Successful Noise Control Cases 2001

MINISTRY OF MANPOWER

SUCCESSFUL CASES OF NOISE CONTROL

2001

OCCUPATIONAL SAFETY AND HEALTH DIVISION

MINISTRY OF MANPOWER

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Foreword

Noise induced deafness (NID) is the most prevalent occupational disease in Singapore. The best way to prevent NID is to eliminate the risk of exposure to noise at its source. However, those who encounter noise problems at work often face a daunting task in controlling noise by engineering means. Although keen to take measures to reduce noise exposure, people in the industry are at times unsure of the best way to deal with what may be a common industrial problem.

The compilation of successful cases of noise control in this publication is intended to illustrate solutions which have been found by some local companies to tackle their noise problems. The methods illustrated have proved to be effective in practice, and the benefits from the expenditure are considered worthwhile by the companies.

These documented cases do not provide detailed design information on noise control but they show some viable measures that have been employed in noise control. The principles or methods established for one industry may also be applicable to other industries.

The Occupational Safety and Health Division will continue to compile successful cases of noise control and disseminate such information to those who need it.

Dr Phoon Wai Hoong
Director
Occupational Safety and Health Division

Introduction

The more enlightened employers are willing to take measures to control noise and to safeguard their employees' hearing against the noise hazard. However, lack of knowledge in engineering noise control may at times render their efforts ineffective.

This publication provides some information on successful noise control measures that have been implemented in local factories. Photographs and brief notes on application of noise control techniques are provided wherever available to give a better understanding of engineering noise control.

This compilation of noise control cases is intended to be used as a guide only. Its purpose is merely to highlight the achievements that can result from the application of such measures. Assistance from acoustics consultants is still needed, especially in complex cases, to tailor to the needs of different noise problems.

The noise control measures featured in this publication may not be practicable in all industries and are not endorsed by the Occupational Safety and Health Division for necessarily complying with the Factories (Noise) Regulations.

Contents

Acoustical Enclosures

There have been much progress made in reducing noise at its source over the years. However, some industrial and manufacturing equipment such as power presses and grinders are still very noisy.

Acoustical enclosures are the most commonly used noise control measures in many industries. Such enclosures may be in the form of machine enclosures or even personnel enclosures. They provide excellent means for reducing noise exposure.

In constructing an acoustical enclosure, a systematic approach and careful attention to design detail is necessary. This includes determination of the transmission loss of the enclosure material based on the noise reduction required, and taking into consideration the reverberant buildup within the enclosure.

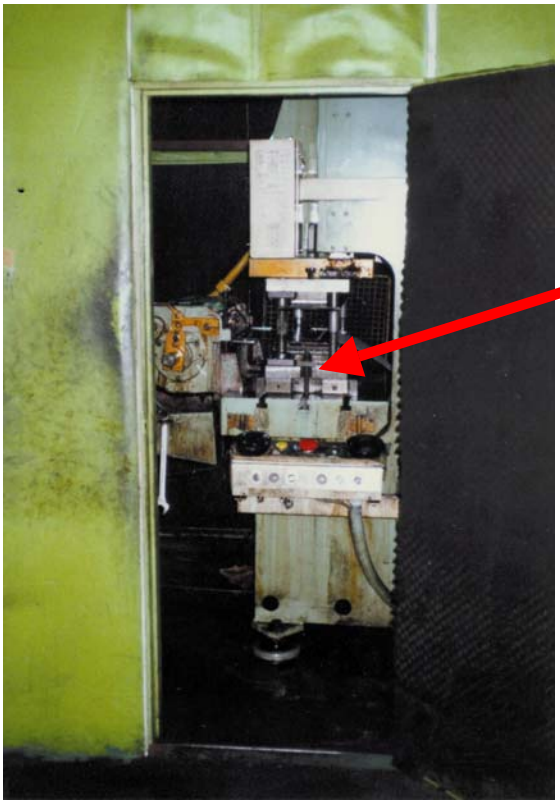
1. Total Enclosure of Perforation Machine

Problem

An automatic machine was used to perforate steel sheets. The noise produced was continuous with impact intervals at less than 1 second. The noise level was in the range of 98 to 105dBA.

Inlet of perforation machine

Outlet chute of machine



Machine housed in enclosure

Inner walls lined with acoustic materials

Solution

A total enclosure was constructed to enclose the perforating process using plastic sheet with reinforced wire mesh. The inner walls of the enclosure were lined with acoustic material, polyurethane foam. This resulted in a 20 dBA noise reduction.

Cost

About $7,000.

Results

After installation of the enclosure the noise level outside the enclosure was 80 dBA.

2. Total Enclosure for Engine Test Cabin

Problem

Noise was generated from the testing of engines and machines. The noise level measured at 1 metre away from engine under testing was 96 dBA.

Cabin for engine test runs

Solution

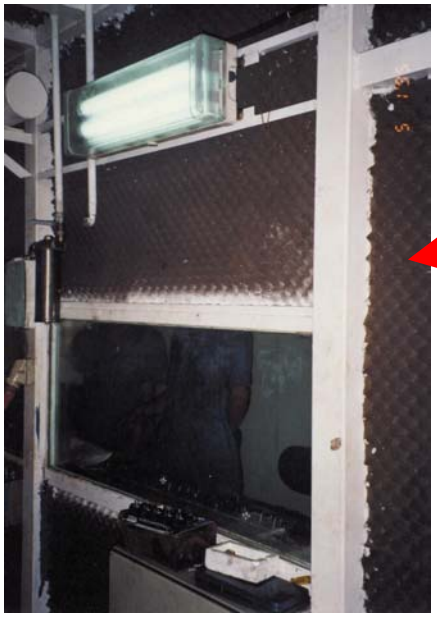
A test cabin was constructed to house the engines for testing. The cabin was constructed of sheet metals with interior surfaces lined with polyurethane foam. Exhaust ducting with silencers was provided. A control room for a technician is also integrated into the cabin.

Cost

$200,000 (inclusive of materials and construction)

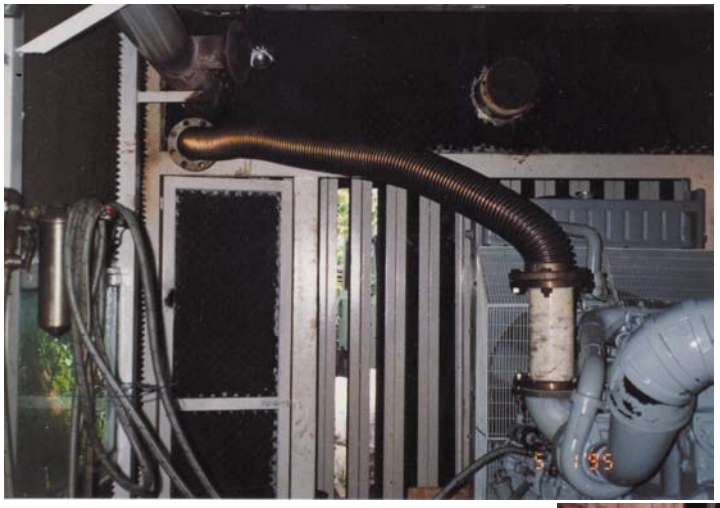
Result

The noise level in the control room was 79 dBA whilst the noise level outside the cabin is 66 dBA.

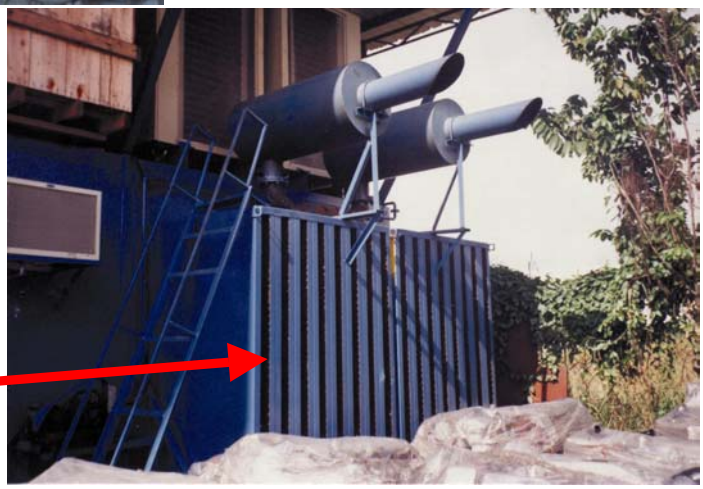


Acoustic materials (polyurethane foam)

Inner walls of test cabin



Ducting for exhaust gases

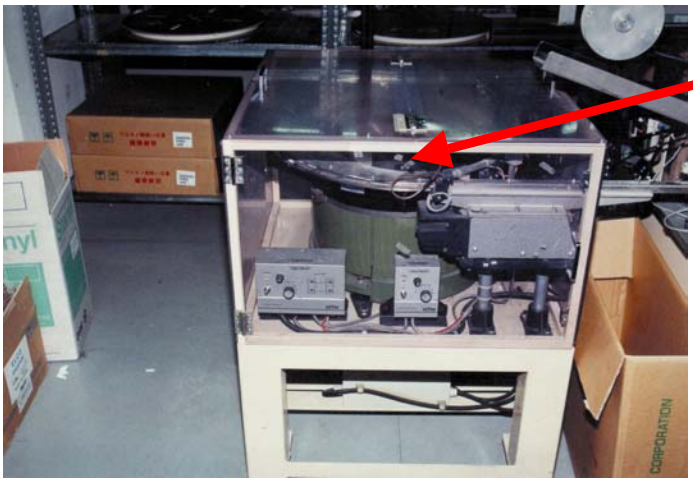


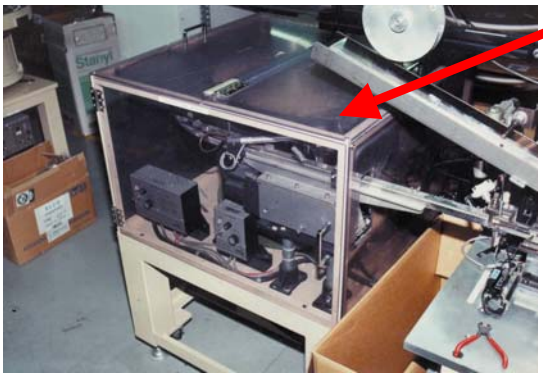
Rectangular silencer

3. Total Enclosure for Vibratory Bowl Feeder

Problem

A vibratory bowl was used for feeding electronic connectors. The vibrations from the bowl feeder generated a noise level of 93 dBA.





Solution

The vibratory bowl feeder was totally enclosed with a 3mm thick transparent PVC plastic.

Cost

Not available

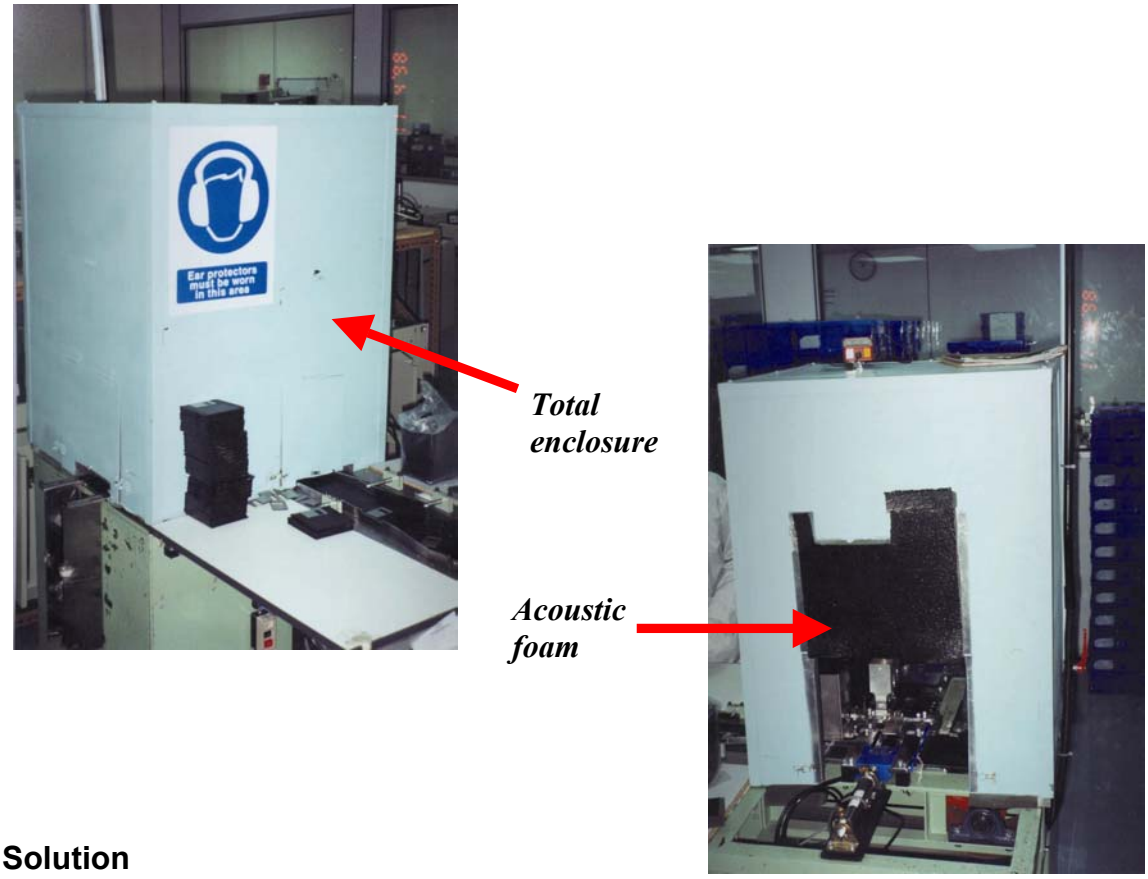
Result

The noise level was measured to be 77 dBA outside the enclosure. This is a reduction of 16 dBA.

4. Total Enclosure for Ultrasonic Welding Machine

Problem

A noise level of 120 dBA was generated by an ultrasonic welding machine used to seal diskettes.



Solution

The ultrasonic machine was totally enclosed within a metal panel box lined with 2.5cm thick acoustic foam.

Cost

$600 for material costs.

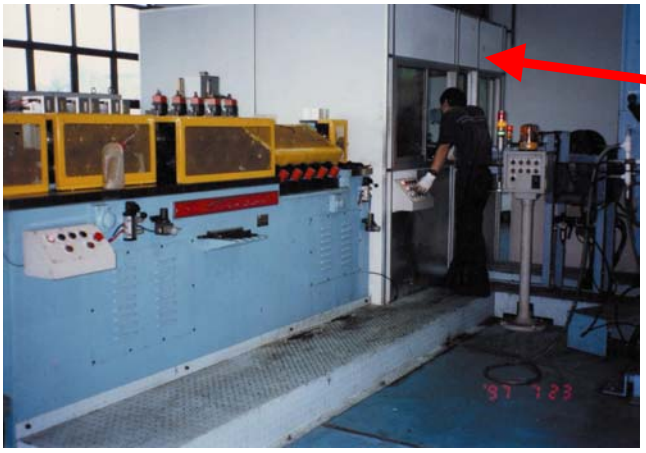
Result

The noise level was reduced by 31 dB(A).

5. Total Enclosure for Iron Cutting Machine

Problem

Noise is generated from the cutting and forming of iron was measured to be 93 dBA.



A worker checking on process through window

Door for easy access to machine

Solution

Part of the machine was enclosed using a 12mm gypsum board and galvanised stud with fibreglass insulation in the partition. External surface of enclosure is a 1mm galvanise sheet. A door and window were built in to facilitate easy maintenance.

Cost

$2,950

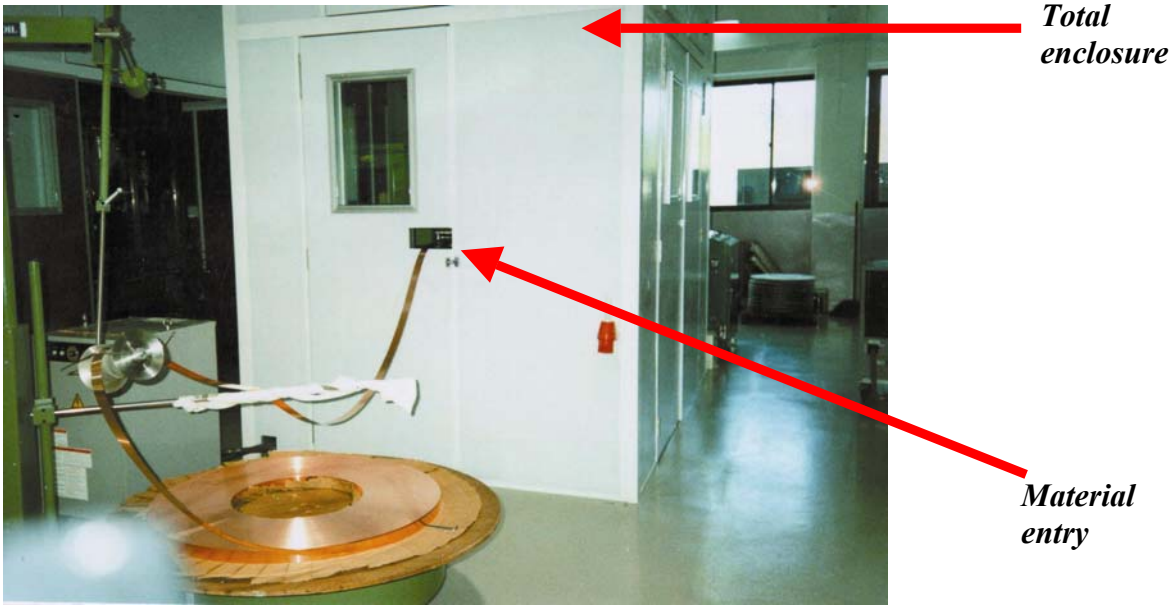
Result

A noise reduction of 7 dBA was achieved.

6. Total Enclosure for Stamping Machine

Problem

Noise level of 90 dBA was generated from a stamping machine. The process was automatic and requires minimal supervision from workers. However, the stamping machine is located in the middle of the production floor posing a noise hazard to other workers.



Solution

A total enclosure was installed for the stamping machine. Doors and windows were incorporated for easy access and production control. The enclosure was constructed of a 1.25cm thick hardboard and packed with a layer of fibreglass of 5cm in thickness.

Cost

$18,500 per enclosure.

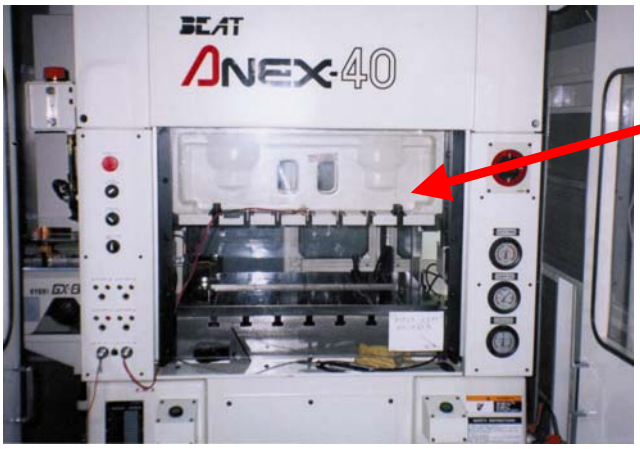
Result

A noise reduction of 10 dBA was obtained.

7. Total Enclosure for Stamping Machine

Problem

High-speed automatic stamping machines was used for making connector pins. The noise generated from the 60 ton press was 95 dBA and noise from the 40 ton press was 96 dBA.



High-speed stamping machine

Sliding doors

Solution

The stamping machines were totally enclosed with sound absorption materials on the inner walls.

Cost

$50,000 for each enclosure.

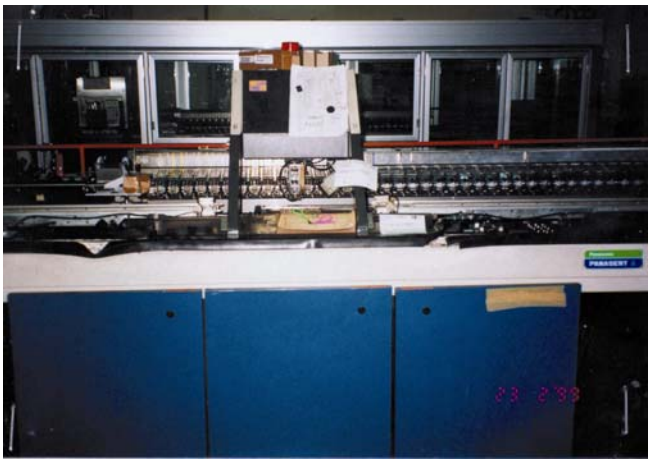
Result

Noise reduction of 16 dBA for the 60 ton Press and noise reduction of 13 dBA for the 40 ton Press.

8. Total Enclosure for Automatic Insertion Machine

Problem

Noise was generated from the automatic insertion of electronic parts. The noise level from the machine was about 85 dBA.



Auto insertion machine without enclosure

Acoustic material for ceiling of enclosure

Solution

The machine was enclosed with steel sheet. The inner walls were lined with a 30mm thick sound absorbing material. Operators access was enclosed using double-glazed glass with vacuum in between. All gaps were sealed with rubber sealant.

Machine enclosure mounted on damping material

Double-glazed glass door

Cost

Approximately $12,000

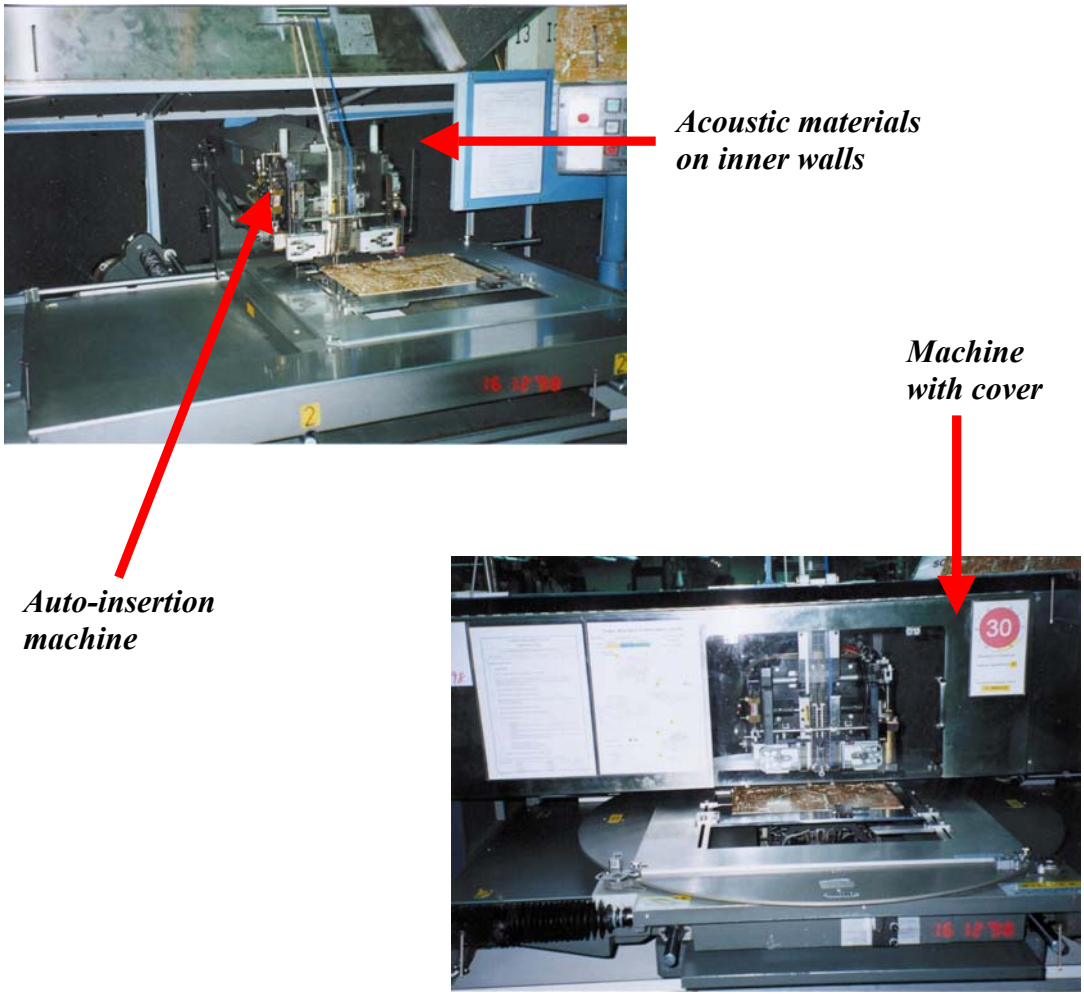
Result

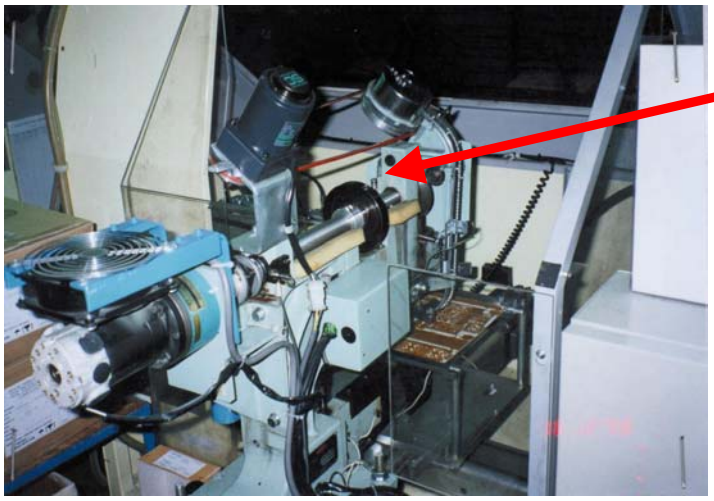
The noise levels were measure to 70 dBA after installation of enclosure. A noise reduction of 15 dBA.

9. Total Enclosure for Auto Insertion Machine

Problem

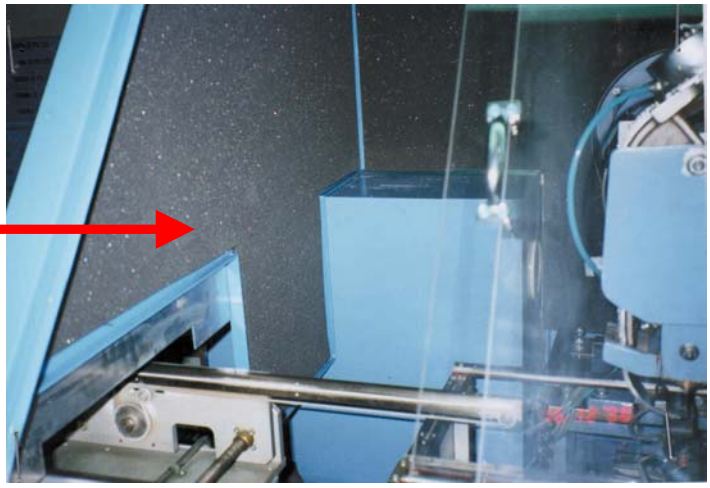
Noise was generated from the automatic insertion of electronic components onto printed circuit boards. The machines involved were the radial inserts, axial inserts and eyelet inserts. The noise level was 89 dBA.





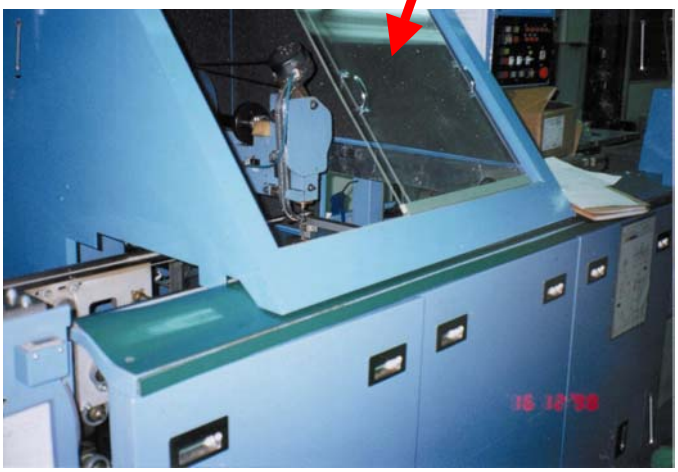
Eyelet insertion machine without cover

Acoustic material on inner walls



Total Enclosure of machine

Sliding Window for access



Solution

The automatic insertion machines were fully enclosed with acoustic absorbing materials on the inner walls. Sliding windows were installed to provide easy access for inserting tools and for monitoring.

Cost

$10,000

Result

An average noise reduction of 6 dBA was achieved on the various insertion machines.

10. Total Enclosure for Tumbling Machine

Problem

A tumbling machine was used in a foundry to break up sand moulds. Steel cubes were placed in the machine to break up the sand moulds during tumbling. The process generated excessive noise as a result of metal to metal contact between the tumbling bin and the steel cubes. The noise level was measured to be 91 dBA.

Tumbling machine

Total enclosure for machine

Solution

A total enclosure for the machine was constructed with a 5cm thick rubber padding in between.

Cost

$2,000

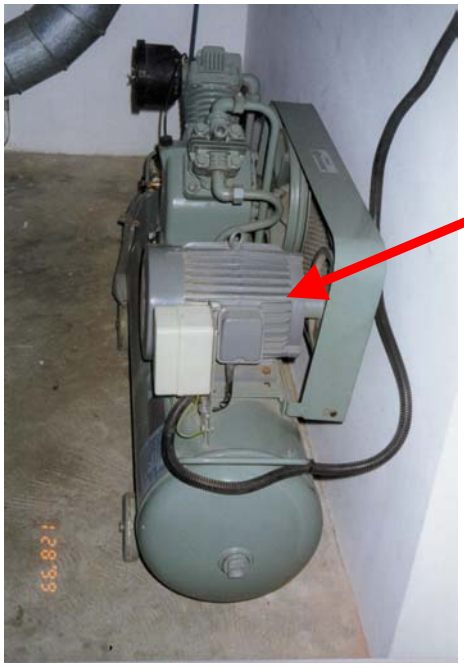
Result

A noise reduction of 11 dBA was attained.

11. Total Enclosure for Air Compressor

Problem

Noise was generated from an air compressor for a binding machine. The noise level was measured to be 86 dBA.



Air compressor

Total enclosure with exhaust vent

Solution

A total enclosure for the air compressor was installed. An exhaust vent was also built in to facilitate ventilation.

Cost

Not available

Result

A noise reduction of 8 dBA was achieved.

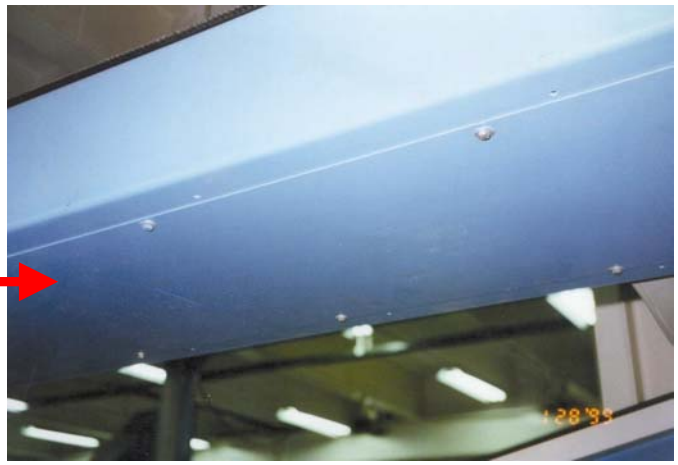
12. Total Enclosure for Conveyor Belt

Problem

An overhead conveyor belt used to transport bounded printed items emits a noise level of 82 dBA.

Exposed underside of conveyor belt

Covers to underside of conveyor belt



Solution

Metal covers were installed on the underside of the conveyor belts.

Cost

Not available

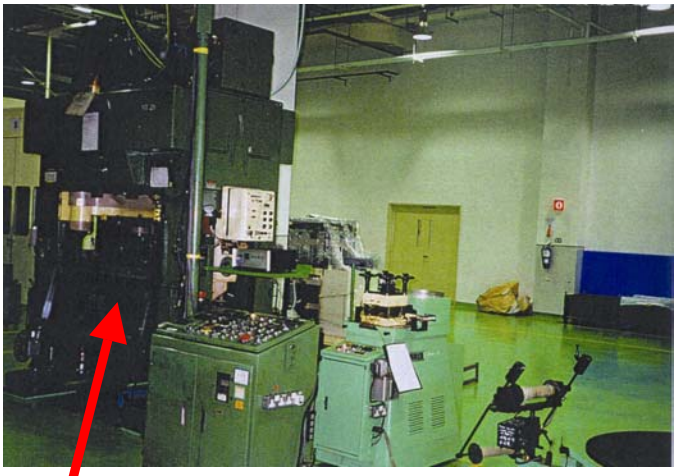
Result

A noise reduction of 7 dBA was achieved with the installation of the metal covers.

13. Total Enclosure for Stamping Machine

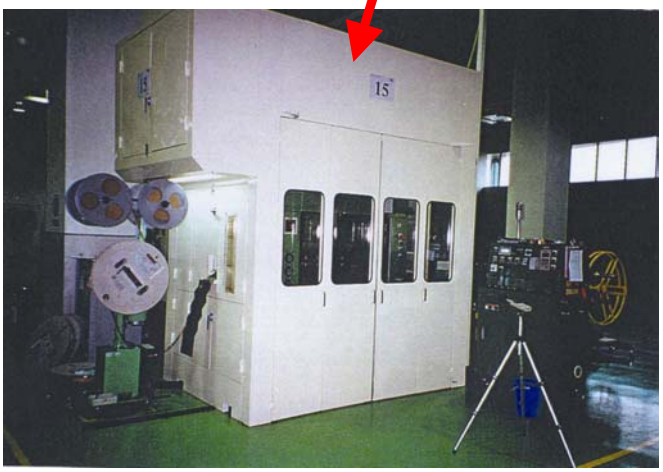
Problem

A stamping machine used for manufacturing Integrated Circuit leadframes generated a noise level of 93 dBA.



Stamping machine

Total enclosure



Solution

A total enclosure was constructed for the stamping machine.

Cost

Not available

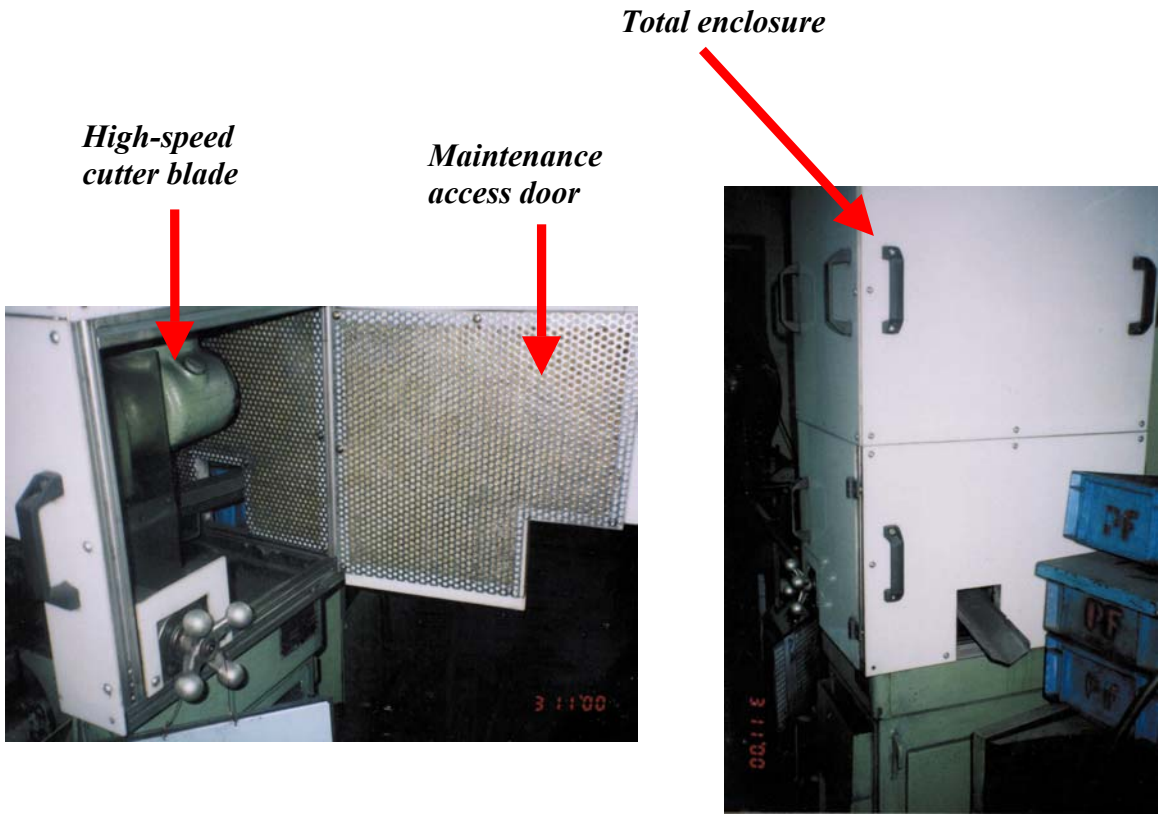
Result

An average noise reduction of 13 dBA was recorded.

14. Total Enclosure for Tube Cutting Machine

Problem

A noise level of 92 dBA was generated from the high-speed cutting of copper tubes.



Solution

The high-speed cutter blade was totally enclosed with a maintenance door for easy access. The enclosure comprises acoustic materials sandwiched between perspex sheets and perforated plates. The perforated plates are on the inner walls to prevent metallic debris from sticking onto the acoustic materials.

Cost

Not Available

Result

A noise reduction of 10 dBA was achieved from enclosing the machine.

15. Total Enclosure for Stamping Machine

Problem

A 60 ton stamping machine generated a noise level of 93 dBA.

Photograph of a high-speed reel-to-reel stamping machine.

Solution

A total enclosure of the stamping machine was installed. The unique feature incorporated into the design was the portability of enclosure. This feature allows the worker to monitor the stamping process without leaving the enclosure door open, hence reducing the noise exposure to other workers.

Enclosure door opened

Cost

Not available

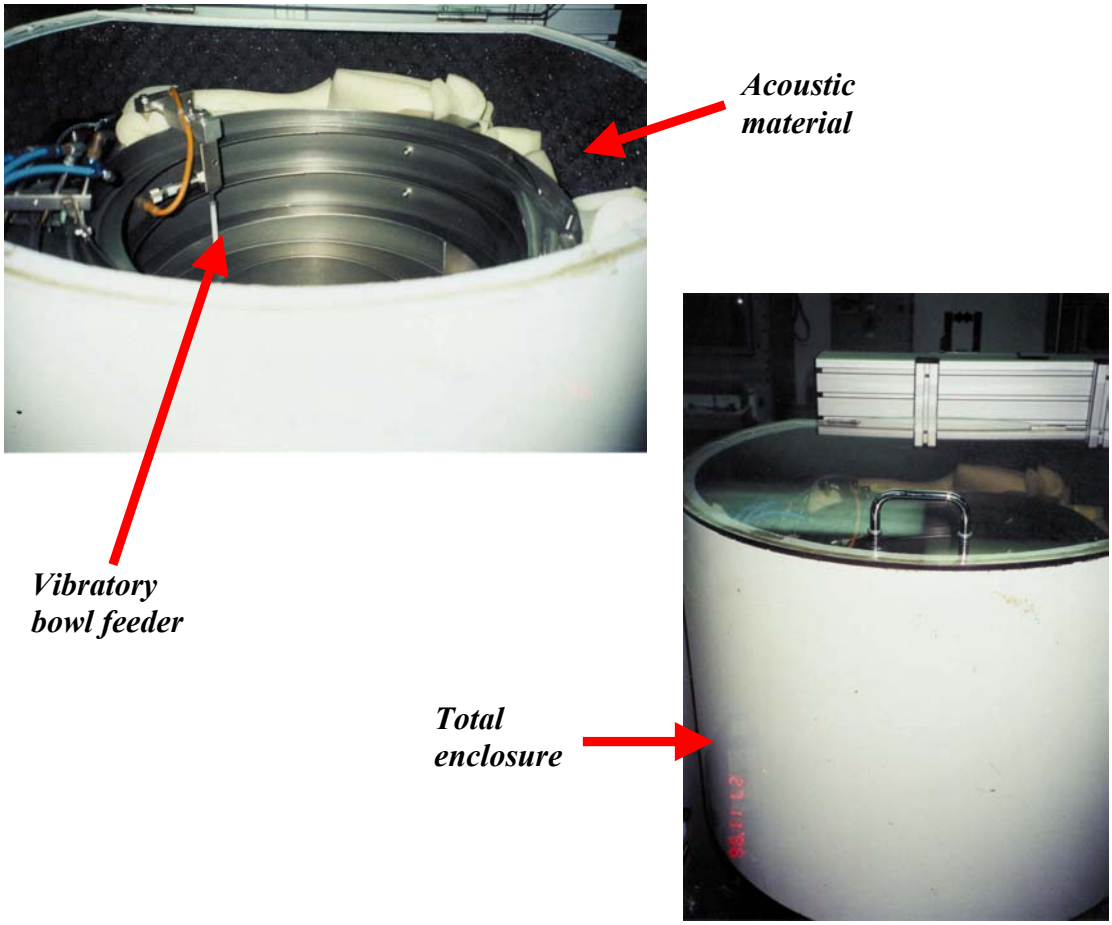
Result

A noise reduction of 15 dBA was achieved.

16. Total Enclosure for Vibratory Bowl Feeder

Problem

A vibratory bowl feeder generated a noise level of 91 dBA.



Solution

The vibratory bowl feeder was fully enclosed. The inner walls of the enclosure were lined with acoustic materials.

Cost

Not available

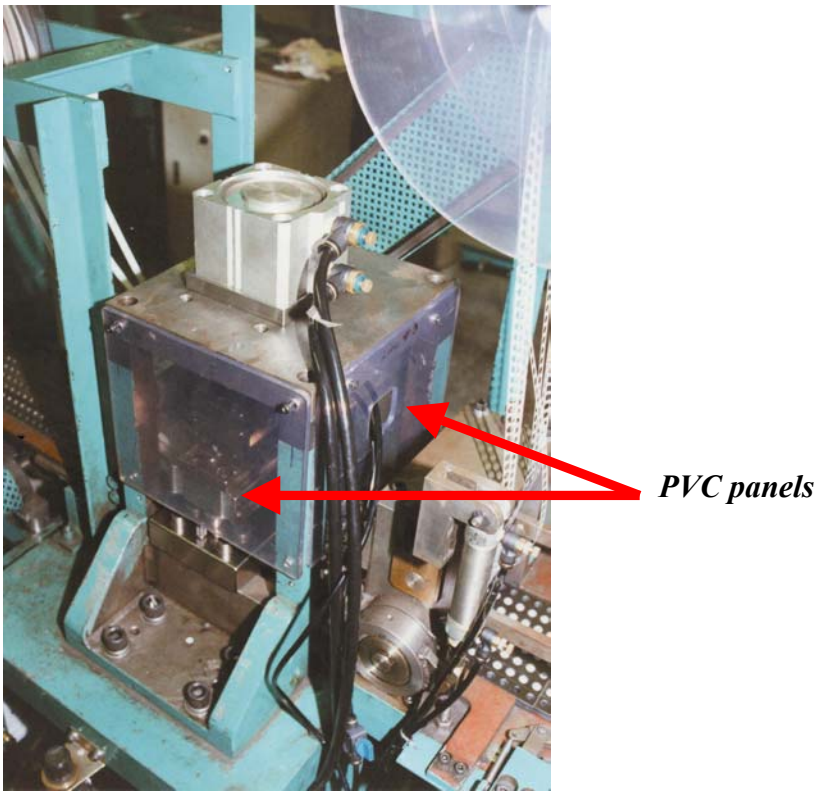
Result

Noise reduction of 12 dBA was achieved.

17. Partial Enclosure for Cell-Separator Cutting Unit

Problem

In the process of manufacturing of primary button cell a noise level of 88 dBA was generated from the cell-separator cutting unit.



Solution

The four sides of the cutting unit were partially covered with PVC panels of 4mm in thickness.

Cost

Not available

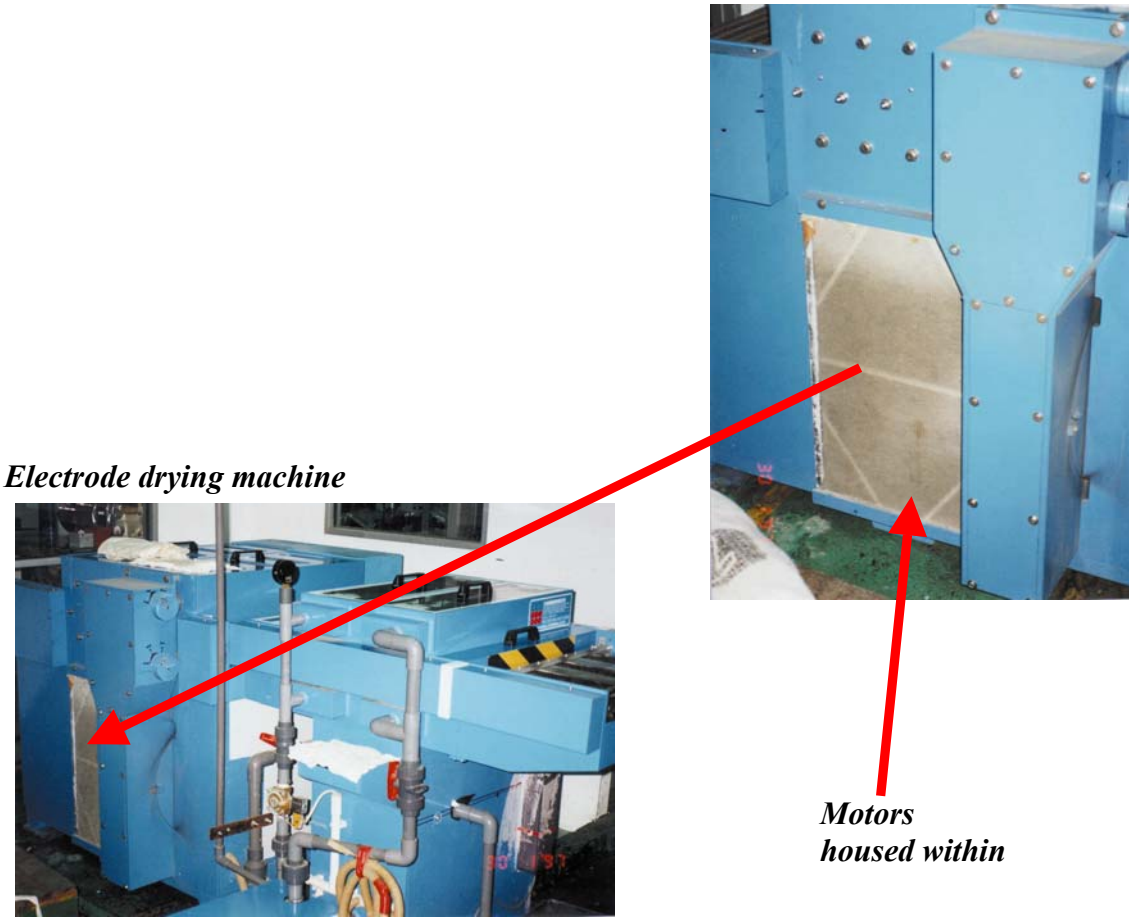
Result

A noise reduction of 5 dBA was achieved from the installation of PVC panels.

18. Partial Enclosure for Electrode Drying Machine

Problem

Noise was generated from 2 motors used to blow air onto electrodes for drying purposes. Although these motors were housed within the drying machine, the air inlets for the blowers allowed noise to leak.



Before control measure

Noise source

Enclosure

After control measure

Solution

A partial enclosure lined with acoustic material was installed at the air inlet of the blower.

Cost

$60

Result

A noise reduction of 5 dBA was achieved.

Noise Barriers

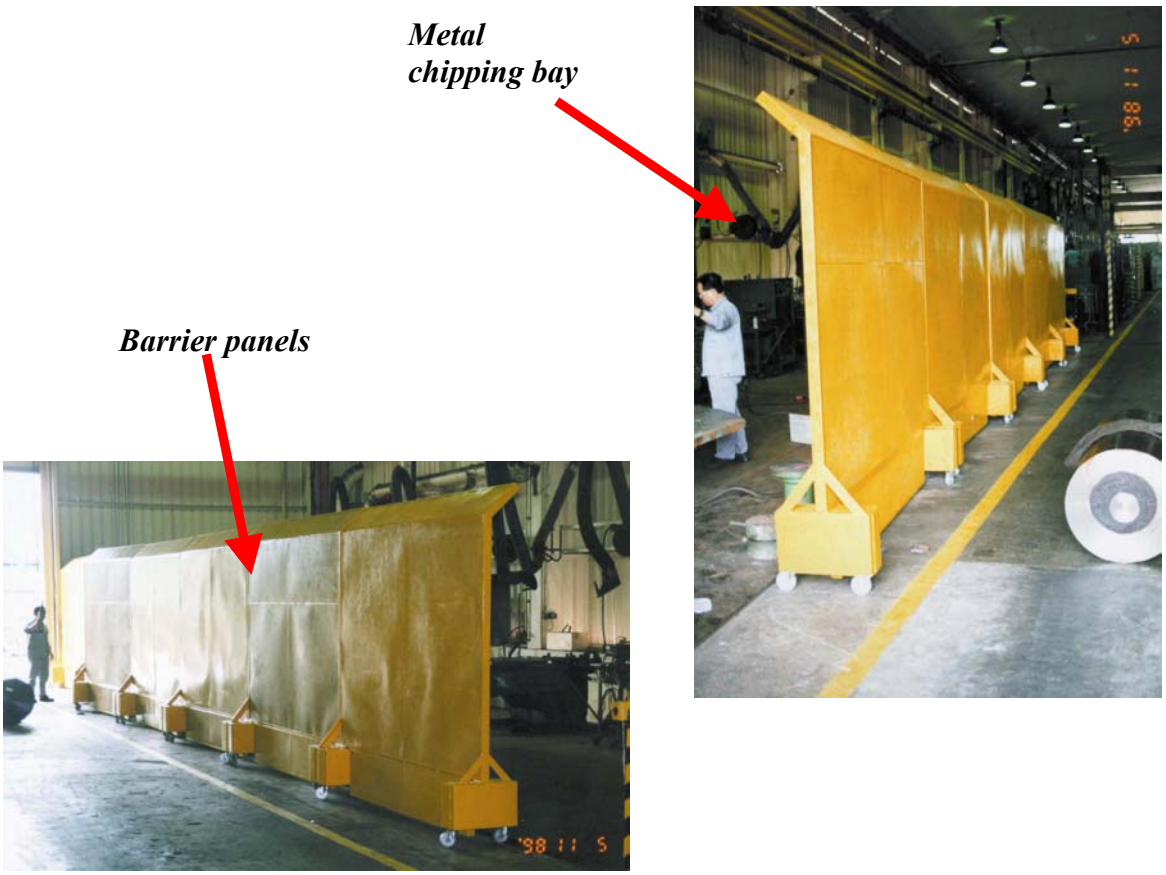
A noise barrier is a shield or a s freestanding wall used to control the transmission of air-borne noise when placed between a noise source and receivers. Barriers are used to provide acoustic shielding in cases where complete covering of machine or other noise sources would interfere with its operation.

Barriers are effective for medium and high frequency noise but less effective for not low frequency noise. The effectiveness is gradually reduced with increasing distance from the barrier.

19. Noise Barrier at Metal Chipping Bay

Problem

The metal chipping operation produced a noise level of 91.3 dBA.



Solution

6 portable barrier panels were erected around the metal chipping bay to reduce noise exposure to other workers. Each panel measured 2.5 m by 3.5 m and was made of a 50 mm thick rockwool and sandwiched between 2 perforated metal plates.

Cost

$8,400 for 6 barrier panels.

Result

The noise level measured at 1 metre away from the barrier panels was 77 dBA, indicating a noise reduction of 14 dBA.

Acoustical Curtains

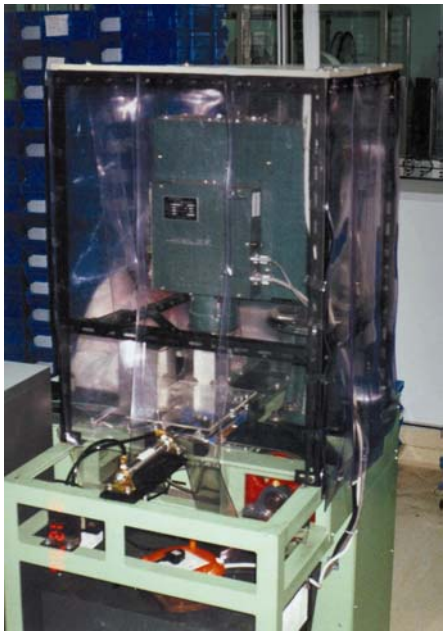
The use of acoustical curtains is rather popular in the industry. This may be attributed to its acoustical effectiveness, versatility and ease of installation. Curtain materials are usually smooth vinyls, which are limp and highly resistant to industrial environment.

Noise reduction from acoustical curtains is limited to the number of acoustical leaks and the amount of noise flanking over or under the curtain. The acoustical performance of the strip curtains increases with both thickness and overlap. However, a noise reduction of more than 10 dBA is rarely achieved.

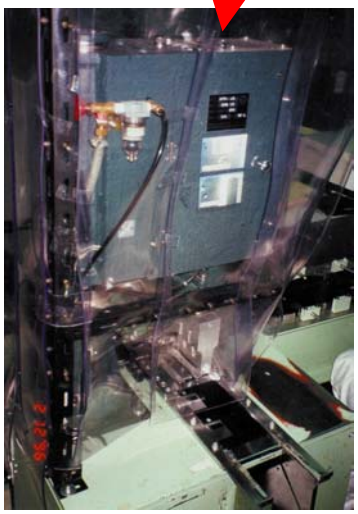
20. Acoustic Curtain for Ultrasonic Welding Machine with Parallel Baffles

Problem

A noise level of 121 dBA was generated from by an ultrasonic welding machine used to seal diskettes.



Ultrasonic welding machine



Overlapping plastic flaps

Solution

The ultrasonic welding machine was enclosed using overlapping plastic flaps of 1.5mm thickness.

Cost

$300 for metal-frames and plastic flaps

Result

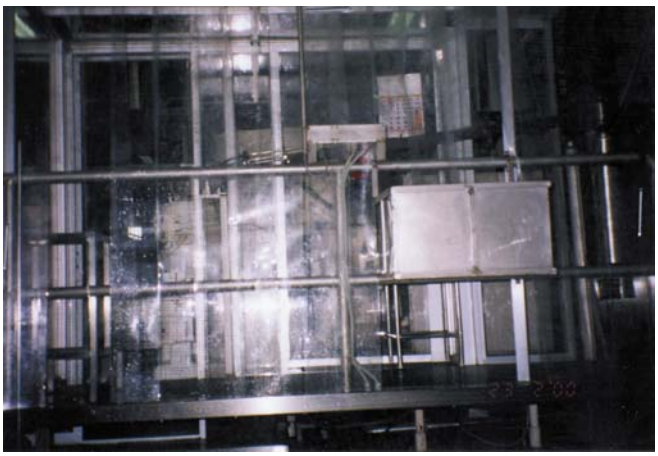
A noise reduction of 15 dBA was achieved.

21. Acoustic Curtain for Filling and Lid Seaming

Problem

Noise was generated during the filling and seaming process of drink cans. Noise level before control measure was 92 dBA.

Plastic curtain



Rear view of machine

Pathway to control booth

Sliding door of control booth

Solution

Acoustic curtains made of thick plastic sheets were used to enclose the filling and lid seaming process. Workers were isolated in a control booth.

Cost

$5,500

Result

A noise reduction of 3 dBA was achieved.

Flow Regulators

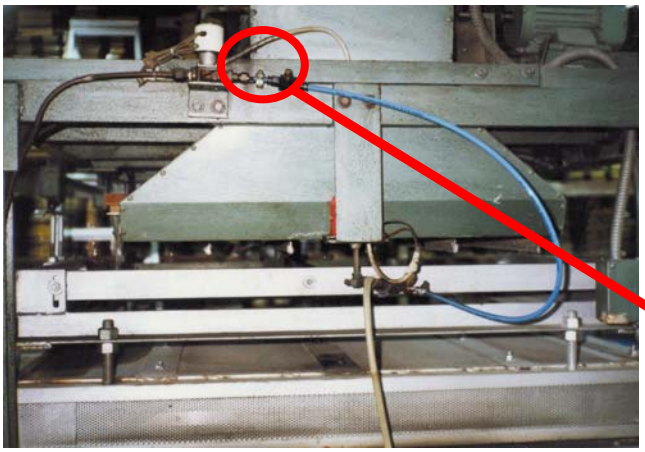
A common and troublesome noise source in industrial environment is the air jet. Examples are blow-off nozzles and pneumatic control discharge vents.

For the simple high-velocity air jet commonly used to eject parts or for cooling purposes such as air curtains, straightforward noise reduction methods can be applied. The basic principle to control air jet noise is to reduce the air velocity of the air ejected. This can be achieved by installing flow regulators at the air supply system.

22. Flow Control Valves for Vacuum Forming Machine

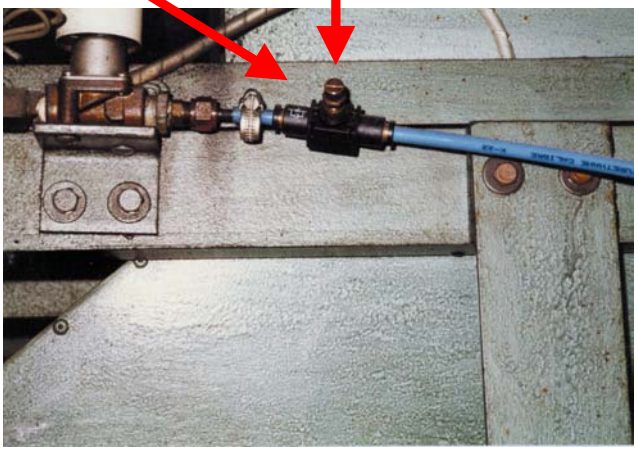
Problem

Two vacuum forming machines were used to form plastic containers from plastic sheets. A noise level of 91 dBA was generated from the compressed air used for spraying water to cool the formed containers. The operating air pressure was 14 bars.



Vacuum forming machine

Flow control valve



Solution

Flow control valves were installed at the two machines to reduce the operating pressure to 5 bars during water spraying.

Cost

$14 for each control valve.

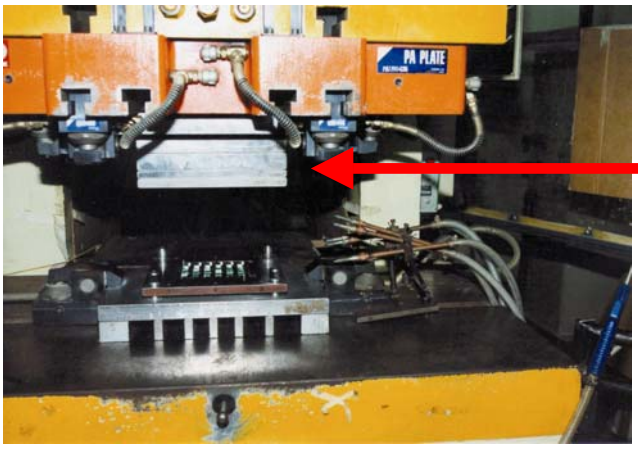
Result

Installation of the control valves reduced the noise level by 8 dBA.

23. Pressure Regulators

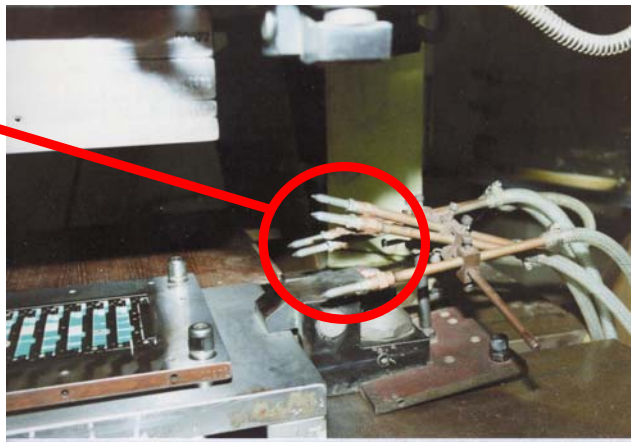
Problem

7 power presses were used for punching of holes on printed circuit boards (PCBs). After punching, compressed air was used to blow out the dust from the workpieces. Each PCB required air-jets to blow cleanly. Each air blow generated a noise level of 105 dBA.



PCB punching machine

Pressure Regulator Attachments



Solution

Pressure regulators were installed on all power press machines. The air pressure during the air blowing process was reduced to less than 7 bars from the original 8 bars.

Cost

$2,000

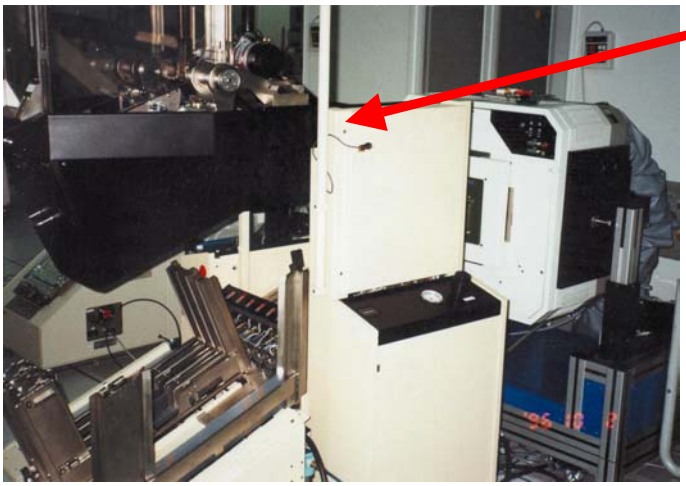
Result

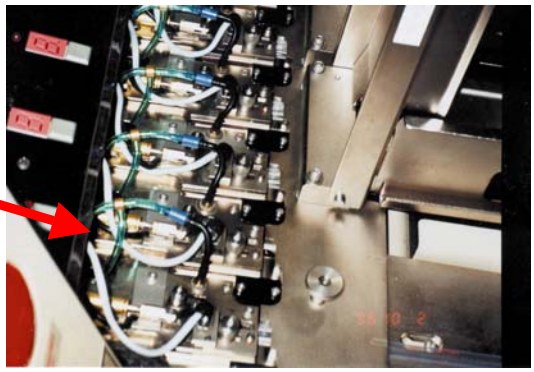
A 10 dBA reduction was achieved.

24. Pressure Regulators

Problem

Noise was generated from the use of compressed air with air pressure of 6 bars to push integrated circuits (ICs) through an automated IC Test-Handler machine. Compressed air is required because of the need to move the ICs quickly. Mechanical means did not satisfy the operational requirements of the product.





Solution

The automated IC Test Handler machine was modified to incorporate air flow resistors to regulate the air flow.

Cost

$150

Result

A noise reduction of 6 dBA was achieved.

Silencers and Mufflers

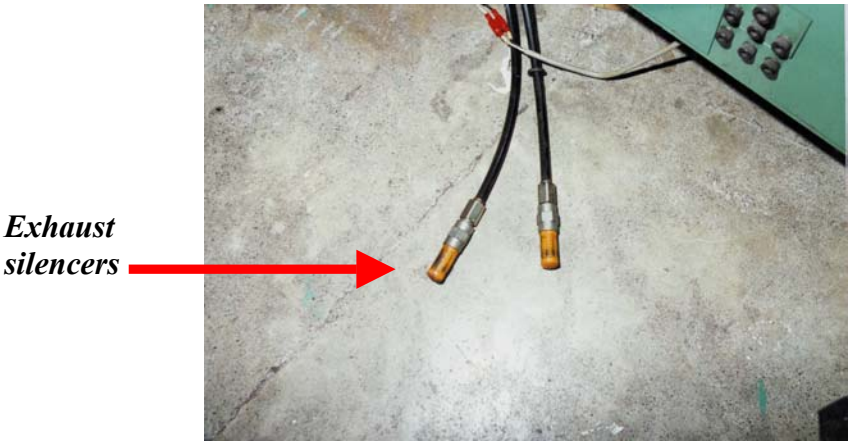
Acoustic silencers or mufflers are devices designed to attenuate and/or absorb sound waves propagated in a flowing medium. Typical applications include air handling systems, exhaust and intake units, pumps, compressors and air discharge lines.

This section highlights some successfully implemented noise control cases using silencers or mufflers.

25. Exhaust Silencers for Plastic-Bag Sealing Machine

Problem

Noise was generated from the exhaust outlet hoses of a plastic bag sealing machine. The air jet emitted a noise level of 110 dBA.



Solution

Exhaust silencers were fitted to the exhaust outlet hoses.

Cost

$3 for each exhaust silencer.

Result

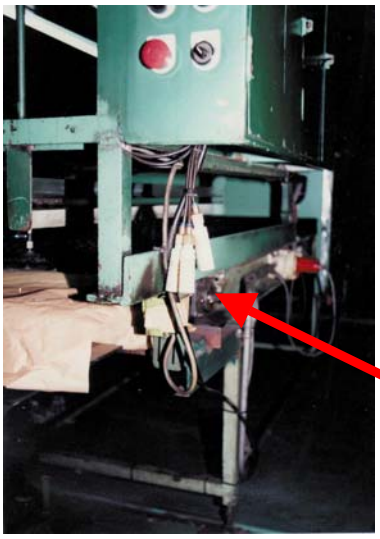
The noise level from the air-jet was reduced by 20 dB(A).

26. Exhaust Silencers for Plastic-Bag Sealing Machine

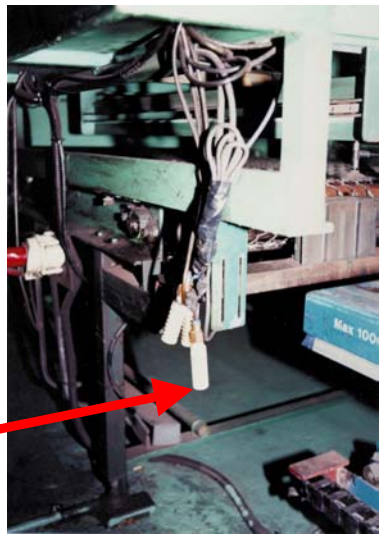
Problem

A noise level of about 100 dBA was generated by the air-jet emitted from the exhaust outlet hoses of a pneumatic metal sheet feeder machine.

Automated metal sheet pick and place machine



Exhaust silencers



Solution

Exhaust silencers were fixed to the exhaust outlets.

Cost

$6.80 per silencer.

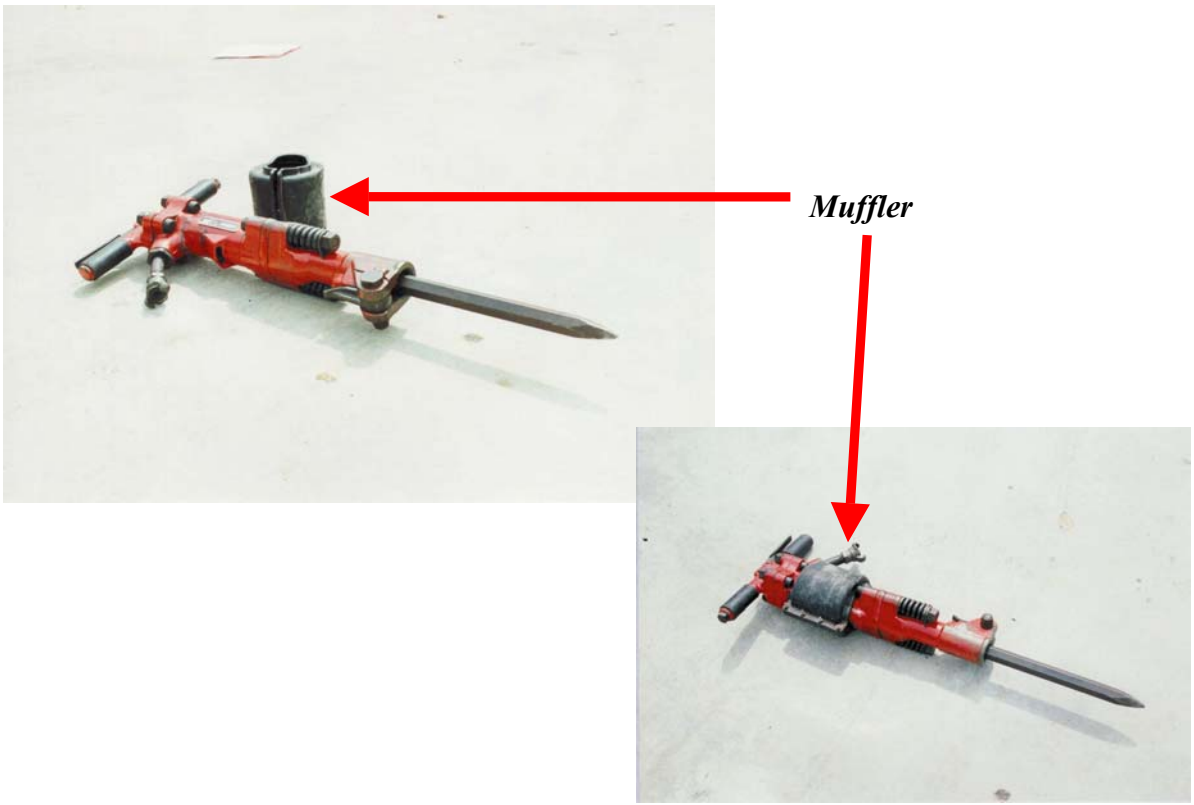
Result

A 16 dBA noise reduction was achieved.

27. Mufflers

Problem

Breaking of concrete using a pneumatic breaker was found to generate noise levels of up to 110 dBA. The pneumatic breaker produced a noise level at 108 dBA when not in contact with concrete (i.e. free operation)



Solution

A muffler was installed at the air exhaust outlet of the breaker.

Cost

$150

Result

The noise level during free operation was reduced by 5 dBA.

Substitution

Noise may be reduced by substitution of equipment or process. It is far simpler to avoid making noise than to eliminate it after it has been produced.

Some equipment or process are inherently more quiet than others. It is invariably more economical to choose a quieter, more expensive machine or process than to use a cheaper type which requires considerable additional noise and vibration control.

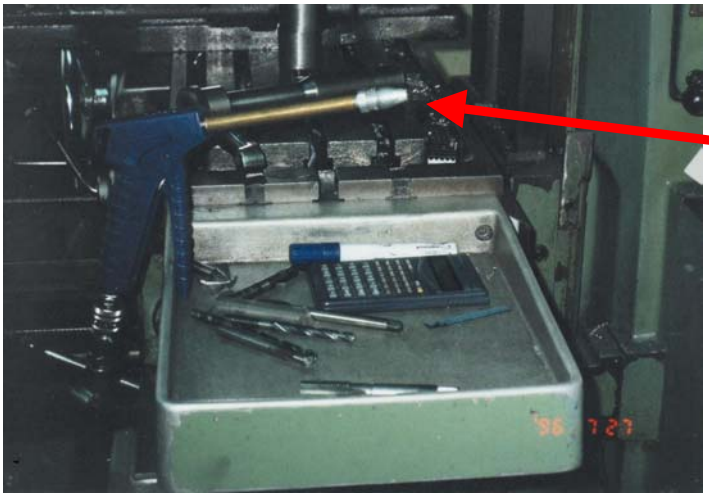
This section shows how some companies have redesigned or substituted their equipment or processes.

28. Switching to Low Noise Air Guns

Problem

Air guns were used extensively to blow off metal chips and excess coolant from metal moulds. The air pressure was 8 bars.

Extensive use of air guns



Low noise air gun

Solution

The existing air guns were replaced with silent type air guns. However, the process time however has increased with the usage of the silent type air guns.

Cost

$309

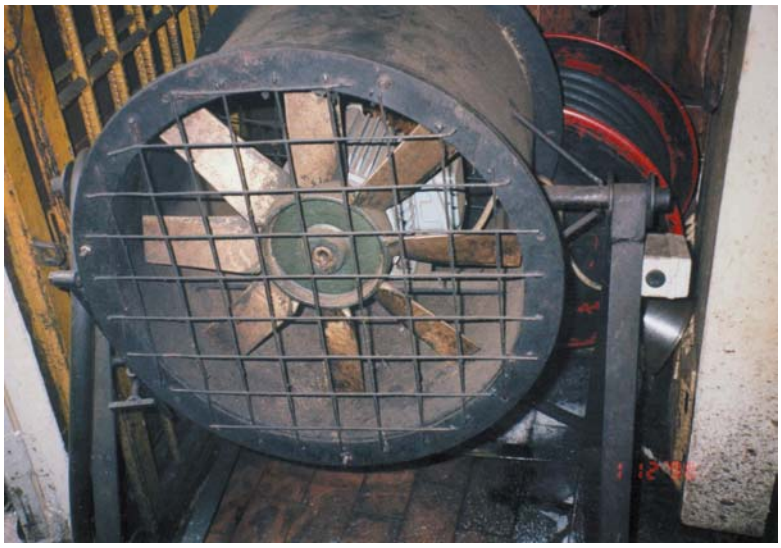
Result

The noise reduction was 8 dBA.

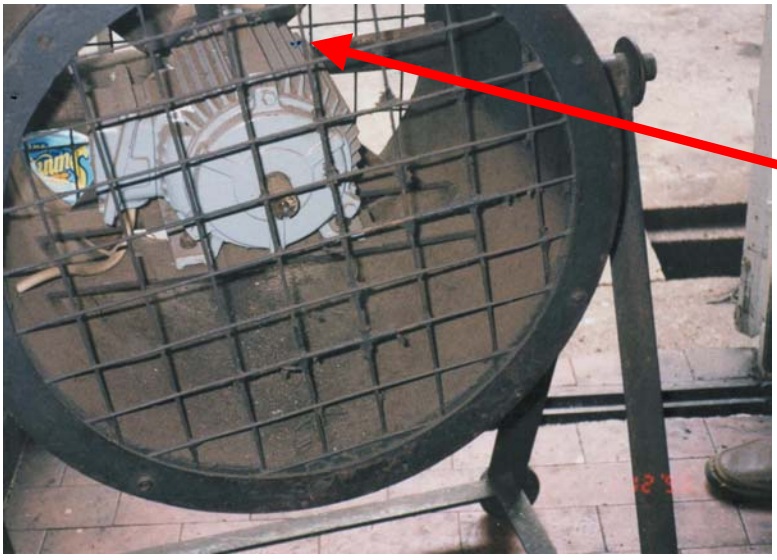
29. Switching to Low Powered Motor Generators

Problems

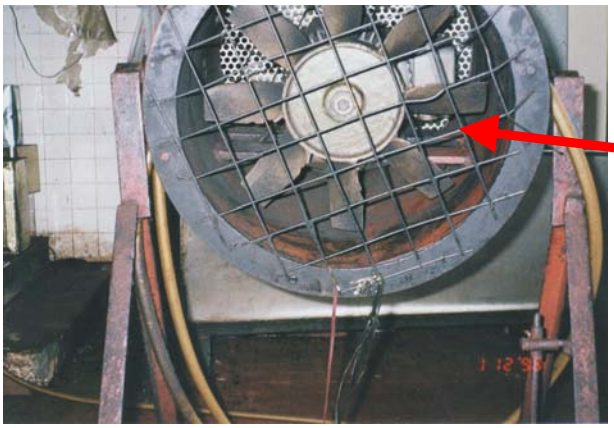
The axial flow blowers were used for cooling of coffee beans. The noise level generated from this process was 90 dBA.



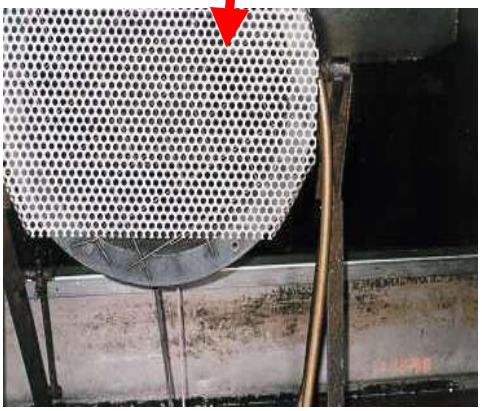
Axial-flow fan



High capacity horsepower motor



Smaller capacity motor with wire mesh cover



Solution

The axial-flow fans were replaced with blowers of lower horsepower. The new blowers were also covered with meshed metallic gauze to reduce noise.

Cost

$900

Result

There was a noise reduction of 4 dBA.

30. Redesign of Vibratory Bowl Feeder

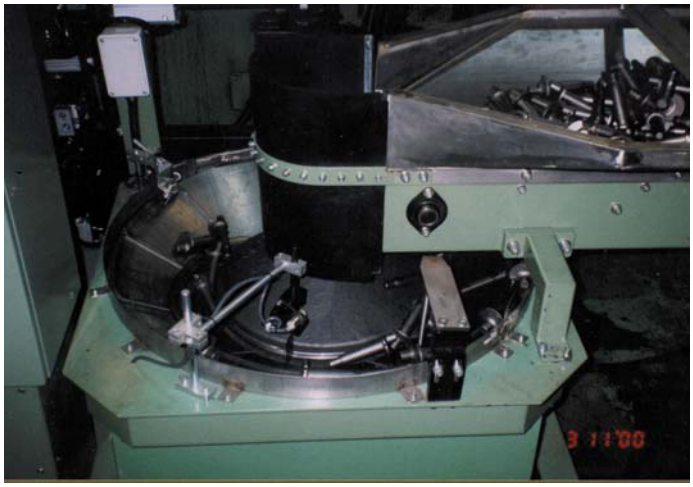
Problem

Excessive noise was generated from tumbling crankshafts and a vibratory bowl feeder. The noise from the process was 90 dB(A).

Tumbling crankshafts being fed into vibratory bowl

Vibratory bowl feeder

Polyurethane layer on receiving tray



Redesigned bowl feeder

Solution

The crankshaft receiving trays were lined with a 1mm thick layer of polyurethane to reduce the impact of tumbling crankshafts and hence the noise level. The vibratory bowl feeder was redesigned to a quieter rotating bowl feeder.

Cost

$25,000

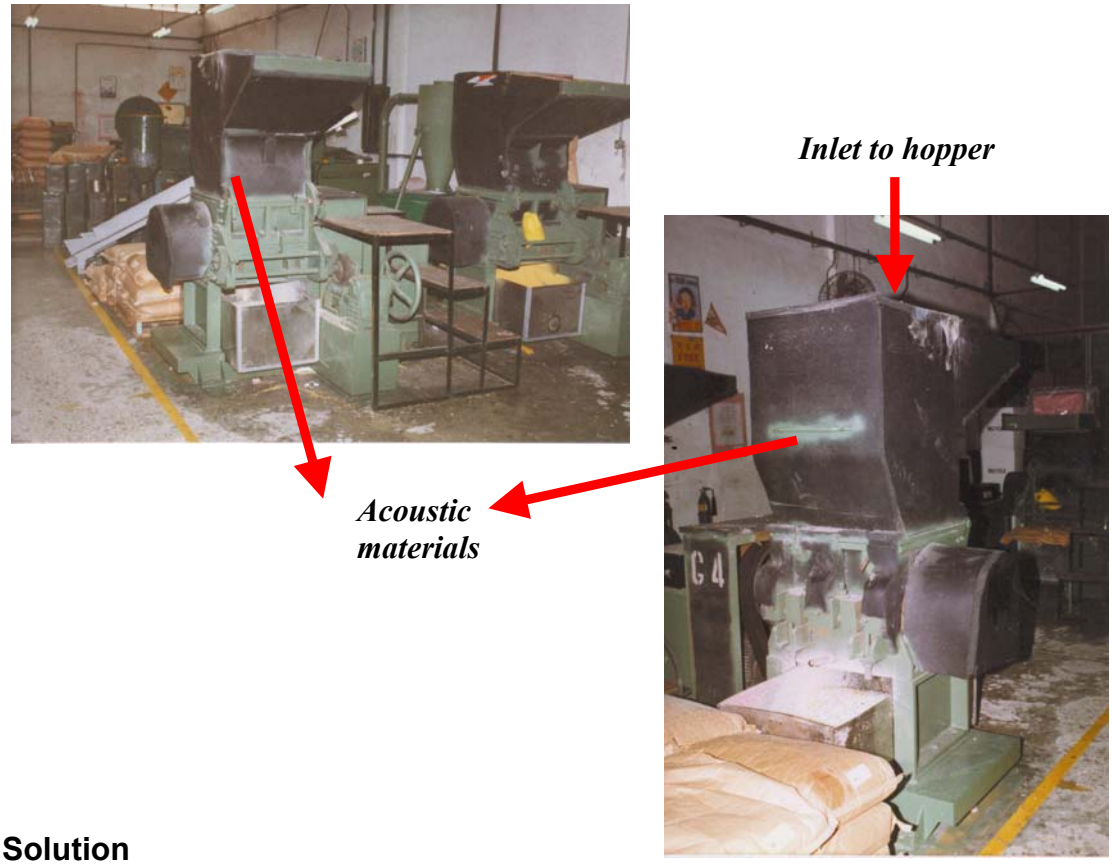
Result

The noise level generated after commissioning of the new machine was 75 dBA. This is a reduction of 15 dBA.

31.Lining Acoustical Material on External Walls of Crusher

Problem

A plastic granulator/crusher was used to grind plastic offcuts. The noise level varied with the type of material being crushed. Typical noise levels were above 95 dBA.



Solution

The external walls of the machine including the hopper were lined with soft foam material

Cost

Minimal

Result

A minimum noise reduction of 3 dBA was achieved.

32. Reducing Height of Fall of Materials from Cutting Machine

Problem

A cutting machine was used to cut steel bars. The cut bars were then dropped from the discharged chute onto the floor, resulting in an impact noise level of 90 dBA.

Cutting machine

Table placed at discharge chute

Solution

A table was placed on par with the discharge chute to reduce the height of fall of the cut steel bars. Rubber mats were placed on the table to cushion the impact of the bars.

Cost

$180

Result

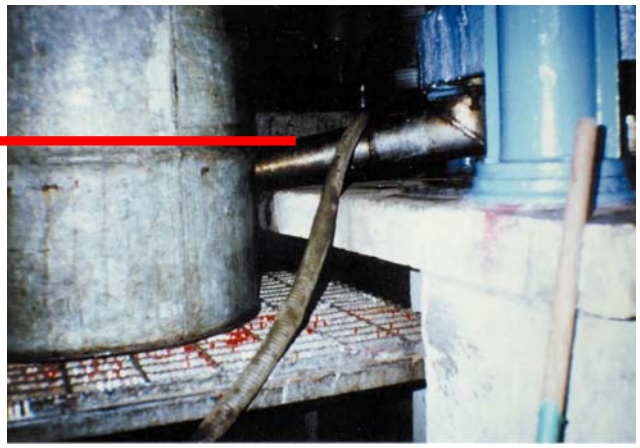
A noise reduction of 6 dBA was achieved.

33. Equipment Maintenance

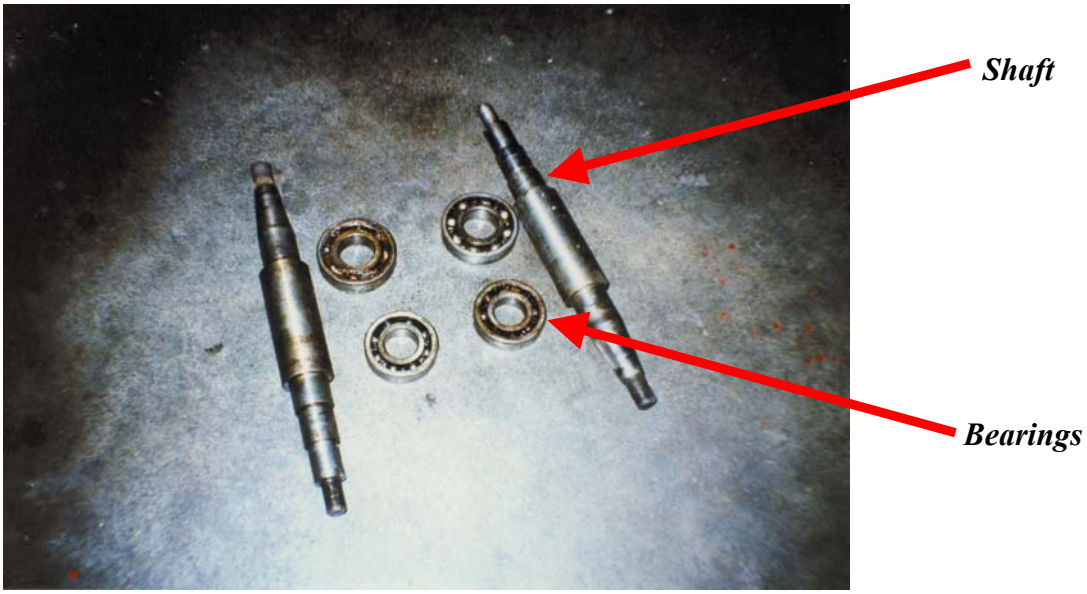
Problem

Four centrifugal separators were used in a factory that manufactured refined eucalyptus oil. The noise level from one of the centrifugal separators was found to be producing a noise level of 96 dBA. The other separators were around 83 dBA. Noise was also generated from a vibrating drainage pipe which was in contact with a hard surface.

Vibrating drainage pipe in contact with hard surface.



Centrifugal Separator



Solution

The centrifugal separator in question was sent for repairs and servicing. The driving shafts and bearings were also replaced. The vibrating drainage pipe was isolated from the hard surface to reduce noise generation.

Cost

$1,800 in maintenance cost.

Result

The noise level was reduced to 85 dBA. This is a reduction of 11 dBA.

Acknowledgement

This publication is designed to provide information to anyone interested in implementing noise control measures at the workplace.

The publication was produced with help from the technical and professional staff of the Occupational Safety and Health Division, Ministry of Manpower, in particular the following persons: -

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