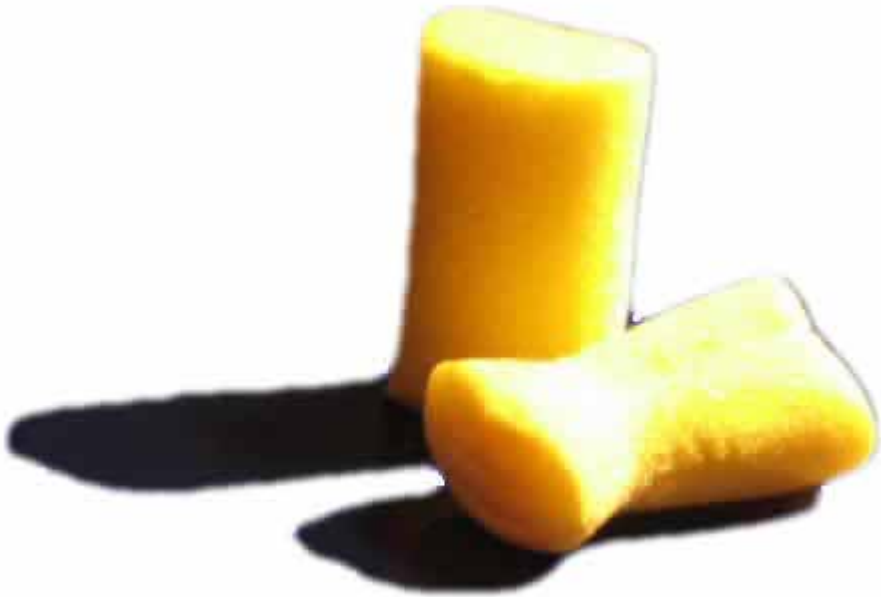
noise

Best Practice in Noise Control

And now for something completely different…

Noise Control

R.I.P?



Noise Control Best Practice Elements

- Attitude
- Accurate diagnosis and costing of the options
- Simple engineering solutions to common problems
  - fans
  - pneumatics
  - damping
  - isolation

- Buy Quiet purchasing policy

This approach can produce noise control measures that actually improve productivity and reduce costs - in contrast to reliance on conventional enclosures and acoustic guarding.

noise

Noise Control

Placebo Silencers

The Noise Control Audit

Objectives

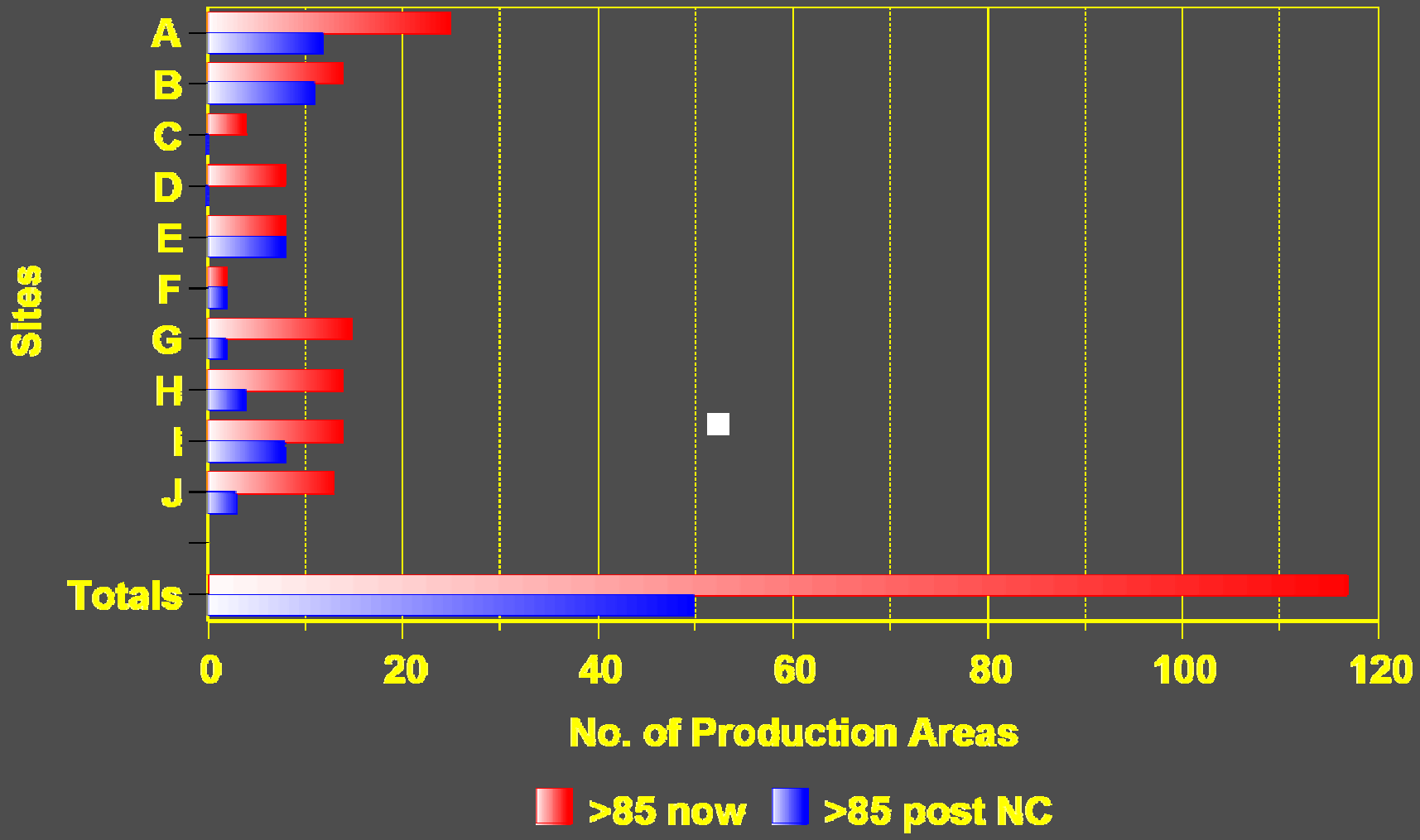
- assess the noise control options across the company using the best of current technology
- generate cost v noise reduction trade-offs for each item of noisy plant
- plan the most practical and cost effective noise control programme possible across the company

The results of the Audit also take into account factors such as:-

- hygiene
- access / maintenance
- productivity

There are several instances where implementing noise control measures will improve productivity and reduce costs - in contrast to conventional enclosures and acoustic guarding.

Site Audits: Noise Control Project Benefits



Noise control programme would potentially provide c £200,000 savings per annum on PPE alone ...

k14 Noise Control is ....

Noise control is **not** a safety issue

- Noise control is an engineering problem that should be solved by engineering means, in particular through noise control at source.
- Effective noise control must be based on an accurate diagnosis and not on assumptions
- All the options must be considered, not just the conventional high cost palliatives of enclosures and silencers. These techniques should only be used where it can be proved that there is no engineering alternative.

Conventional Palliative Solutions

Enclosure: press has to be run with the doors open …

Hanging Absorbers: 5 - 8 dB average and up to 15dB reduction quoted. In fact, there is no reduction close to noisy plant (2 - 4 m) - which is the natural habitat of operators

Noise Generators

Aerodynamic

- fans
- flow induced
- pneumatics
  - nozzles
  - exhausts
- combustion

Mechanical

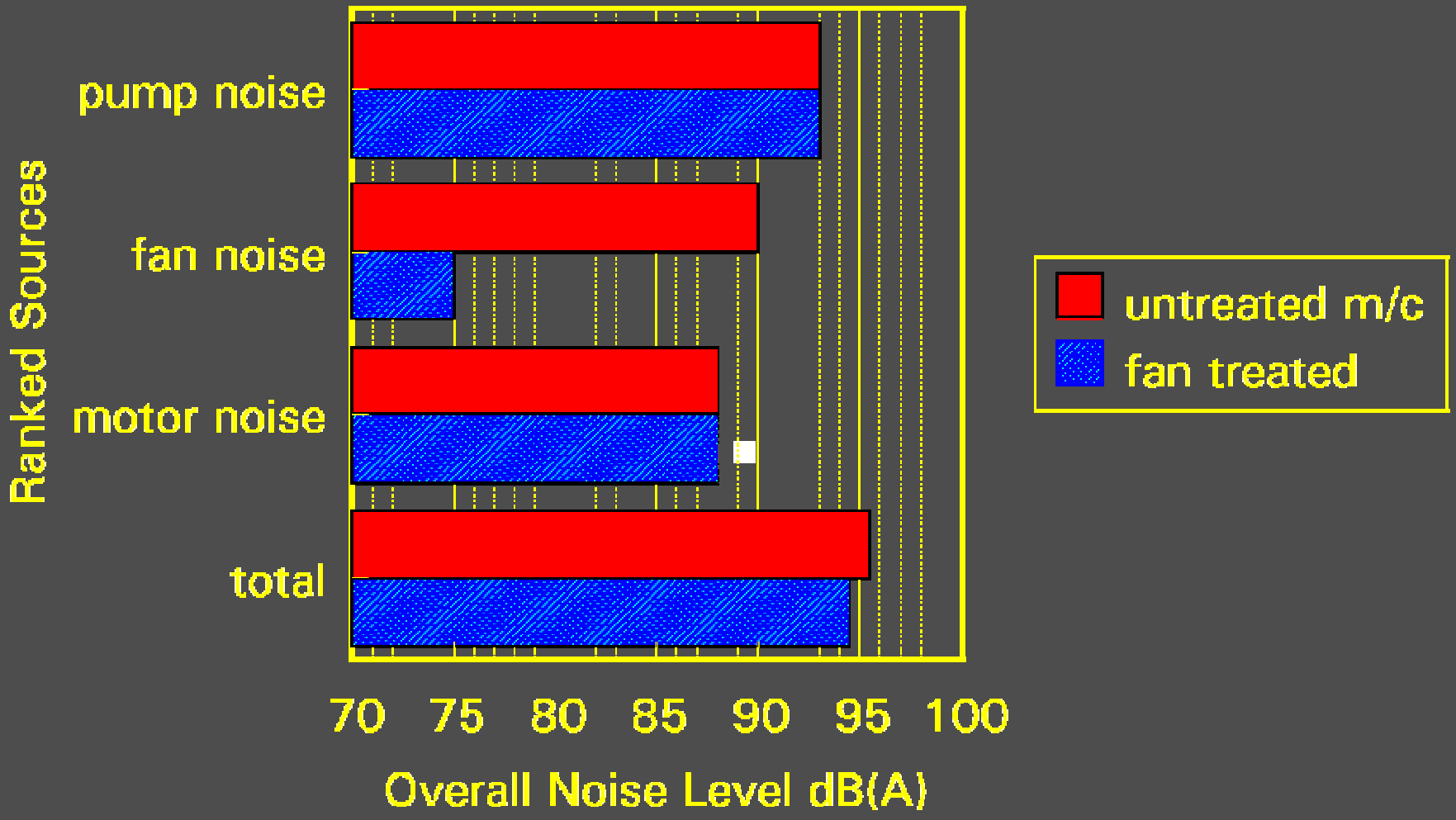
- impacts
  - presses, stops etc
  - mechanical handling
- rotating machines
  - gears, pumps, motors
  - bearings
  - electrical forces
- friction forces
  - cutting tools, brakes

BPM Noise Control Audit Steps

- List all the potential noise sources on each piece of noisy plant
- Rank the sources
- Assess all the noise control options for the dominant source
  - potential reduction in noise from this source
  - operational, productivity, hygiene constraints
  - operator acceptance
  - cost
- If engineering control is not practical for the dominant source, then you have proved that screening / enclosure etc are the only options

The results are used to generate cost v noise reduction trade-offs for each item of noisy plant and to plan the most practical and cost effective noise control programme possible across the company.

Multiple Source Ranking



Unless the dominant source is treated first, the overall noise reduction will be disappointing

Engineering Noise Control: Added Benefits

- Reduced Maintenance and Running Costs
  - elimination of some existing enclosures - improved access; design-in features to reduce down-time
    - *e.g. conveyor wear; reduced air consumption; elimination of fatigue problems; £80000 pa cost savings on vacuum pump running costs (energy and water)*
- Off-set against Maintenance Costs
  - maintenance carried out as part of noise control implementation, off-setting noise control costs against maintenance
    - *e.g. moulding vibrators - existing doors needed maintenance and design modifications for safety reasons*
- Hygiene and Cleaning
  - upgrading materials / eliminating hygiene problems due to poor design
    - *e.g. moulding vibrators – badly designed door seals causing a hygiene problem*
- Improved Productivity
  - noise control improved design modifications can increase productivity
    - *e.g. vibratory feeder/grader modifications doubled throughput; 10% reduction in chocolate coating thickness via enrober modifications; engine cleaning – 20% reduction in air consumption and better cleaning and 12dB quieter*

noise

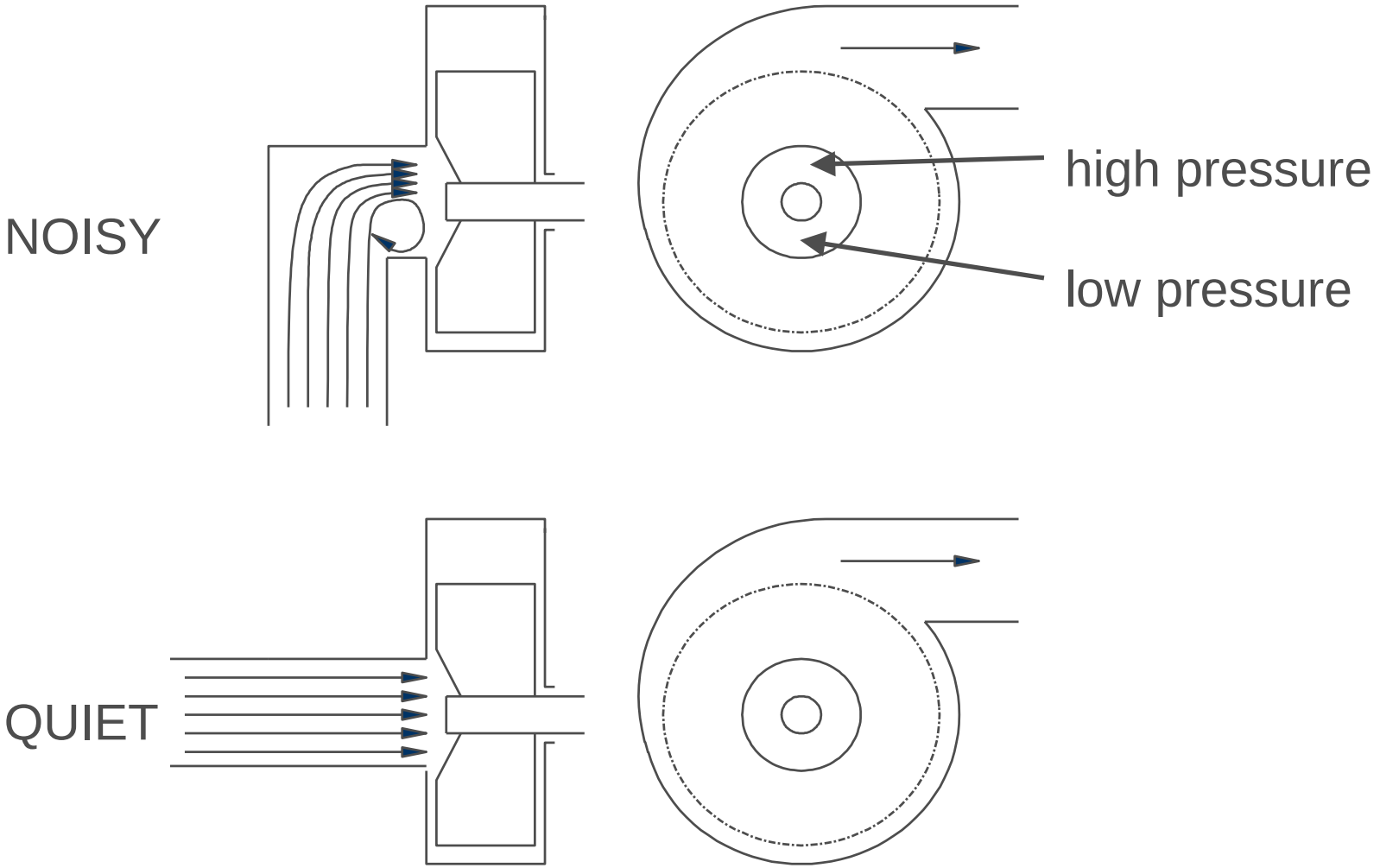
Fans

Fan Designs

centrifugal fan

axial fan - quiet impellor

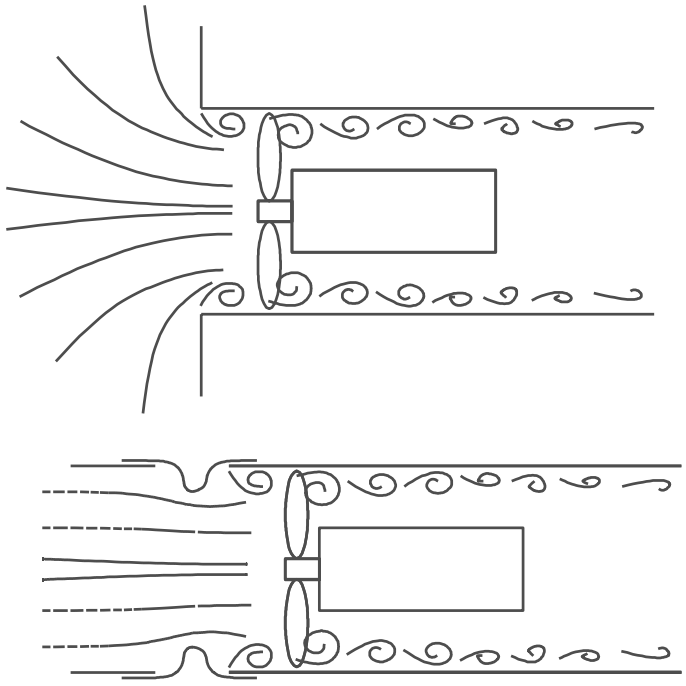
Centrifugal Fan Installation

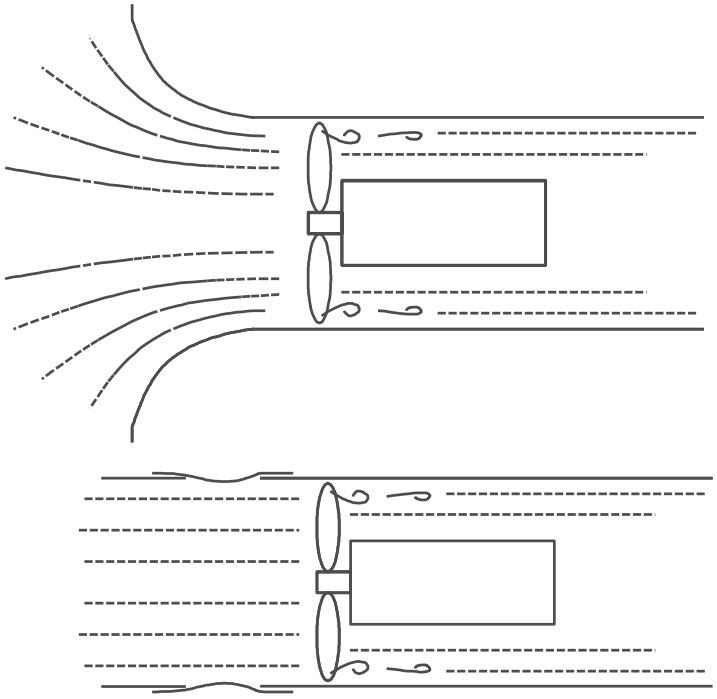


m16 Axial Fan Installations

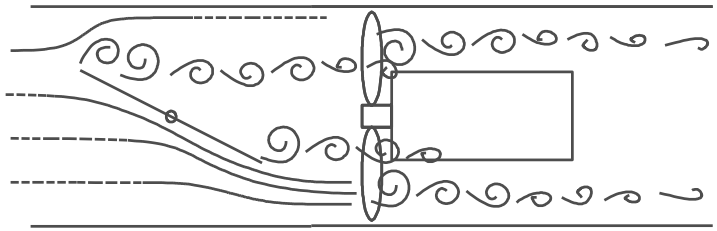
NOISY

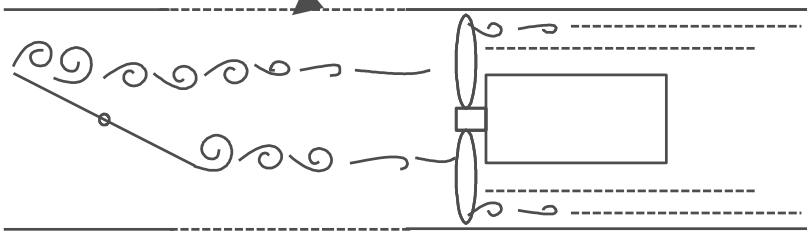
QUIETER





>2-3 duct diameters





Modifying Fan Internals – Quiet Fan Technology

Reduce fan noise at source

- No silencers
- No enclosures
- No lagging
- No clogging or maintenance

Oops!

Scrap Can Extract and Chopper Fans

Problem

Occupational and environmental tonal noise

Conventional

- silencers, lagging and enclosures
- capital cost > c£35000 + maintenance costs

BPM Engineering

- internal fan modification reduced tones by 23dB and overall noise by 22dB(A)
- Cost c £3000 - no maintenance costs (lasts the lifetime of the fans despite passage of cans)

modified fan

Fan Speed v Noise

speed reduction	noise reduction dB
10%	2
20%	5
30%	8
40%	11
50%	15

noise

Pneumatics

Quiet Nozzles

photo courtesy Unilever

Entraining Nozzles

- c10dB quieter for the same thrust
- use c 20% less air than conventional nozzles
- pay for themselves very quickly
- intrinsically "safe" (end cannot be blocked)

Filler Cooling Pipes

Problem

- 94dB(A) from cooling pipes for sealed tube ends - rapid cooling a necessity

Conventional Solution

- enclosure - high cost with hygiene and productivity issues

BPM Solution

- Coanda effect linear nozzles
  - ➢ 12dB(A) noise reduction (82dB(A))
  - ➢ improved performance (less turbulence disturbing tubes)
  - ➢ 20% less air consumption - pay for themselves very quickly
  - ➢ no effect on access or operation

m87 Pneumatic Silencers

photo courtesy Unilever

Problems

1. clogging / back-pressure
2. number of different types
3. left off after maintenance
4. insufficient attenuation

Solutions

5. straight-through silencers - zero back-pressure
6. standardise on 3 sizes
7. fix silencers to machine with pipe to exhaust outlet and manifold multiple exhausts
8. high performance units available

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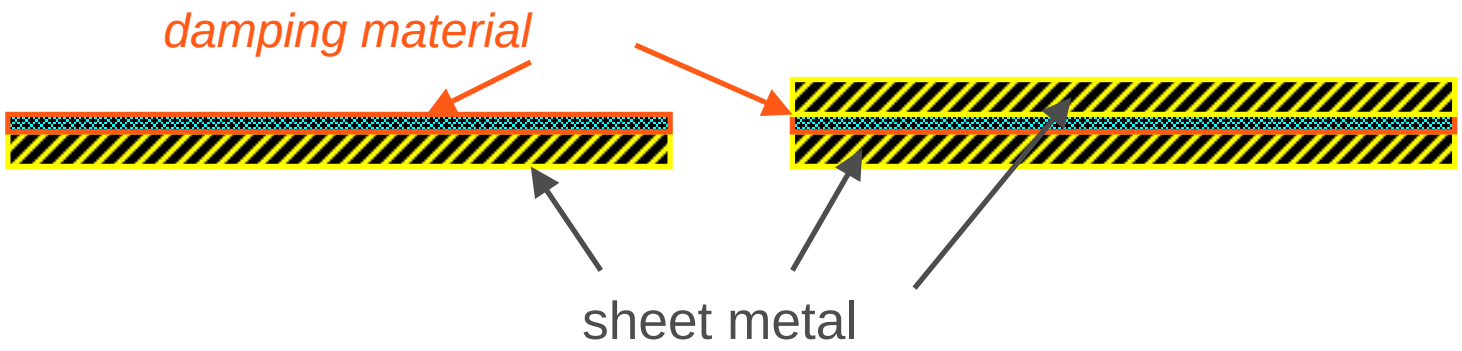
Vibration Damping

Damping Thin Plates

unconstrained layer of damping material

damping material in sandwich construction



damping material deforms only near bends

damping material made to shear over whole area

s90 Vibratory Bottle Unscrambler

Problem

Vibratory feed hopper for unscrambler generating 90dB(A)

BPM

- poor design: vibrators at high level to vibrate whole hopper - feed still inefficient
- laminated plate inside existing hopper (grommet isolation), connected to vibrators through holes in hopper: cost c £400
- reduced vibrator level, improved feed, noise reduced from 90dB(A) down to 82dB(A)

Weighing Machine Enclosures

- 94dB(A) with enclosure
- 82dB(A) with engineering noise control and enclosure removed
- PPE unnecessary; improved productivity, cleaning, access, maintenance ...

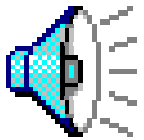
Problem

- typically 87- 98B(A) - high hygiene

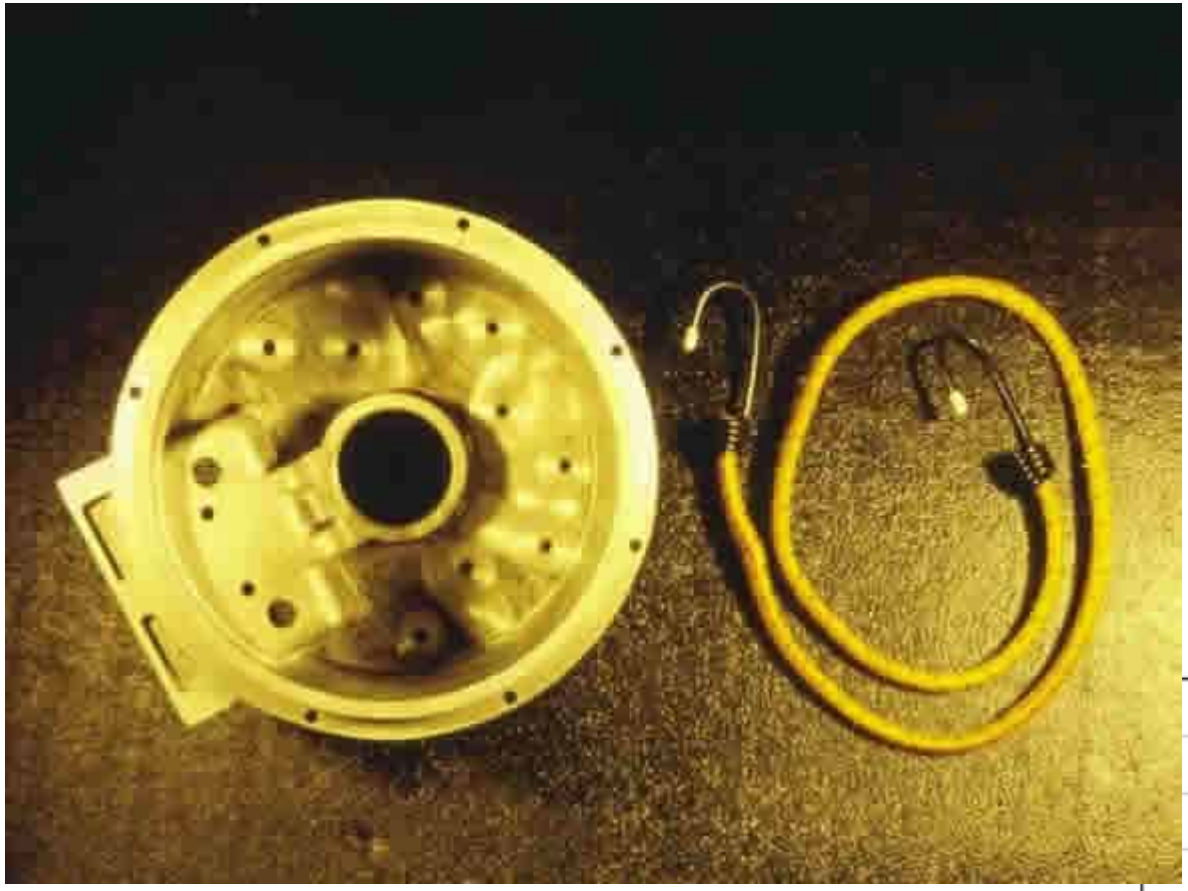
- Conventionally: Enclosure
  - Enclosures - c5dB(A) reduction
    - *usually increases operator noise level by 2 - 3dB(A) under platform!*
  - c£8000+ capital + access / hygiene / maintenance problems

BPM - engineering control

- engineering source modifications
- 10 - 12dB(A) reduction at <<50% of the cost
- x4 performance + no effect on access or hygiene compared with untreated machine.
- maintenance and cleaning simplified



Machining Castings

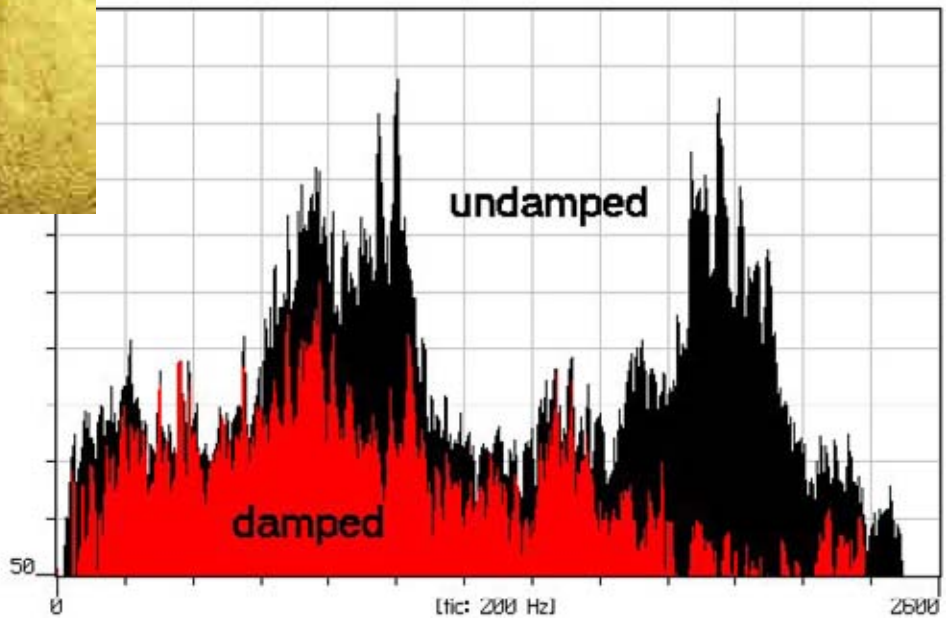


Untreated

- 104dB(A); highly tonal

Treated

- 88dB(A); tones -32dB
- 30% reduction in cycle time
- improved tool life



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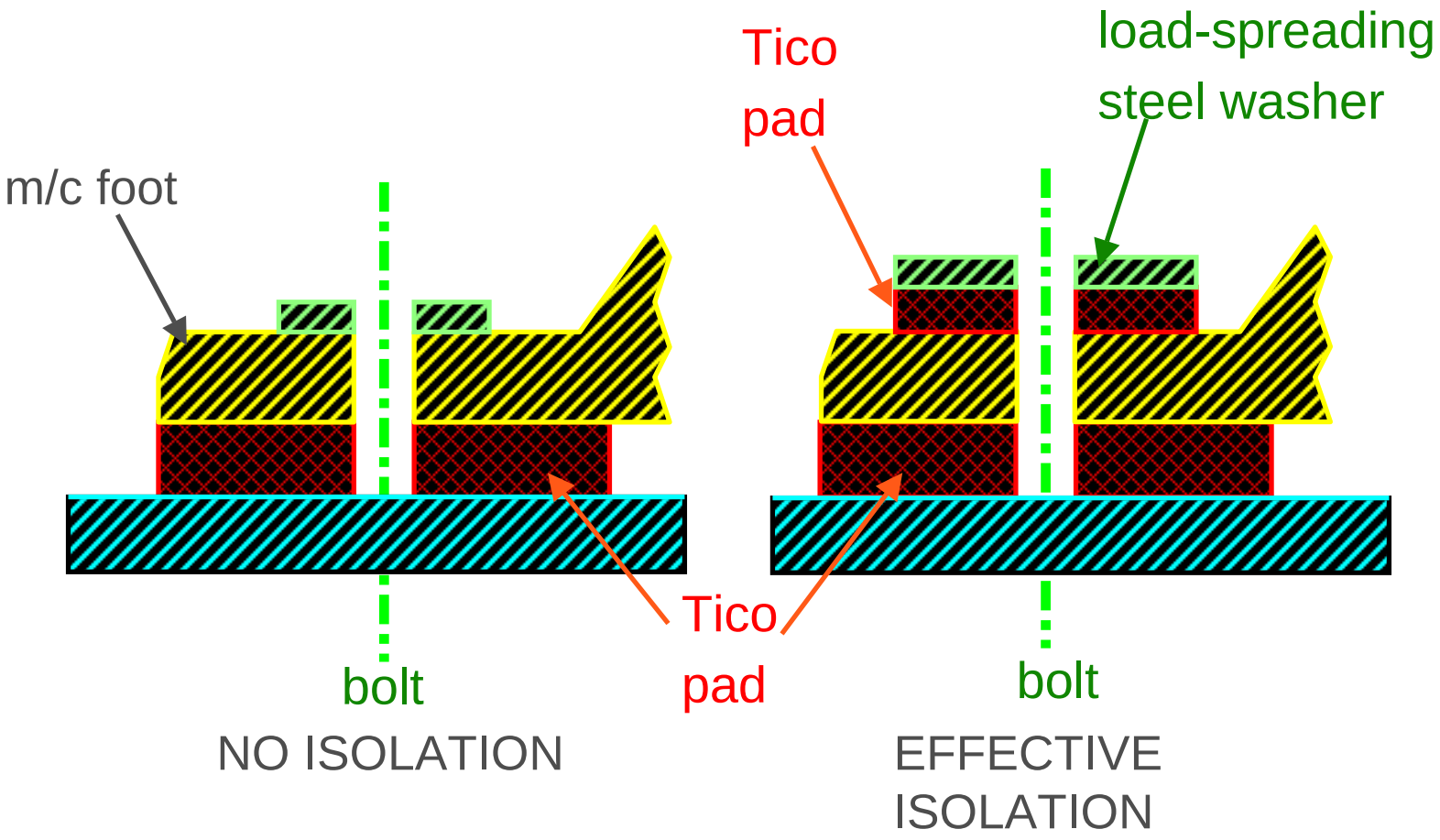
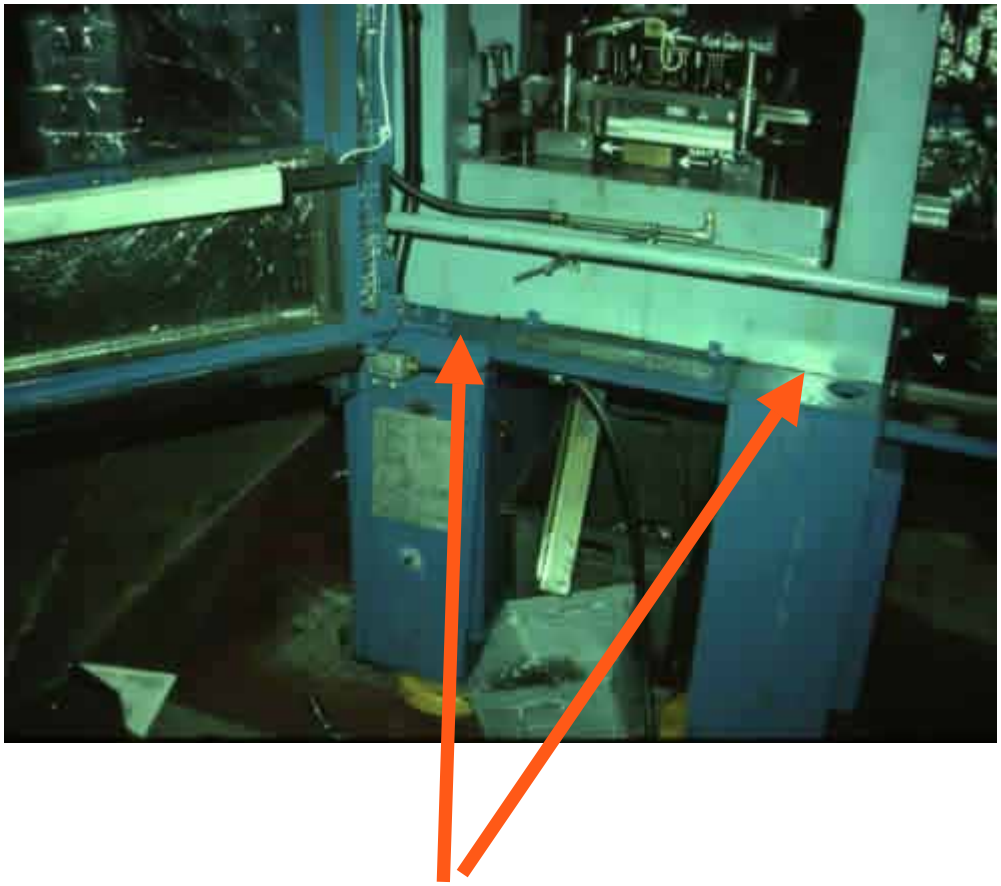
Vibration Isolation

Machine Foot Isolation



Verso Press



isolation pads

Problem

High speed strip fed press at 101dB(A) in a quiet area

Conventional

Manufacturer supplied "acoustic guards" gave only 3dB(A) reduction. Full enclosure suggested.

BPM

- Noise Control Audit showed dominant source to be fabricated press legs.
- Tico isolation fitted between frame and legs tuned to give natural frequency of 65Hz for both legs (different loads)
- 9dB(A) noise reduction at closest operator position. £45 materials, 1 man day to fit

w63 Hopper Vibrator

- design and angles of chute
- vibration isolation of chute to reduce required vibrator amplitude
- isolate vibrator from chute - tuned to amplify low frequency, attenuates high frequencies
- damp chute to reduce high frequencies
- vibrate material inside rather then whole chute
- fit purpose designed "anvil" to allow hammering without damage

noise

Buy Quiet

Purchasing Policy

N.B.S. Objectives

Probably the single most cost effective noise control measure that a company can take.

- reduce the chance of importing fresh noise problems (once on site it becomes your responsibility to reduce noise levels to comply with the legislation).
- generates commercial pressure to develop quiet plant
- more cost effective to introduce noise control prior to installation

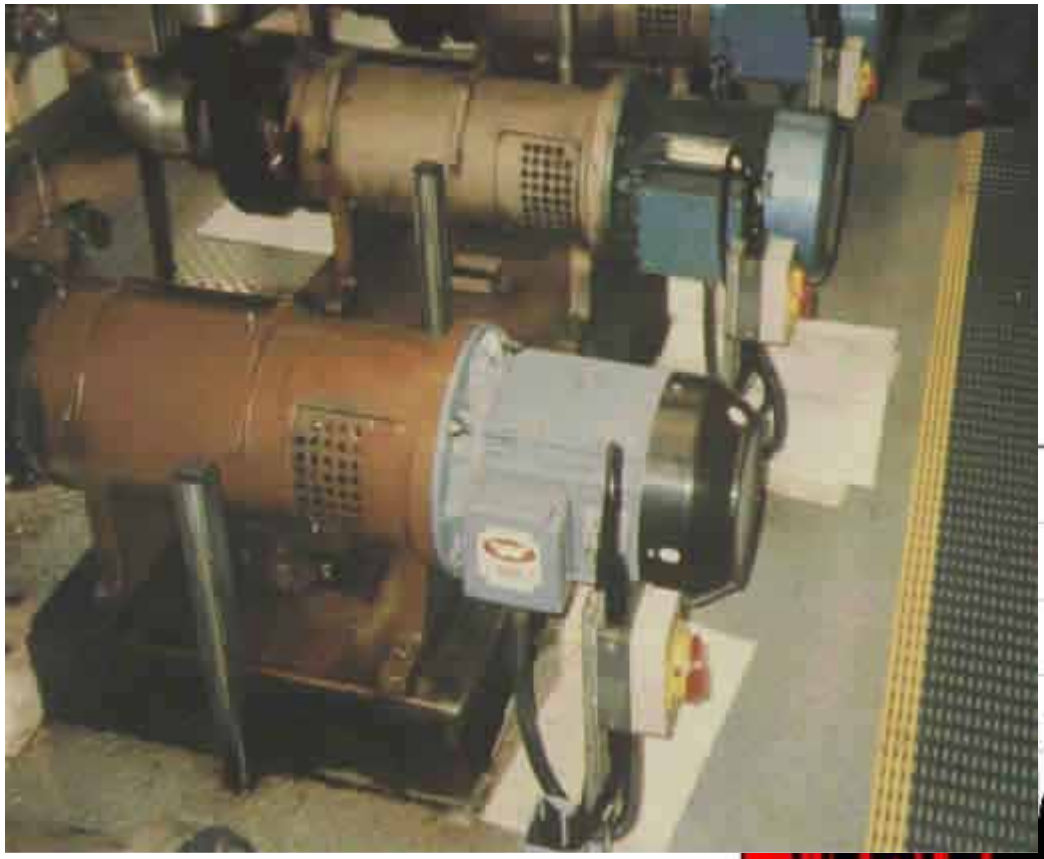
BUT - Do not allow your suppliers to spend your money on noise control without close scrutiny and evidence that they have followed diagnostic best practice

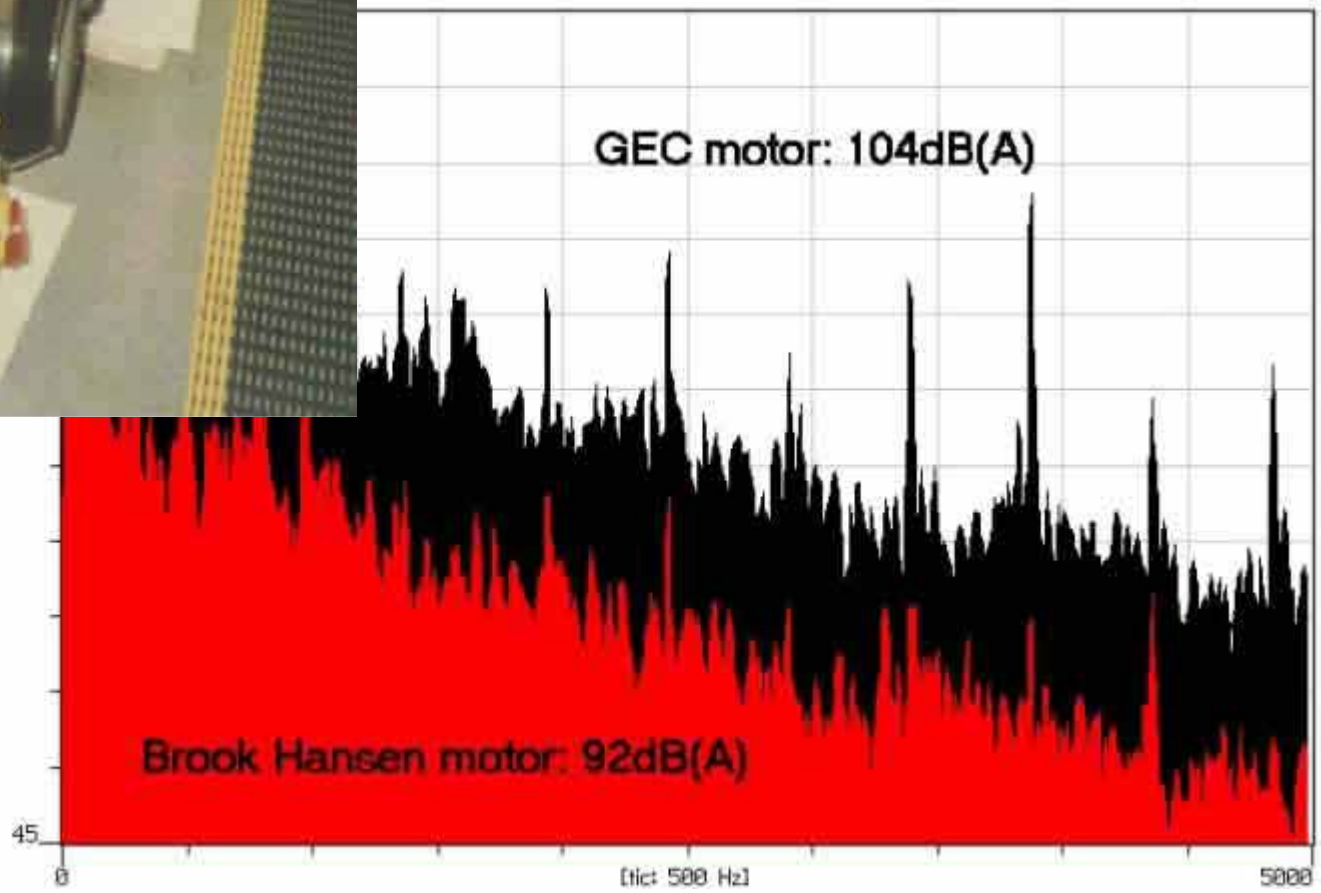
- most suppliers do not have much technical expertise in noise control and usually buy-in proprietary materials, enclosures, silencers etc and add these to the cost - regardless of what constitutes BPM using the best of current technology

w79 Quiet Tape

- quiet tape uses stronger glue - generating more tension
- may have to adjust machines to use the new tape

e76 Pump Motors





Buy Quiet Main Elements

- CRITERIA
  - *set target noise levels for new plant in company policy*
- MEASUREMENT PROCEDURE
  - *define in detail*
- RESULTS FORMAT
  - *provide a standard format*
- NOISE CONTROL
  - *assess proposed modifications and ensure that BPM is used*
- GUIDANCE NOTES
  - *user manual providing advice on applying the NBS for specifying engineer(s)*
- TRAINING / PUBLICITY
  - *ensure all personnel involved understand the requirements*
- POLICING - CONTRACTS
  - *check noise levels and apply contractual obligations*

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Best Practice in Noise Control

Noise Control Best Practice Elements

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