in practice, with the same connections and seals between component parts. The edge supports shall not overlap the sample by more than 70 mm and shall be sealed to prevent the leakage of sound.

Where posts are employed in construction, at least one post shall be included in the specimen, with panels attached on both sides. The length of the panels on one side of the post shall be greater than or equal to 2 m. The side that would face the traffic shall face the source room.

The sound reduction indices $R_i$ in each one-third octave band in the range 100Hz to 5 KHz shall be determined using the method described in EN ISO 140-3.

A single-number rating shall be derived to indicate the performance of the product. The individual sound reduction indices shall be weighted according to the normalized traffic noise spectrum defined in EN 1793-3. And the single-number rating of airborne sound insulation $DL_R$, in decibels, is given by:

$$DL_R = -10 \log_{10} \left[ \frac{\sum_{i=1}^{18} 10^{0.1L_i} 10^{-0.1R_i}}{\sum_{i=1}^{18} 10^{0.1L_i}} \right]$$

## *Job Reference*

Testing the acoustics panel 3060mm X 3300mm

Testing the aluminium window 1250mm X 1500mm with 6mm glazing

Testing the roof cladding 3060mm X 3300mm

## ***HOKLAS Accredited* Sound Absorption Measurement according to ASTM C423-02**

The Sound absorption measurement is carried out according to ASTM C-423-02 'Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method'.

A band of random noise is used as a test signal and turned on long enough for the sound pressure level in the room to reach a steady state. When the signal is turn off, the sound pressure level will decrease and the rate of decay may be determined from measurements of the average time for the sound pressure level in a specified frequency band to decay through a certain range. The absorption of the room and its contents is calculated from the Sabine equation:

$$A = 0.9210Vd / c \qquad \ldots(4)$$

Where

$A$ = sound absorption, $m^2$;
$V$ = volume of reverberation room, $m^3$
$c$ = temperature, °C;
$d$ = $N / \overline{T}$ = rate of decays, dB/s;
$N$ = range of decay measured, dB;
$\overline{T}$ = average time for $N$ dB decay, s.

The absorption of the reverberation room is measured as both before and after placing a specimen of sound absorptive material in the room. The minimum number of decay measurements required for each frequency band is six. At least one loudspeaker position and three microphone positions with two readings in each case shall be used. The increase in absorption by the test specimen is the absorption of the test specimen which is calculated as:

$$A = A_2 - A_1 \qquad \ldots(5)$$

Where

$A$ = absorption of the specimen, $m^2$;
$A_1$ = absorption of the empty reverberation room, $m^2$;
$A_2$ = absorption of the room after the specimen has been brought in, $m^2$.

For each test frequency, calculate the sound absorption coefficient of the test specimen using the following equation:

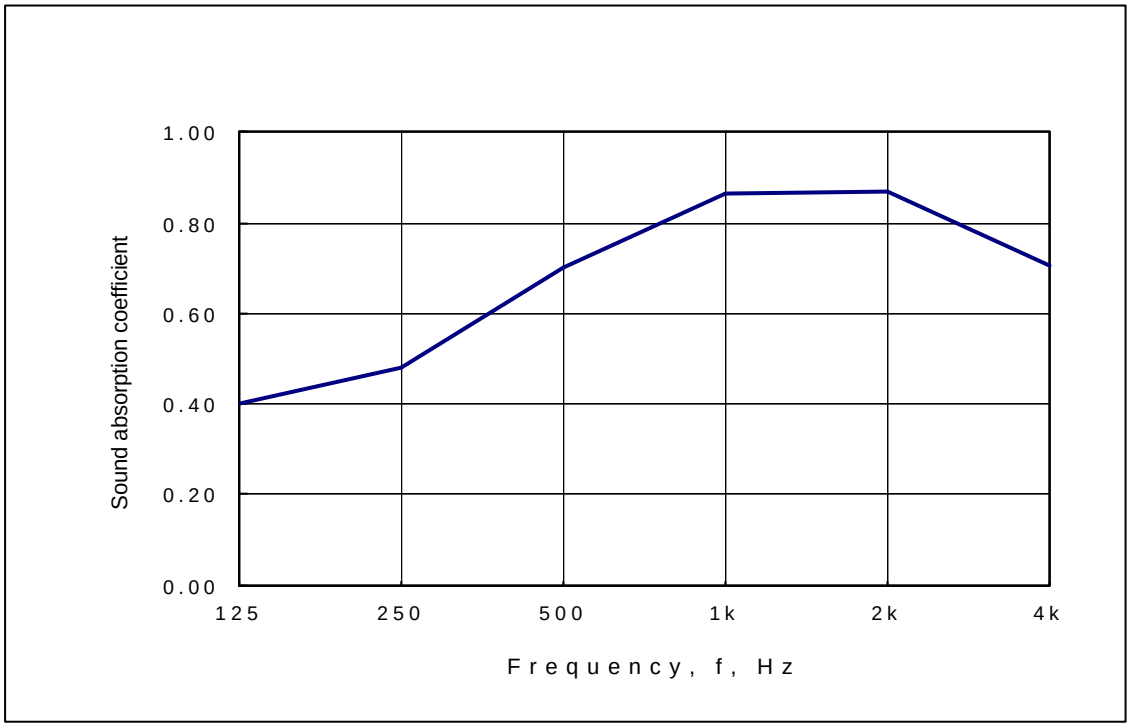
$$a = \left[\left(A_2 - A_1\right) / S\right] + a_1 \qquad \ldots(6)$$

Where

$a$ = absorption coefficient of test specimen;
$S$ = area of test specimen, $m^2$;
$a_1$ = absorption coefficient of the surface covered by the specimen.

The absorption coefficient, $a_1$ of the room surface covered by the specimen should be added when it is significant. However, the absorption coefficients of a smooth, hard, rigid surface, such a reverberation room floor, are small that they may be neglected. It is required that no adjustment be made for the floor area covered by the specimen.

A single number rating called the Noise Reduction Coefficient (NRC). Round the average of the sound absorption coefficient calculated in equation (6) for 250 Hz, 500 Hz, 1000 Hz and 2000 Hz to the nearest multiple of 0.05. If the unrounded average is an exact midpoint, round to the next higher multiple of 0.05.




Sound absorption coefficient chart

## *Reverberation Chamber in City University of Hong Kong*

The reverberation chamber was joint established by (A+A)*L and the Department of Building and Construction, City University of Hong Kong, in the summer of 2001. It is used for teaching, research, and commercial consultancy in architectural acoustics.

This reverberation chamber meets all requirements of ISO 354: 1985 and ASTM C423-99a. It is mainly made of massive concrete and damped steel. The reverberant sound field within the chamber is closely diffuse during the steady and decay states.

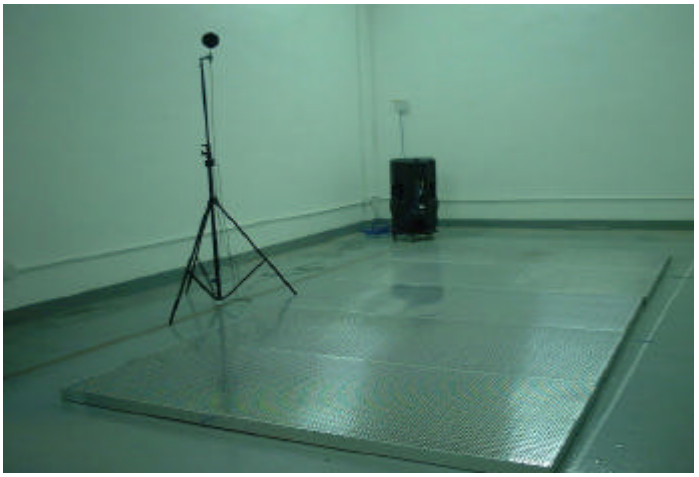
The room volume of the reverberation chamber is approximately 200 $m^3$. The reverberation times of the chamber without testing specimen are listed in the following table.

The Reverberation Times of Chamber

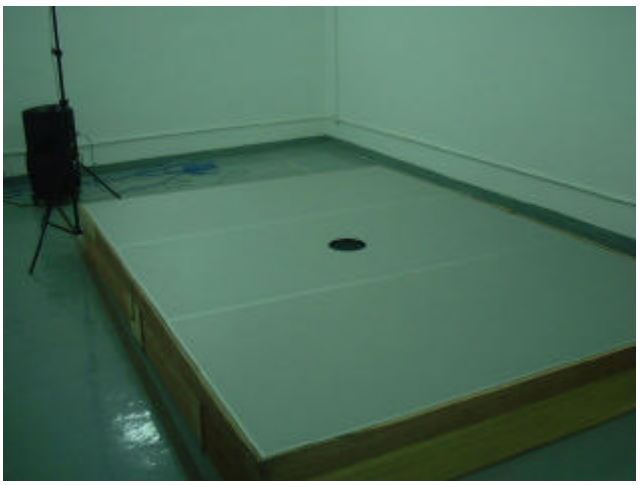
| Octave Band Centre Frequency, Hz | 125 | 250 | 500 | 1000 | 2000 | 4000 |
|---|---|---|---|---|---|---|
| Reverberation Time T60 (sec) | 6.5 | 9.6 | 8.1 | 6.4 | 5.2 | 3.2 |

Acoustics and Air Testing Laboratory Company Limited - (A+A)*L is cooperating with the Department of Building and Construction, City University of Hong Kong in the HOKLAS Accreditation of the Laboratory Sound Absorption Measurement.

***Job Reference***



Set-up of the tested sample in the Reverberation Chamber



Set-up of Metal Ceiling System (Type E-600 & Type E-200) in the Reverberation Chamber

## *Field Measurements:*

- Noise Isolation Class Measurement
- Vibration Measurement
- Environmental Monitoring and Audit
- Handling Noise Abatement Notice
- Noise Exposure Assessment in Working Places

### Noise Isolation Class Measurement

The Noise Isolation Class (NIC) measurement was carried out according to ASTM E-336 'Testing Method for Measurement of Airborne Sound Insulation in Buildings' and the calculation was carried out according to ASTM E-413.

NIC of the test specimen was determined by comparing the noise levels sampled inside the source and receiving rooms between which the test specimen separating them. Sound measurment was carried out inside the two rooms. The loudspeaker (OmniPower Sound Source) is fed with white noise in 1/3 octave bands. The averaged sound pressure level was measured in 1/3 octave band frequencies, from 100 Hz to 5000 Hz. The microphone positoins are located 1 m in front of the test specimen.

The Noise Reduction ( $NR$ ) in a specified frequency band is the difference between two rooms and was derived using the relation:

$$NR = L_1 - L_2$$

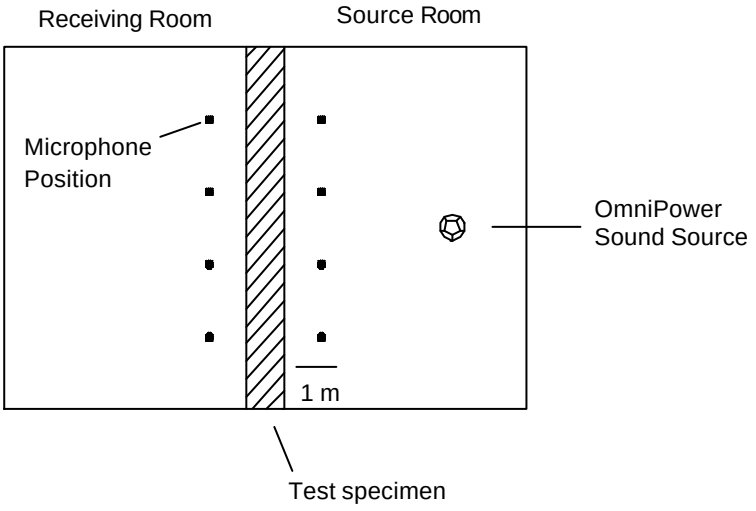
Where

$NR$ is the noise reduction, in decibels;

$L_1$ is the average sound pressure level in the source room, in decibels;

$L_2$ is the average sound pressure level in the receiving room, in decibels.

A single number descriptor, NIC is used to facilitate comparison of the performance of different element. To determine the NIC for a particular element, a curve fitting technique is used to fit the calculated 1/3 octave band $NR$.



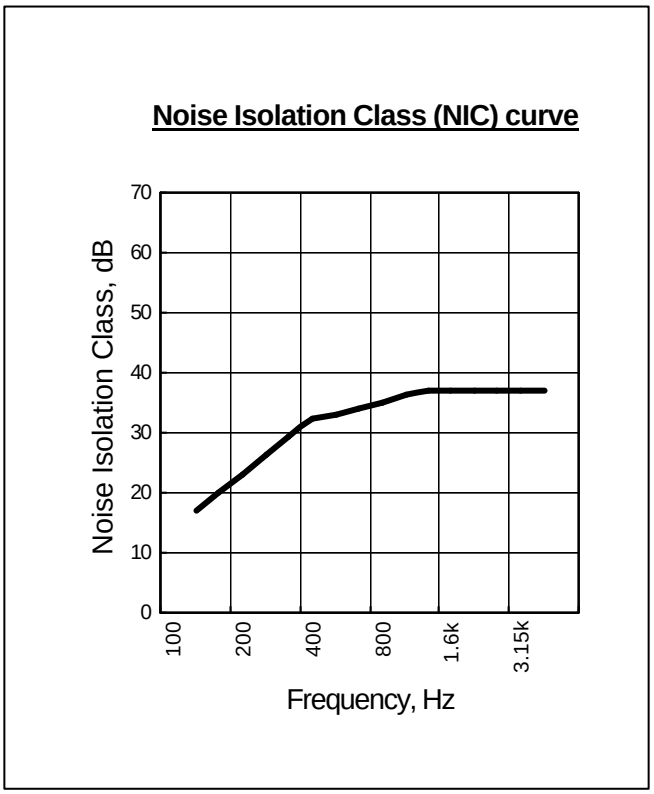
NIC contour consists of a horizontal segment from 1250 Hz to 4000 Hz, a middle segment increasing by 5 dB from 400 Hz to 1250 Hz and a low frequency segment increasing by 15 dB from 125 Hz to 400 Hz. The NIC rating of an element is determined by plotting the 1/3 octave band $NR$ of the element and comparing it with the NIC contour. The NIC contour is shifted vertically until the NR curve fall mainly below the contour and the following criteria are met:

1. the $NR$ curve is never more than 8 dB below the NIC contour in and 1/3 octave band; and

2. the sum of the deficiencies below the contour over the 16 1/3 bands does not exceed 32 dB.

When the NIC contour is shifted to meet these criteria, the NIC rating is given by the value of the contour at 500 Hz.

Conrad Hotel Ball Room LL4 movable partitions




Noise Isolation Class (NIC) curve

**Preferable Building Materials in NIC Test**

| | |
|---|---|
| Acoustics Door, | Perforated Panel, |
| Fabric Panel, | Fiberglass Panel, |
| Timber Panel, | Movable Partition, |
| Acoustic Linings, | Acoustic Louvers, |
| False Ceiling, | Barrier, |
| Enclosure, | Windows, etc. |

## Vibration Measurement

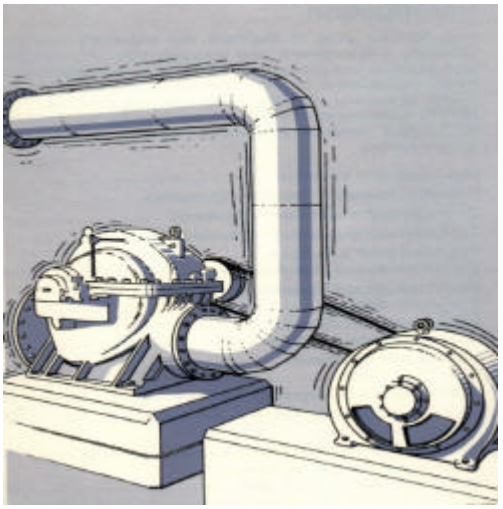
People expose to vibration which can interfere with comfort, health and safety; machines expose to inherent vibration which can reduce the working efficiency, damage the bearing parts, and generate structural born noise, also, this is necessary to consider the energy waste to vibration.

### *Identify Vibration Sources*

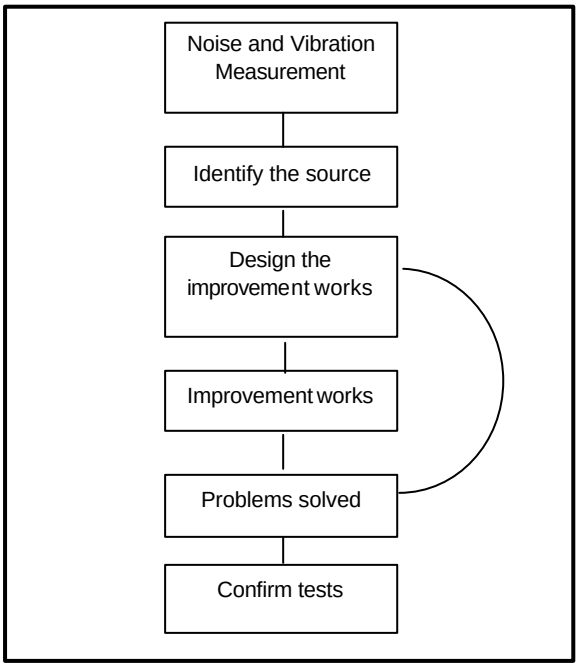
To solve the vibration problem, the most important step is to identify the source. This is a thankless task to find out vibration source by eye and ear estimation. Experienced plant engineers have been able to recognize the vibration by touch and hearing, but it is time consuming and not the way in some cases. Moreover the detail of the vibration like, vibration frequency, amplitude and transmission path never can be detected by this method.

### *Twins Problem - Sound and Vibration*

Vibration from machines operation, likes lift system and chiller plant, may be transmitted indoors through building structure at points where the machine is rigidly fixed to the structure without proper isolation. The vibration transmitted may activate the building structure to generate noise which causes noise disturbance to noise sensitive receiver inside the building.



Vibration causes noise problems




Strategy of Vibration Control Program

### *Experienced in Vibration and Noise Measurement*

Our company has extensive practical experience in solving a wide variety of complex noise and vibration problems. For the complete series of anti- vibration and noise service ranging from noise survey, vibration measurement, vibration source identification, treatment design, installation, and after work test.

### *Measure Vibration with Scientific Instrument*

To investigate the true natural of vibration includes detail physical parameter, our company provides field and laboratory vibration measurement services. We have a portable real time frequency analyzer, which fulfils the requirement listed in international standard, both IEC and ISO.

| Vibration Measurement Feature | Provides |
|---|---|
| Real-time measurement | ✓ |
| Wider frequency range (1.6 Hz up to 20kHz) | ✓ |
| FFT measurement | ✓ |
| Dual channel measurement | ✓ |
| Measure vibration time history | ✓ |
| Amplitude & displacement measurement | ✓ |
| Noise and Vibration simultaneously measurement | ✓ |

### *Job Reference*

Vibration Measurement in machine room at Valverde Hall
11 May Road

Noise and Vibration Measurement with MTRC

Vibration measurement at plant room

## *Acoustics Design with Computer Modeling*

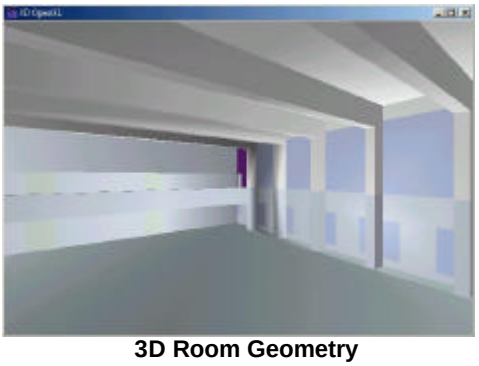
### Room Acoustics Modelling

Acoustics and Air Testing Laboratory is a licensed user of ODEON program in Hong Kong. We are available in room acoustics, auditorium acoustics and industrial noise control.

ODEON is a famous acoustics program, and provides prediction software for acoustic consultants and universities worldwide.

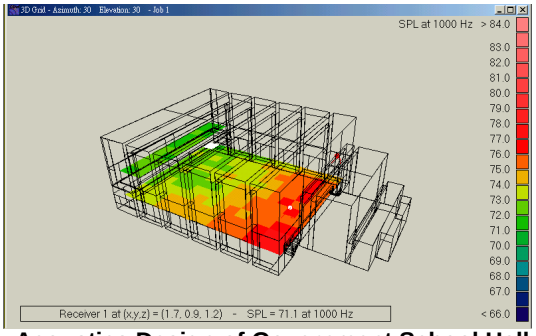
**Simulation**

ODEON provides a 3D view environment for engineer to design and view indoors acoustics condition. Room geometry is being imported from CAD systems. A material list with sound absorption coefficients and transmission characteristic is built in program. Sound absorption coefficients of specified materials can also be input by the users for room acoustics simulation. The room surface can be assigned with different building materials to match the real situation. The sound sources with directivity properties at each frequency band is allowed to locate anywhere inside the room. The receiver can be defined as a whole surface or just a single point which positions by x-y-z coordinate.



**3D Room Geometry**

**Result**




**Acoustics Design of Government School Hall**

Estimated reverberation times in terms of T20 and T30 can be represented as graphical format, and single point response, multi point response and grid response can be mapped in the 3D room surface. Sound field generated by different sound source can be calculated and every sound ray can be tracked; any weak receiving area can be easily identified.

**Design Tool**

Any modification in geometry or relocation of material will change the room acoustic properties, in order to achieve the best acoustic behavior; (A+A)*L provides a powerful room acoustics modeling services for Architect, Acoustics Consultant and Sound & AV Designer.

## Sound Insulation Prediction

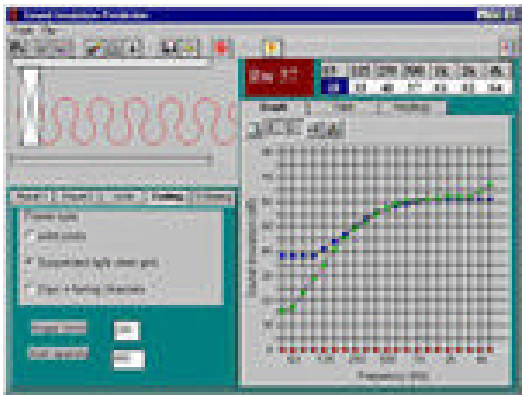
Acoustics and Air Testing Laboratory has INSUL computer program for predicting the airborne sound insulation performance of walls, floors and glazing.

INSUL is based on classical theoretical models that onle require easily obtainable construction information. The programme can make good estimates of the Transmission Loss (TL) in 1/3 octave bands and Weighted Sound Reduction Index (STC or Rw) for use in noise transfer calculations.

INSUL can

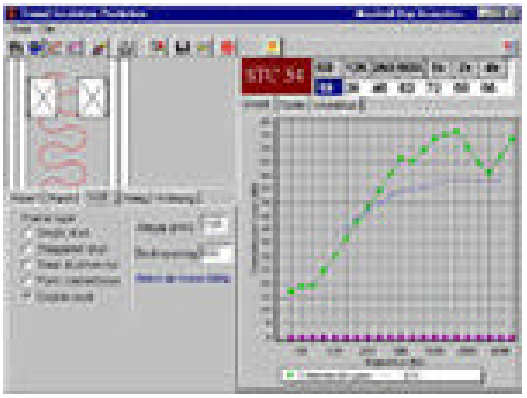
- predicts the sound insulation performance of walls, floors ceilings and windows
- accurate estimates of Sound Transmission Class (STC and Weighted Sound Reduction Index (Rw)

INSUL can be used to quickly evaluate new materials and systems, or to investigate the effects of changes to existing designs. It models materials using well known elastic plate theory including allowances for thick panel effects as published by Ljunggren, Rindell and others. More complex partitions are modelled using work by Sharp, Cremer and others.



It can predict the effect of installing an acoustic blanket in the stud cavity. It has evolved over several versions into a very easy to use tool that takes advantage of the Windows environment, and has been refined by continued comparison with laboratory tests to provide acceptable accuracy for a wide range of constructions.

Test data can be entered to permit easy comparison with predictions and constructions can be saved for later recall.



INSUL takes account of finite size effects which are very important when predicting small samples such as windows and also for normal elements at low frequencies.

Like any prediction tool INSUL is not a substitute for measurement. However, comparisons with test data indicate that INSUL reliably predicts STC values to within 3dB for most constructions.

INSUL will greatly enhance the ability of acoustic consultants and product manufacturers to quickly and confidently specify constructions in order to achieve a desired airborne sound insulation

## *Environmental Monitoring and Audit*

During construction phase of a project, many environmental problem likes, air-dust, noise, sewage and solid waste etc, will be arose. Apply EM&A system effectively is a good method to control and minimize those environmental problems.

Our environment auditing covers identification of sources and characteristics of air emission, noise, effluent, and solid waste; and recommends appropriate procedures for reduction of pollution.

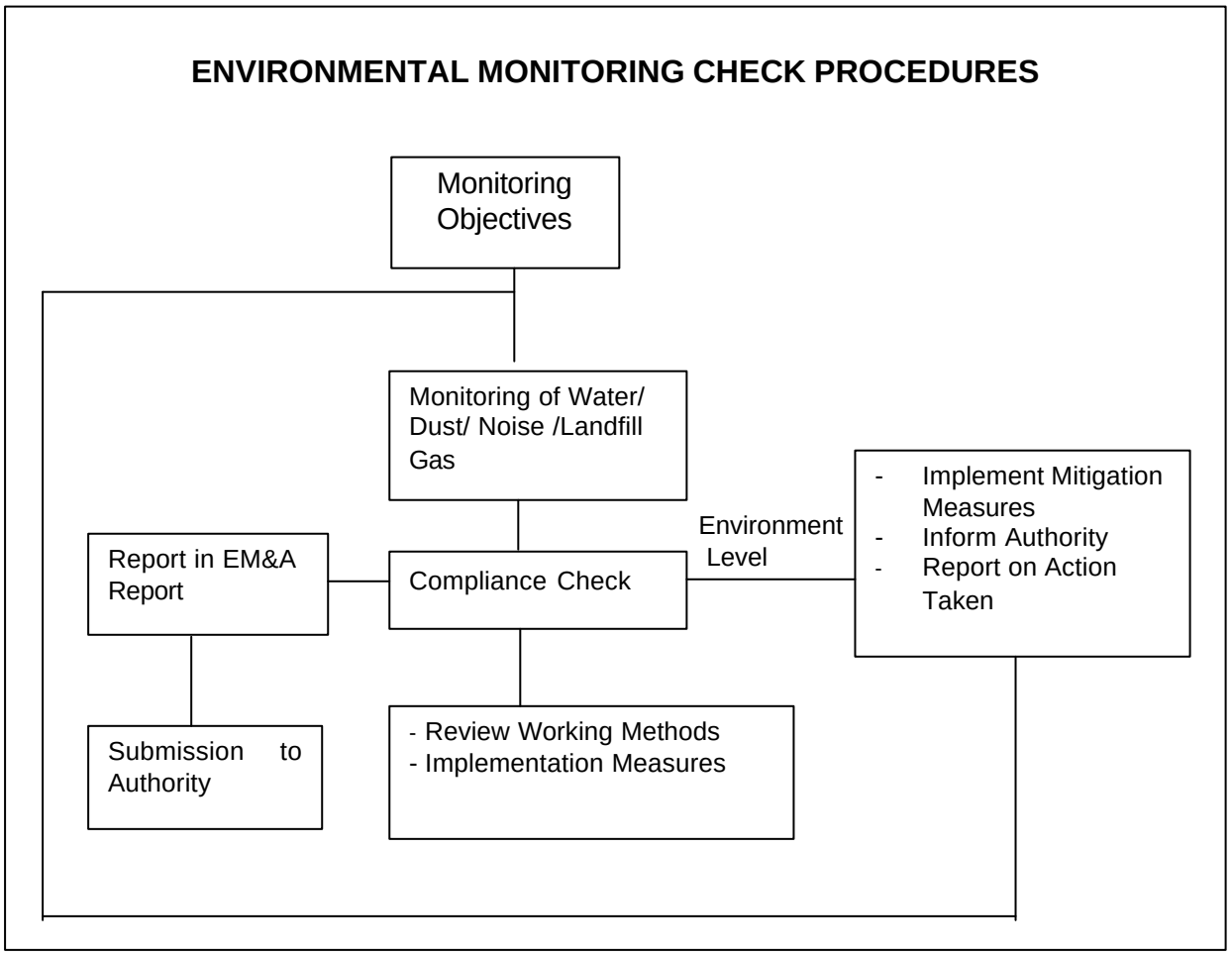
(A+A)*L conducts project-specific environmental monitoring for construction sites and its nearby sensitive receiver. The aim is to obtain baseline environmental conditions information, and to evaluate the impact on the air and water quality, as well as the noise level due to the on-going works. (A+A)*L has the portable equipment to sample and analyze pollutants. Trigger-Action-Target (TAT) Levels will be devised along with timely, cost effective, and practical solutions to problems through communication with site engineers, contractors and Government works agencies.

Baseline Measurement in Ma Wan (Noise)

Baseline Measurement in Penny' s Bay (Air)

Our Environmental Monitoring and Audit (EM&A) service covers the following items:

- monitor the various environmental parameters as required in Environmental Impact Assessment (EIA) study final report;
- investigate and audit the Contractors' equipment and work methodologies with respect to pollution control and environmental mitigation, and anticipate environmental issues for proactive action before problem arise;
- audit and prepare audit reports on the environmental monitoring data and the site environmental conditions;
- report on the environmental monitoring and audit results to Contractor, the Consultant and the EPD.

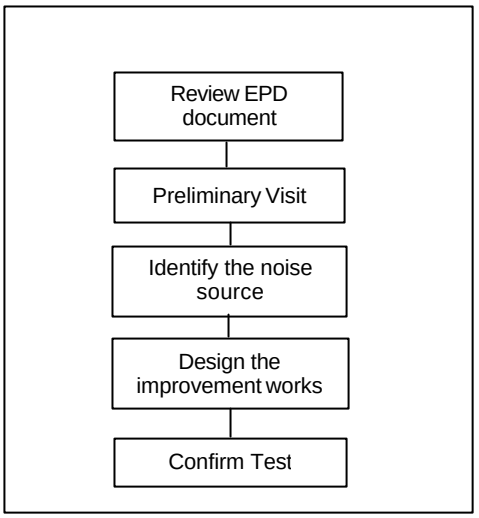


## Handling Noise Abatement Notice

Noise abatement notices control excessive noise emanating from places such as industrial, commercial, trades or business premises in Hong Kong.

### What is a noise abatement notice?

A noise abatement notice is a statutory document served under Noise Control Ordinance. It may contain noise limits or standards and may also impose condition relating to the operation of any plant or equipment. When a company received this notices, the company person is required to reduce the noise emission from his noisy machine. It should be noticed that it is an offence if the person whom failed to bring down the noise level to the limited level.




Strategy of Vibration Control Program

### When can a noise abatement notice be served?

Environmental Protection Inspector will only conduct an investigation in response to a complaint and make an assessment in accordance with the Technical Memorandum. If the noise exceeds the appropriate criterion laid down in Technical Memorandum the Environmental Protection Department may serve a noise abatement notice.

**What can Acoustics and Air Testing Laboratory help?**

When you receive a noise abatement notice, immediate attention should be paid to comply with the notices, by lowering the noise emission from the premises to the required level within the stipulated period. For complicated cases where extensive noise control measures are required professional advice from specialist consultants/ contractors is required. Our company is one of the registered contractors in EPD contractor list. We are able to solve your noise abatement notices problem, and we are experienced in solving various types of noise problems, especially in handling ventilation noise.

**Ventilation noise**

Most of noise abatement notices served to commercial which are related to ventilation noise. Ventilation system like, refrigerator, chilling plant, cooling tower, air duct exhaust and AHU are easily to annoy surrounding noise sensitive receiver. Acoustics enclosure, barrier, screens, silencers, louvers and linings are the common solution, we have experienced tailor to manufacture those product to suit your need in the most economic and effective way. After improvement works, a noise measurement will be carried out to ensure that the noise level has been reduced and fulfilled EPD requirement.

***Job reference***

Ventilation system noise reduction works in a Chinese restaurant

## Noise Exposure Assessment in Working Places

For a responsible employer, it is necessary to provide a safety working condition to your employees, it is not only enhance working efficiency, and moreover, it could protect your employees not being hurt during the working time. Noise at works always is a neglectful and potential risk, it may not cause damage to your employees immediately, but regular exposure to high noise levels over a long period of time may result in permanent and incurable hearing loss.

### *Action Levels and the Main Requirements*

A daily personal noise exposure can be regarded as the total exposure throughout the working day, taking into account the average noise levels in working area and time spent in them, but taking into no account of any ear protector worn. The peak pressure is the highest pressure of the sound wave. The three action levels defined in Noise at Work Regulation are:

a) First Action Level – a daily personal noise exposure ($L_{EP,\,d}$) of 85 dB (A)
b) Second Action Level – a daily personal noise exposure ($L_{EP,\,d}$) of 90 dB (A)
c) Peak Action Level – a peak sound pressure level of 140dB or peak sound pressure of 200 Pa

The Regulation requires the employer to take certain basic steps where an employee is likely to be exposed to noise at or above the First Action Level. The first thing need to do is finding a **competent person to assess the noise exposure** at working places and sending assessment report to Labour Department within 28 days, but the assessment procedure and reporting format is difficult for the layman in acoustics and occupation safely to understand.

Noise Assessment with a Competent Person

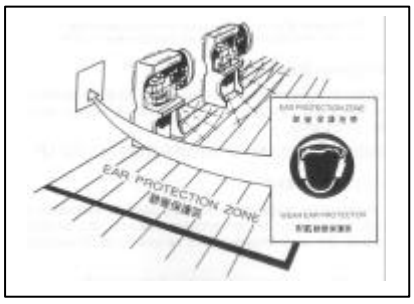
***Assess the Noise with Competent persons***

Acoustics and Air Testing Laboratory's staff have appropriate qualification to complete the Noise Assessment and prepare the Noise Assessment Report for **Labour Department**. Our Noise Assessment service included following item:

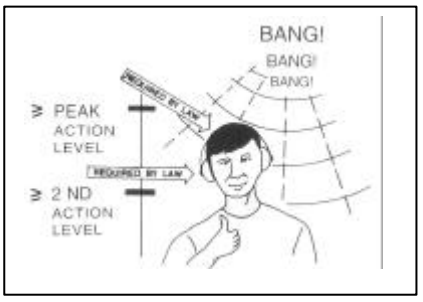
1. propose a corrected assessment method;
2. carry out assessment with accurate instrument;
3. survey and investigate workers job routine;
4. record the results and explain them to clients;
5. interpret assessment result and prepare report to Labour Department; and
6. propose the practicable noise reduction method.

**Ear Protection**

Method to minimize the hazard noise risk will be proposed after finished the Noise Assessment.




Use a sign and demarcation lines to mark an ear protection zone




Using proposed ear protector

Specifications of a distance for noisy machine in construction sites

**Reduce the Noise at Sources**

The active method to solve the noise problem at working place is reducing the noise at source. Control the noise at source sometime is most effective and easy. Building enclosure on the plant, adding lining on the wall, reduce the machine vibration etc. are the common solution. We could help you to design and build those products to suit your need.

## *Indoor Air Quality Assessment*

The Draft Guidance Notes for the Management of Indoor Air Quality (IAQ) in Offices and Public Places was published on November of 1999 by the Indoor Air Quality Management Group of the Government of the HKSAR. A 2-level Indoor Air Quality Objectives is established inside the Guidance Notes. They are classified as follows:

Level 1 represents very good indoor air quality that a high-class and comfortable building should have.

Level 2 represents indoor air quality that provides protection to the public at large including the very young and the aged.

The IAQ parameters selected for IAQ Objectives include the followings:

*Carbon Dioxide ($CO_2$)*
*Carbon Monoxide (CO)*
*Respirable Suspended Particulates (RSP)*
*Nitrogen Dioxide ($NO_2$)*
*Ozone ($O_3$)*
*Formaldehyde (HCHO)*
*Total Volatile Organic Compound (TVOC)*
*Radon (Rn)*
*Airborne Bacteria*
*Room Temperature*
*Relative Humidity*
*Air Movement*

We will conduct an initial walk-through inspection before the detail investigation. During the initial inspection, concentration of Carbon Dioxide will be measured. Carbon Dioxide has been commonly adopted by IAQ researchers as an indicator with level above 1,000 part per million (ppm) in office environments indicate that the ventilation rate is low and that other airborne contaminants are accumulating and therefore, further detail investigation may need. During the detail investigation, concentration level of the individual parameter mentioned above will be measured. Sampling time will be either a single measurement for half an hour during the expected occurrence of worst scenario, or four 15 minutes measurement evenly distributed during the normal office hours. A report with all the concentration level of the measured parameters will be prepared. A certificate stating the Indoor Air Quality Level according to the Indoor Air Quality Objectives proposed by the Guidance Notes will be issued if all the 12 parameters mentioned above have been measured. Upon request, suggestion of the measures on how to improve the Indoor Air Quality will be proposed. After the implementation of the suggested mitigation measures, final investigation of the improvement will be conducted.

Listed below is the instrument that we use to measure the IAQ parameters:

| **Parameter** | **Monitoring Instrument** |
|---|---|
| *Carbon Dioxide ($CO_2$)* | *Telaire 7001* |
| *Carbon Monoxide (CO)* | *Interscan 4148* |
| *Respirable Suspended Particulates (RSP)* | *DustTrak* |
| *Nitrogen Dioxide ($NO_2$)* | *Teco 42* |
| *Ozone ($O_3$)* | *Teco 49* |
| *Formaldehyde (HCHO)* | *SKC Passive Bubbler Sampler* |
| *Total Volatile Organic Compound (TVOC)* | *ppbRAE* |
| *Radon (Rn)* | *RAD-7* |
| *Airborne Bacteria* | *Andersen N6* |
| *Room Temperature* | *Telaire 7001* |
| *Relative Humidity* | *Engelhard* |
| *Air Movement* | *TSI VelociCALC Plus* |

Equipment mentioned above has appropriate sensitivity more than enough to identify the Indoor Air Quality Level 1 Objective. The detection methods of this equipment are following the reference method stated in the Guidance Notes published by the Indoor Air Quality Management Group of the Government of the HKSAR.

IAQ measurement at Bank

IAQ measurement at Ka Wah Centre

# Job References

## Sound Transmission Loss:

1. Hong Kong Housing Authority (1996)
   Laboratory Sound Reduction Index Measurement according to BS 5821: 1984 Part I for comparison of uPVC and Aluminium flamed windows.

2. Maze Aluminium Engineering Company Ltd. (1996)
   Transmission Loss Measurement for Airport Fire station and Police station Glass Cladding System.

3. Paliburg Development Consultants Ltd. (1997)
   Window System Acoustics Mock-up Test for Proposed Hotel Development at Chek Lap Kok.

4. Far East Aluminium Works Co. Ltd. (1997) .
   Transmission Loss Measurement for Cathay Pacific CLK Headquarters Metal and Glass Cladding System.

5. Maxii High-Technique Engineering Co. Ltd. (1998)
   Laboratory Sound Reduction Index Measurement of Roofing, External Wall and Internal Partition Wall according to ISO 140-3

6. Campbell Shillinglaw Cook & Associates Ltd. (1998)
   Transmission Loss Measurement for Roofing System of CPA Flight Training Centre for Associated Engineers Ltd.

7. Research Engineering Development Facade Consultants Ltd. (1998)
   Laboratory Sound Reduction Index Measurement for Aluminium Window for Far East Aluminium Works Co. Ltd. according to ISO 140-3:1995.

8. MBM (H.K.) Ltd. (1998)
   Laboratory Sound Reduction Index Measurement for Curtain Wall for King's Road Project according to ISO 140-3: 1995.

9. ENPAC Ltd. (1998)
   Laboratory Sound Reduction Index Measurement for Aluminium Window in accordance with ISO 140-3: 1995.

10. Architectural Acoustics (H.K.) Ltd. (1999)
    Laboratory Sound Reduction Index Measurement for Acoustic Panel in accordance with ISO 140-3: 1995.

11. Felix Construction (H.K.) Ltd. (1999)
    Laboratory Sound Reduction Index Measurement for Internal Wall Cladding Panel according to ISO 140-3: 1995.

12. Luen Shing Decoration Engineering and Trading Co. (1999)
    Laboratory Sound Reduction Index Measurement for Aluminium Window according to ISO 140-3: 1995.

13. Flour City Architectural Metal (Asia) Ltd. (1999)
    Laboratory Sound Reduction Index Measurement of Mock-up Test for South Wall of Main Block at Chek Lap Kok according to ISO 140-3.

14. Kelly Construction Co. Ltd. (2000)
    Transmission Loss Measurement for Cinema Auditoria Party Wall for CityPlaza.

15. NANIWA International Co. Ltd. (2000)
    Laboratory Sound Reduction Index Measurement for V-Block according to ISO 140-3: 1995.

16. Builders Federal (H.K.) Ltd. (2000)
    Transmission Loss Measurement for Acoustic Louvre.

17. Campbell, Shillinglaw, Lau Ltd. (2000)
    Laboratory Sound Reduction Index Measurement for Acoustic Panel according to ISO 140-3: 1995.

18. SPS Co. Ltd. (2000)
    Laboratory Sound Reduction Index Measurement for Double Sandwich Board according to ISO 140-3: 1995.

19. Campbell, Shillinglaw, Lau Ltd. (2000)
    Transmission Loss Measurement for Metal Roof System according to ASTM E336 for CLP Power Hong Kong Limited Science Park Project.

20. S. M. Engineering Ltd. (2000)
    Laboratory Sound Reduction Index Measurement for Metal Roof System according to ISO 140-3: 1995 for CLP Power Hong Kong Limited West Kowloon Reclamation 'A' Substation and Maintenance Depot

21. Elewinton Ltd. (2000)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Double Leaf Acoustic Door according to ISO 140-3: 1995.

22. Yung Shing Machinery Engineering Co. Ltd., Taiwan (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Acoustic Door and Acoustic Window according to ISO 140-3: 1995.

23. Industrial Acoustics Company (HK) Ltd. (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Acoustic Barrier Panels according to ISO 140-3: 1995 for MTRC Contract 520A Stage 1.

24. Wins Consultants Ltd. (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for 125mm Drywall System of WINS Panels according to ISO 140-3: 1995

25. Hofmann Chen (Taiwan) Limited (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for 125mm Drywall System of Perlitec S. Boards according to ISO 140-3: 1995

26. Daido Building Materials Co. Ltd. (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for 100mm YTONG Panel Wall according to ISO 140-3: 1995

27. Proflex Office System Limited (2001)
    Laboratory Sound Transmission Loss Measurement for PROWALL Full Ceiling Height Demountable Panel System according to ASTM E90

28. Saffire Acoustic Engineering Limited (2001)
    Laboratory Sound Reduction Index Measurement for Operable Wall Panels for Medical Complex, HKU.

29. Techwell Engineering Limited. (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for "KAIZIP" Roof System according to ISO 140-3: 1995 for West Rail, KCRC

30. CEMAC Engineering Limited. (2001)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for two acoustic door panels according to ISO 140-3: 1995 for TVB Project.

31. Industrial Acoustics Company (HK) Ltd. (February-March 2002)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Acoustic Barrier Panels according to ISO 140-3: 1995 for MTRC Contract 520A Stage 2.

32. Yung Shing Machinery Engineering Co. Ltd., Taiwan (March 2002)
    Laboratory Sound Reduction Index Measurement for Acoustic Door of 2100mm by 945mm according to ISO 140-3: 1995.

33. Campbell, Shillinglaw, Lau Ltd. (April 2002)
    Laboratory Sound Transmission Loss Measurement for Acoustic Panel according to ASTM E90-99.

34. Fugro Technical Services Ltd. -- MateriaLab Division (May 2002)
    Laboratory Sound Transmission Loss Measurement for 75mm EcoWall System according to ISO 140-3: 1995.

35. Extensive Trading Co. Ltd. (May 2002)
    Laboratory Sound Transmission Loss Measurement for 153mm EcoWall System according to ASTM E90-99.

36. Unison Projects Company Limited (June 2002)
    Laboratory Sound Transmission Loss Measurement for Cladding System according to ASTM E90-99 for Contract PJ 1978 Ma On Shan Stadium Cum Library - Supply & Install Cladding System.

37. Charming Furnishings Limited (August 2002)
    Laboratory Sound Transmission Loss Measurement for two partition wall systems according to ASTM E90-99.

38. Hinrich International Limited (September 2002)
    Laboratory Sound Transmission Loss Measurement for acoustical door according to ASTM E90-99.

39. RSM Technologies Limited (September 2002)
    Laboratory Sound Transmission Loss Measurement for light-weight wall system according to ISO 140-3: 1995.

40. SPS Limited (September 2002)
    Laboratory Sound Reduction Index Measurement for acoustical door according to ISO 140-3: 1995.

41. Industrial Acoustics Company (HK) Ltd. (October 2002)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Acoustic Barrier Panels for West Rail CC609 according to ISO 140-3: 1995.

42. Arup Acoustics (October 2002)
    Laboratory Sound Transmission Loss Measurement for Curtain Wall "Outside to inside" Setup for URA Project K2 – Hotel and Office Towers according to ASTM E90-90.

43. Arup Acoustics (October 2002)
    Laboratory Sound Transmission Loss Measurement for Curtain Wall "Room to Room" Setup for URA Project K2 – Hotel and Office Towers according to ASTM E90-90.

44. Arup Acoustics (October 2002)
    Laboratory Sound Transmission Loss Measurement for Curtain Wall "Floor to Floor" Setup for URA Project K2 – Hotel and Office Towers according to ASTM E90-90.

45. Sun Hing Steel Furniture Fty Ltd. (November 2002)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for IN8 Wall System according to ISO 140-3: 1995.

46. China Merchants Heavy Industry Co. Ltd. (November 2002)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Composite Aluminum Noise Enclosure Panels according to ISO 140-3: 1995.

47. Salotto Limited (December 2002)
    Laboratory Sound Transmission Loss Measurement for Fabric Mounted Full-Height Panel according to ISO 140-3: 1995.

48. Salotto Limited (December 2002)
    Laboratory Sound Transmission Loss Measurement for 40mm Butterfly Hinged Wood Door – Insulated Core according to ISO 140-3: 1995.

49. China Merchants Heavy Industry Co. Ltd. (December 2002)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for SFEL Composite Aluminum Noise Enclosure Roof/Wall Panels according to ISO 140-3: 1995.

50. Entasis Ltd. (December 2002)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for Entasis 126mm Noiseblock Panels according to ISO 140-3: 1995.

51. Key Honor Limited / Zemac Engineering Company Limited (January 2003)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for one acoustic panel system according to ISO 140-3: 1995.

52. Sonotec Far East Limited (January 2003)
    HOKLAS Accredited Laboratory Sound Reduction Index Measurement for one Sandwich Panel according to BS EN ISO 140-3: 1995.

53. ASA (Hong Kong) Limited (March 2003)
HOKLAS Accredited Laboratory Sound Reduction Index Measurement for lightweight panel system according to BS EN ISO 140-3: 1995.

54. Entasis Limited (May 2003)
HOKLAS Accredited Laboratory Sound Insulation test for absorptive roof panel and absorptive wall panel according to BS EN 1793-2: 1996.

55. G & B International Group Company Limited (May 2003)
Laboratory Sound Insulation test for one steel door and one timber door according to BS EN ISO 140-3: 1995.

56. Building Harmonic (Asia) Limited (May 2003)
Laboratory Sound Insulation test for one acoustical door according to BS EN ISO 140-3: 1995.

57. Techwide Engineering Limited (May 2003)
Laboratory Sound Insulation test for two acoustical timber doors according to BS EN ISO 140-3: 1995.

58. Jeb Greater China Limited(April 2003)
Laboratory Sound Insulation test for double glazed partition according to ASTM E90 for HKMA relocation to International Finance Centre Two.

## Absorption Measurement:

1. Goldtech Building Material Co. Ltd. (1996)
Laboratory Absorption Measurement for the Acoustic Plaster according to ASTM C 423.

2. Erawan Co. Ltd. (1996)
Laboratory Absorption Measurement for the Acoustic Plaster according to ASTM C 423.

3. Pyrok Industries Ltd. (2000)
Laboratory Absorption Measurement for Acoustic Plaster for West Rail Project C203 according to ASTM C 423.

4. Dominic Science & Technology Ltd. (2000)
Laboratory Absorption Measurement for Acoustic Plaster according to ASTM C 423.

5. Campbell & Shillinglaw Ltd. (2000)
Laboratory Absorption Measurement for Acoustic Panel according to ASTM C 423.

6. Tai Ming Fung Co. Ltd. (2000)
Laboratory Absorption Measurement for Acoustic Plaster according to ASTM C 423.

7. CEMAC Engineering Co. Ltd. (2000)
Laboratory Absorption Measurement for Acoustic Wall Lining according to ASTM C 423

8. Kim & Kris Enterprises (Far East) Ltd. (2000)
Laboratory Absorption Measurement for Acoustic Ceiling System according to ASTM C 423.

9. Campbell & Shillinglaw, Lau Ltd. (2001)
   Laboratory Absorption Measurement for Metal Roof System according to ASTM C 423 for CLP Power Hong Kong Limited Science Park Project.
   .
10. S. M. Engineering Ltd. (2001)
    Laboratory Absorption Measurement for Metal Roof System according to ASTM C 423 for CLP Power Hong Kong Limited West Kowloon Reclamation 'A' Substation and Maintenance Depot.

11. CEMAC Engineering Co. Ltd. (2001)
    Laboratory Absorption Measurement for Acoustic Wall Lining according to ASTM C 423

12. Eastwell Enterprise (Asia) Co. Ltd. (2001)
    Normal Incidence Sound Absorption Coefficient Measurement according to ASTM 1050 "Standard Test Method for Impedance and Absorption of Acoustical Materials Using A tube, Two Microphones and A Digital frequency Analysis System" for four different WFC testing samples

13. Andermax (Hong Kong) Limited (May 2002)
    Laboratory Sound Absorption Measurement for acoustical ceiling panels for West Rail Station according to ASTM C423-99.

14. Unison Projects Company Limited (June 2002)
    Laboratory Sound Absorption Measurement for Cladding System according to ASTM C423-99 for Contract PJ 1978 Ma On Shan Stadium Cum Library - Supply & Install Cladding System.

15. China Merchants Heavy Industry Co., Ltd. (July 2002)
    Laboratory Sound Absorption Measurement for 52mm thick acoustical panels according to ASTM C423-99.

16. China Merchants Heavy Industry Co., Ltd. (November 2002)
    Laboratory Sound Absorption Coefficient Measurement for Laboratory according to ASTM C423-02.

17. China Merchants Heavy Industry Co., Ltd. (December 2002)
    Laboratory Sound Absorption Coefficient Measurement for Laboratory of Noise Barrier Panels CMHI-KT-001 according to ASTM C423-02.

18. Wilson, Ihrig & Associates - Hong Kong, Limited (January 2003 – April 2003)
    Sound absorption coefficient measurement using two-microphone impedance tube – B&K Type 4206 including sample preparation for KCRC West Rail.

19. Entasis Limited (May 2003)
    Laboratory sound absorption test for one roof panel and one wall panel according to ASTM C423.

## On-site Sound Insulation Measurement

1. Ever Construction Co. Ltd.
   Field Noise Reduction Measurement of Curtain Wall at 158-160 Waterloo Road according to ASTM E336 and ASTM E413.

2. Builders Federal (Hong Kong) Ltd.
Field Sound Transmission Class Measurement at Conrad Hotel Ball Room LL4 according to ASTM E336 and ASTM E413.

3. Flexible Space Systems Ltd.
Field Noise Isolation Class Measurement of Partition at Olympic Station HSBC Center according to ASTM E336 and ASTM E413.

4. Builders Federal (Hong Kong) Ltd.
Field Sound Transmission Class Measurement for Party Wall at CityPlaza according to ASTM E336 and ASTM E413.

5. Kelly Construction Co. Ltd.
Field Sound Transmission Class Measurement for Party Wall at CityPlaza according to ASTM E336 and ASTM E413

6. Tak Woo Hong Kong Engineering Ltd. (2001)
Field Sound Transmission Class Measurement for Acoustic Door at CityPlaza according to ASTM E336 and ASTM E413

7. Golden Eon Engineering Ltd. (2001)
Field Sound Reduction Index Measurement for Aluminium Window at Regal Airport Hotel according to ISO140-4.

8. Eurasia Architectural Products Ltd. ( April 2002)
Field Noise Isolation Class Measurement for Operable Partition at Hong Kong Sanatorium & Hospital according to ASTM E336 "Measurement of Airborne Sound Insulation in Buildings".

9. Sellmax Limited ( April 2002)
Field Noise Isolation Class Measurement for Partition Systems at Penthouse at Headquarters Building of Hang Seng Bank according to ASTM E336 "Measurement of Airborne Sound Insulation in Buildings".

10. Eurasia Architectural Products Ltd. (May 2002)
Field Noise Isolation Class Measurement for Moveable Partition Systems HKCEC according to ASTM E336 "Measurement of Airborne Sound Insulation in Buildings".

11. Entasis Ltd. (September 2002)
Field Noise Isolation Class Measurement for Moveable Partition Systems HKCEC according to ASTM E336 "Measurement of Airborne Sound Insulation in Buildings".

12. Getstar Builmat Limited (December 2002)
Noise Isolation Class for Operable Partition according to ASTM E336 "Measurement of Airborne Sound Insulation in Buildings".

## On-site Room Acoustics (Reverberation Times) Measurement

1. Jetway Engineering Limited (April 2002)
Field Reverberation Time Measurement inside the Swimming Pool, Homantin Government Building.

2. CH2M Hill (China) Limited (November 2002)
   Field Reverberation Time Measurement inside the Public Transport Interchange (PTI) Areas

3. Andermax (Hong Kong) Limited (February 2003)
   Field Reverberation Time Measurement inside the Canteen and Hall of PLK Siu Hon-Sum Primary School.

4. Pyrok Industries Limited (August 2002)
   Field Reverberation Time Measurement inside inside the Public Transport Interchange (PTI) Areas for MTRC TKO Extension.

5. Chevalier (Construction) Company Limited (May 2003)
   HOKLAS accredited field decay rates and room absorptions for ASD Contract No. SSK338 – The Construction of a Primary School in Lam Tin Estate Redevelopment.

## Acoustic and Vibration Assessment

1. Ecotech Pacific Limited
   Acoustic absorption calculation for KCRC Tai Wai Station.

2. EHS Consultants Limited
   Aircraft Noise Assessment for Government Flying Service Headquarters.

3. Chevalier Biwater Joint Venture
   Noise control for upgrading of Existing Pumping Station.

4. Nestle Dairy Farm Hong Kong Limited
   Assessment of Noise Exposure according to Factories and Industrial Undertakings (Noise at Work) Regulation.

5. Hong Kong Convention and Exhibition Centre
   Assessment of Noise Exposure according to Factories and Industrial Undertakings (Noise at Work) Regulation.

6. Ming Fai Screw Factory (2001)
   Assessment of Noise Exposure according to Factories and Industrial Undertakings (Noise at Work) Regulation.

7. Sino Estates Management Limited
   Night-time Noise and Vibration Measurement at Grand Dynasty View

8. Constructional Systems Limited
   Railway Noise Monitoring at Fo Tan

9. Nature and Technologies Ltd.
   Baseline Noise Monitoring in Hong Kong

10. Hong Kong Society for the Protection of Children
    Noise monitoring for the events in Hong Kong Victoria Park

11. Urban Services Department
    Noise monitoring for the events in Hong Kong Stadium

12. Hong Kong Tourist Association
    Noise monitoring for the events in Tamar Site, Central

13. EHS Consultants Limited
    - Ma Wan Succession Noise Measurement
    - Airport Railway noise survey at Ma Wan

14. ELAN Atkins China Ltd.
    Noise and vibration measurements along Kwun Tong MTR Line.

15. Shaw, Ng & Ma Solicitors and Notaries
    Noise and Vibration Measurement at Room 4, 23/F Block C, Dragon Court.

16. Hyder Environmental Consultants Limited
    Traffic noise monitoring and assessment of effectiveness of road resurfacing.

17. Mouchel Asia Limited
    Study of traffic management schemes for noise mitigation.

18. Environmental Protection Department (1999)
    Baseline Noise Monitoring in Hong Kong

19. Green Valley Landfill Ltd.
    On-site Noise Measurement of Compressor according to CAP. 400 Noise Control (Air Compressors) Regulations.

20. Lam Geotechnics Ltd.
    Baseline Noise and Air Monitoring at Penny's Bay.

21. Industrial Acoustics Co. Ltd. (2000)
    On-site Noise and Vibration Measurement at Hong Kong International Trade & Exhibition Centre.

22. Allied Environmental Consultants Ltd. (2000)
    Baseline Noise Monitoring in Hong Kong

23. Hsing Chong Construction Co. Ltd. (2000)
    On-site Vibration Measurement of Chiller Room in Housing Department Wang Tau Hom Phase 14.

24. Shen Milsom & Wilke Ltd. (2000 – 2001)
    On-site Vibration Measurement for Chiller Pump in Sheraton (H.K.) Hotel.

25. Leisure and Cultural Services Department (2000)
    Noise monitoring for the events in Hong Kong Stadium

26. Dr. C. F. Ng c/o The Hong Kong Polytechnic University (2000)
On site vibration measurement for the project of West Kowloon Drainage Improvement – Stage 2 Kai Tak Transfer Scheme.

27. The Creator Audio-Visual Production Ltd. (2001)
Noise Monitoring for the events at Kai Tak Ex-Airport.

28. Environmental Protection Department (2001-2002)
Traffic Noise Measurements in Hong Kong

29. The Hong Kong and China Gas Co. Ltd. (2001-2002)
On-site Noise Measurement of Air Compressor according to CAP. 400 Noise Control (Air Compressors) Regulations.

30. Fu Wing Motor Co. Ltd (September 2002)
Vehicle Noise Emission Test

31. DHL International (HK) Ltd. (September 2002)
Yearly warehouse noise checking 2002

32. The Creator Audio-Visual Production Ltd. (October 2002)
On-site Noise Measurement at Victoria Park

33. Tak Cheong (Yau Kee) Enterprise Limited (November 2002)
Measurement of Insertion Difference for Telephone Booth in the Reverberation Chamber.

34. EL SHADDAI Prayer Partners Foundation Int'l Ltd (December 2002)
On-site Noise Monitoring at HK Stadium

35. Environmental Protection Department (December 2002 – May 2003)
Carried out structural borne noise and vibration measurement for the West Kowloon Drainage Improvement Works – Kai Tak Transfer Scheme.

36. CH2M Hill (China) Limited (January 2003)
Industrial Noise Measurement for Ap Lei Chau Boatyards Operation

37. Engineering Impact Limited (January 2003)
Noise Monitoring at HK Stadium

38. Environmental Protection Department (January 2003 – March 2003)
Noise Assessment and Digital Video Shooting with Different Types of Construction Activities.

39. Leisure and Cultural Services Department (May 2003)
Noise Monitoring for Hong Kong Performing Artistes Guild – 1:99 Concert.

## Acoustic Consultancy

1. Intertek Testing Services
Design and build an anechoic chamber according ISO 3746 for toy sound power level testing.

2. New Macau Legislative Assembly Building (1999)
   Acoustic consultant for the whole building includes lobby, main hall, theater and S.I. booth.

3. Eastwell Expresswin Co. Ltd. (2001)
   Engineering Estimation of Sound Insulation Performance of "Dost" Partition Systems.

4. Hong Kong Aero Engine Services Limited (HAESL) (2001)
   Design and build of acoustical wall lining for noisy workshops - Fan Blade Rework Cell and Vibratory Trough Room.

5. Sellmax Limited (2001-2002)
   Engineering Estimation of Sound Absorption Coefficient for two modified acoustical wall panels.

6. Jeb Greater China Limited(April 2003)
   Design of double glazing system to meet sound insulation requirement of STC 50.

7. David Decoration Limited(July 2003 – October 2003)
   Acoustics consultancy for HKMA relocation to International Finance Centre Two.

## Sound Power and Sound Pressure Measurement

1. Newton Power Ltd.
   Sound Pressure Level Measurement for two Power Supply Fans in free field condition.

2. Matsushita Seiko Co. Ltd.
   Sound Pressure Level Measurement for Rangehoods Products according to MSK-T-2110.

3. Electrical Core and Motor Manufacturing Ltd.
   FFT Sound Pressure Measurement for three Air Conditioner Motors.

4. Allied Environmental Consultants Ltd.
   Sound Power Measurement for three Vibrating Piling Hammers in accordance with BS 4196:Part4: 1981.

5. Litecraft Electrical & Metal Mfg. Ltd.
   Sound Power Measurement for air handling fluorescent luminaire in accordance with BS 5750.

6. Builders Federal (Hong Kong) Ltd.
   Sound Power Level Testing for a standard fan noise source in accordance with ISO 3740.

7. Melchers (H.K.) Ltd.
   Sound Pressure Level Measurement for hand held stirrer in free field condition.

8. Tack Cheung Plastic Manufactory Ltd.
   Frequency spectrum measurement for Musical Device in free field condition.

9. PI Electronic (H.K.) Ltd.
   Sound Pressure Level Measurement for Power Supply Unit in free field condition.

10. Computime Limited (2001)
    Sound Power Level Measurement for Fans in acoustic chamber.

11. Litecraft Electrical & Metal Mfg. Ltd. (August 2002)
    Sound Power Measurement for air handling fluorescent luminaire in accordance with ASHRAE Standard 70-1991.

12. Igarashi Electric Works (H.K.) Limited (August 2002)
    Sound Power Level Measurement for three Dc motors in the full-acoustic chamber.

13. Ansen Electronics Company (December 2002)
    Sound Power Level Measurement for Ultrasonic Transducer in Semi-anechoic Chamber.

## Room Acoustics Simulation Modeling

1. The Hong Kong Polytechnic University. (2000)
   Room acoustics modeling using a 3 dimensional room acoustics computer program, ODEON.

2. Sellmax Limited (2000 – 2001)
   Room acoustics modeling using a 3 dimensional room acoustics computer program, ODEON for Assembly Hall of Primary and Secondary School in Hong Kong.

3. ANDERMAX (HK) Limited (2001 – 2002)
   Room acoustics design and modeling using a 3 dimensional room acoustics computer program, ODEON for Assembly Hall Classroom of Primary and Secondary School in Hong Kong.

4. ANDERMAX (HK) Limited (2001 – 2002)
   Room acoustics design and modeling using a 3 dimensional room acoustics computer program, ODEON for Lecture Theatre of Hong Kong Police Headquarter.

5. City University of Hong Kong (2001 – 2002)
   Architectural acoustics modeling using a 3 dimensional room acoustics computer program, ODEON for acoustical balcony design.

## Air Flow and Characteristic Measurement

1. General Electric Company of Hong Kong
   Pressure Drop, Throw and Sound Power Level Measurement according to ASHARE 70-1991.

2. Tamglass Far East Ltd.
   Compressed Air Moisture Content and Oil Content Measurement.

3. New Scientific Trading Co. Ltd.
   Air outlets testing for four types of diffusers with ten different sizes according to ASHARE 70-1991.

4. Arup Acoustics
   Total Suspended Solid (TSP) Monitoring in Sheraton Hotel.

5. Thorn Lighting (Hong Kong) Ltd. (2000)
   Air Flow measurement for air handling fluorescent luminaire.

6. Shinryo (Hong Kong) Ltd. (2000)
   Static Pressure Measurement for Air Duct Damper for TKO, MTR

7. Wysermann Co. Ltd. (2000)
   Static Pressure Measurement for Air Duct Damper.

8. Shinryo (Hong Kong) Ltd. 11 Chater Road Project Office (2001)
   Laboratory Measurement of Flow and Acoustic Performance of Air Valves for 11 Chater Road project.

9. Litecraft Electrical & Metal Mfg. Ltd. (August 2002)
   Airflow, Pressure Drop and Throw Measurement for air handling fluorescent luminaire in accordance with ASHRAE Standard 70-1991.

**Indoor Air Quality Measurement**

1. RoboClean (Hong Kong) Co. Ltd. (1999-2000)
   Indoor Air Quality measurement for Immigration Tower, Central Government Office, Trade Department Tower, Prince Dental Hospital and Lam Tin Policlinic.

2. DahSing Bank Ltd. (2000)
   Indoor Air Quality measurement at DahSing Financial Center, Mong Kok Bills Center, San Po Kong Branch and Kwun Tong Branch.

3. ASAT Ltd. (2000)
   Indoor Air Quality Assessment for QPL Industrial Building in Tsuen Wan.

4. Info Stream Indoor Air Quality Ltd. (2000)
   Indoor Air Quality measurement at Shatin Sewage Treatment Work.

5. Alfa Environmental Services Co. (2000)
   Yeast and Mould Count measurement at Island Tower in Hong Kong.

6. Nature and Technologies Ltd. (2000)
   Radon measurement at 23 Horizon Drive, Chung Hom Kok, Hong Kong.

7. ENSR International, Inc. (2000)
   TVOC measurement at No. 8 Lei Yue Mun Road Oil Station.

8. CMA Testing Certification Laboratories (April & October 2001)
   TVOC and Radon measurement at Concordia Plaza, No.1 Science Museum Road, Tsimshatsui.

9. Info Stream Indoor Air Quality Ltd. (May 2001)
   Carbon Monoxide, Respirable Suspended Particulates, Total Volatile Organic Compounds,

Radon, Airborne Bacteria, Room Temperature, Relative Humidity and Air Movement measurement at Industrial Center, The Hong Kong Polytechnic University, Kowloon, Hong Kong.

10. Homecare Specialty Ltd. (August 2001)
Airborne Bacteria Count using Swab Kit and RSP measurement at The Kau Yan School, Sai Wan, Hong Kong.

11. Homecare Specialty Ltd. (August 2001)
Airborne Bacteria, CO2 and RSP measurement at The Foreign Correspondents Club, Central, Hong Kong

12. Steamatic Technologies (HK) Ltd. (August 2001)
Airborne Bacteria, CO2 and Ozone measurement at CLP Engineering, Kwai Chung, New Territories, Hong Kong.

13. Homecare Specialty Ltd. (August 2001)
Airborne Bacteria Count using Swab Kit and CO2 measurement at The Neighbourhood Advice Action Council Yuen Long Day Nursery, Yuen Long, N.T.

14. Homecare Specialty Ltd. (August 2001)
Airborne Bacteria and CO2 and Room Temperature measurement at Vogue Laundry Service Ltd., Tuen Mun, N.T., H.K.

15. Homecare Specialty Ltd. (September 2001)
Airborne Bacteria, CO2 and RSP measurement at G-2000 Head Office, Kwai Chung, New Territories, Hong Kong

16. Homecare Specialty Ltd. (November 2001)
Airborne Bacteria, CO2 and RSP measurement at Superterminal I, Hong Kong Int'l Airport

17. Homecare Specialty Ltd. (November & December 2001)
Airborne Bacteria, CO2, TVOC, Formaldehyde and Ozone concentration measurement at U-FREIGHT LIMITED, Kowloon, Hong Kong.

18. Homecare Specialty Ltd. (December 2001)
Airborne Bacteria, CO2 and RSP measurement at Eternal Way Ltd., Wan Chai, Hong Kong.

19. Homecare Specialty Ltd. (January 2002)
Airborne Bacteria, CO2 and RSP measurement at Just Gold (Head Office), North Point, Hong Kong

20. Homecare Specialty Ltd. (January 2002)
Airborne Bacteria, CO2 and RSP measurement at United Dragon Ltd., Tuen Mun.

21. Homecare Specialty Ltd. (August 2001 & February 2002)
Airborne Bacteria, CO2 and RSP measurement at Tsuen Wan Adventist Hospital, Tsuen Wan, N.T.

22. Steamatic Technologies (HK) Ltd. (February 2002)
Airborne Bacteria and Yeast & Mould measurement at Lever Shirt G. W. B. & D. Factory Limited., Kwun Tong, Kowloon.

23. Homecare Specialty Ltd. (March 2002)
Airborne Bacteria, CO2 and RSP measurement at Lee Kum Kee Tai Po Factory, Tai Po, N.T..

24. Homecare Specialty Ltd. (March 2002)
Airborne Bacteria, CO2 and RSP measurement at Clarins Ltd., Kwun Tong, Kowloon.

25. City University of Hong Kong. (May 2002)
Nitrogen Dioxide measurement at United Christian Hospital, Kowloon, Hong Kong.

26. City University of Hong Kong. (May 2002)
Nitrogen Dioxide measurement at Alice Ho Miu Ling Nethersole Hospital, Kowloon, Hong Kong.

27. City University of Hong Kong. (May 2002)
Nitrogen Dioxide measurement at Our Lady of Maryknoll Hospital, Kowloon, Hong Kong.

28. City University of Hong Kong. (June 2002)
Nitrogen Dioxide measurement at Princess Margeret Hospital, Kowloon, Hong Kong.

29. EHTO (Hong Kong) Ltd. (June 2002)
Airborne Bacteria and RSP measurement at Shun Tak Fraternal Association, Cheung Yu Tung Secondary School, TKO.

30. CY Services Co. (June 2002)
Airborne Bacteria, CO2 and RSP measurement at Vitasoy International Holdings Ltd., Tuen Mun, N.T..

31. CY Services Co. (June 2002)
Airborne Bacteria, CO2 and RSP measurement at CLP Power, Black Point Power Station.

32. CY Services Co. (July 2002)
Airborne Bacteria, CO2 and RSP measurement at Allan International Holdings Ltd., Quarry Bay, Hong Kong.

33. Steamatic Technology (HK) Ltd.. (July 2002)
Airborne Bacteria and Yeast and Mould Measurement at Matilda & War Memorial Hospital, Peak Level, Hong Kong.

34. CY Services Co. (July 2002)
Airborne Bacteria, CO2 and RSP measurement at K and P International Holdings Ltd., Kwai Chung.

35. City University of Hong Kong. (July 2002)
Nitrogen Dioxide measurement at Caritas Medical Centre, Kowloon, Hong Kong.

36. CY Services Co. (July 2002)
Airborne Bacteria, Yeast and Mould, CO, CO2, Room Temperature and Humidity measurement at Adidas-Salomon International Souring Ltd., Tsim Sha Tsui, Kowloon.

37. Homecare Specialty Ltd. (September 2002)
Airborne Bacteria, CO2 and RSP measurement at Pearson Education North Asia Limited, Quarry Bay, Hong Kong.

38. Homecare Specialty Ltd. (September 2002)
Airborne Bacteria, CO2 and RSP measurement at OKIA OPTICAL Co. Ltd., Cheung Sha Wan, Kowloon, Hong Kong.

39. CY Services Co. (October 2002)
Airborne Bacteria, CO2 and RSP measurement at Epson Precision (HK) Ltd., Kwai Chung, N.T..

40. Steamatic Technology (HK) Ltd. (December 2002)
Airborne Bacteria, CO2 and RSP measurement at Flynt International Forwarders Ltd., Tokawan, Kowloon, Hong Kong.

41. Homecare Specialty Ltd. (November 2002)
Airborne Bacteria, CO2 and RSP measurement at Mok Law Sui Wah Memorial Sheltered Workshop, Wah Kwai Estate, Aberdeen.

42. Homecare Specialty Ltd. (January 2003)
Airborne Bacteria, CO2 and RSP measurement at Leimen Enterprise Limited, Wah Wai Industrial Building, Wo Heung Street, Fotan.

43. Homecare Specialty Ltd. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Joint Publishing (Hong Kong) Co., Ltd., Tusen Wan Industrial Center, Tsuen Wan.

44. Homecare Specialty Ltd. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Lai's Knitwear manufacture Limited, Wing Shing Industrial Building, Ng Fong Street, San Po Kong.

45. CY Services Co. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Epson Precision (H.K.) Ltd., Vanta Industrial Center, Tai Lin Pai Road, Kwai Chung.

46. CY Services Co. (April 2003)
Airborne Bacteria, CO2, RSP, TVOC and Radon measurement at Epson Precision (H.K.) Ltd., Ying Tung Industrial Building, Lai Chi Kok Road, Kowloon.

47. Homecare Specialty Ltd. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Texwood International Ltd., How Ming Street, Kowloon Bay.

48. Homecare Specialty Ltd. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Tungtex Trading Co. Ltd., Tungtex Building, Wai Yip Street, Kwun Tong.

49. Homecare Specialty Ltd. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Tat's Carin Tunnel, Siu Lek Yuen, Shatin.

50. Homecare Specialty Ltd. (April 2003)
Airborne Bacteria, CO2 and RSP measurement at Smart Shirts Manufacturers Limited, King Yip Street, Kwun Tong.

51. Homecare Specialty Ltd. (April 2003)
    Airborne Bacteria, CO2 and RSP measurement at Fong Shu Chuen District Elderly Community Center, Shau Kei Wan, Hong Kong.

52. Equity Marketing Hong Kong Limited (April 2003)
    Full IAQ measurement at Equity Marketing Hong Kong Limited at China Hong Kong City, Canton Road, Kowloon.

53. Homecare Specialty Ltd. (May 2003)
    Airborne Bacteria, CO2 and RSP measurement at Migros (Hong Kong) Ltd., China Hong Kong City, Canton Road, Kowloon.

54. Carrier Hong Kong Limited (May 2003)
    Airborne Bacteria measurement at Hong Kong International Airport.