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Ballina Shire Council
Road Surface Noise Levels Study

Prepared by
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11/11/13

1 INTRODUCTION

Ambience Audio have been engaged by Ballina Shire Council to conduct a noise survey of the noise levels from selected different types of road surfaces. The aim of the survey is to compare the noise levels from different pavements and give a quantifiable and subjective comparison.

Measurements were conducted in general accordance with procedures laid down in Australian Standard AS 2702 -1984: '*Acoustics – Methods for the Measurement of Road Traffic Noise Levels.'*

Data from the sound level meters were downloaded into Bruel & Kjaer Type 7815 Environmental Noise Software and Excel spreadsheet for analysis. A manual count (where practical) of the types of vehicles and estimated speed of the vehicles passing the sound level meters during the monitoring periods was noted. The temperature, humidity, wind direction and speed and a description of the surrounding area were also noted.

The results were evaluated for the subjective change in level were there were two different road surfaces.

2 SITES AND TEST CONDITIONS

The selected sites were:

1. Tanamera Drive Alstonville (east of Green Street) – assess traffic noise levels for the 10/7mm sprayed bitumen surface and adjoining asphalt surface

2. Cherry Street Ballina (north of Swift Street) - assess traffic noise levels for the 14/7mm sprayed bitumen surface and adjoining concrete surface

3. Byron Bay Road Lennox Head (80 km/hr zone north of Ballina Street) - assess traffic noise levels for the 10/7mm sprayed bitumen surface and adjoining asphalt surface

4. Angels Beach Drive Ballina (80 km/hr zone north of Bangalow Road) - assess traffic noise levels for the asphalt surface

5. The Coast Road Flat Rock (80 km/hr zone north of Condon Drive) – assess traffic noise levels for the 10mm sprayed bitumen surface

6. Martin Street Ballina (between Tamar St and Crane St) - assess traffic noise levels for the 14/7mm sprayed bitumen surface.

2.1 Tanamera Drive Alstonville

Date	07/11/13	Road Surface 1	10/7 sprayed bitumen
Start Time	2:47pm	Road Surface 2	asphalt
End Time	3:42pm	Centre to SLM (m)	7
Temp (°C)	31	**Description of surrounding area**	
Humidity (%RH)	40	Suburban residential , local traffic serving residential estate, approx 10m setback from kerb	
Wind Direction	North		
Wind Speed (m/s)	2		
Posted Speed Limit (km/h)	50		
Estimated Vehicle Speed (km/h)	40 - 55		

Notes

Corner intersection near one of the monitoring locations.
Engine noise due to acceleration and braking excluded from results.
Single individual pass-bys best data for comparison.
Measurement period shorter due to increase in traffic flows which gave uncorrelated data.

2.2 Cherry Street Ballina (north of Swift Street)

Date	01/10/13	Road Surface 1	Concrete
Start Time	10:38am	Road Surface 2	10/7 sprayed bitumen
End Time	11:53am	Centre to SLM (m)	11
Temp (°C)	30	**Description of surrounding area**	
Humidity (%RH)	60	Urban/ commercial/ residential / schools , main road, reflective surface on opposite side of road	
Wind Direction	SW		
Wind Speed (m/s)	1		
Posted Speed Limit (km/h)	50		
Estimated Vehicle Speed (km/h)	35 - 50		

Notes

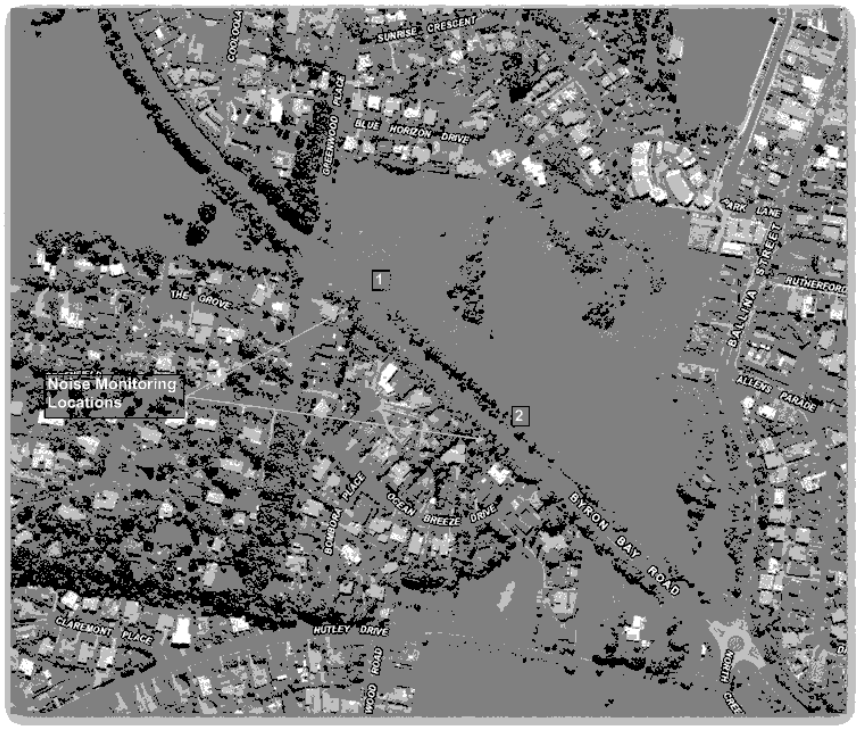
Main road – generally traffic speed at lower than posted speed limit of 50km/h.
Mainly tyre noise. Engine noise on heavy vehicles.
Good traffic flows to give sufficient data.

2.3 Byron Bay Road Lennox Head (80 km/hr zone north of Ballina Street)

Date	26/09/13	Road Surface 1	asphalt
Start Time	3:00PM	Road Surface 2	10/7 sprayed bitumen
End Time	4:10PM	Centre to SLM (m)	7
Temp (°C)	26	**Description of surrounding area**	
Humidity (%RH)	75	Suburban residential , farm land, main road servicing Ballina - Lennox Head – Byron coast, approx 20m setback from kerb, embankment giving slight noise reduction to residential estate on SW of measuring location.	
Wind Direction	NE		
Wind Speed (m/s)	1.5 – 3.5		
Posted Speed Limit (km/h)	80		
Estimated Vehicle Speed (km/h)	75 - 85		

Notes

Corner intersection near one of the monitoring locations.
Engine noise due to acceleration and braking excluded from results.
Measurement comparison only valid for 12 minutes (2nd noise logger stopped)

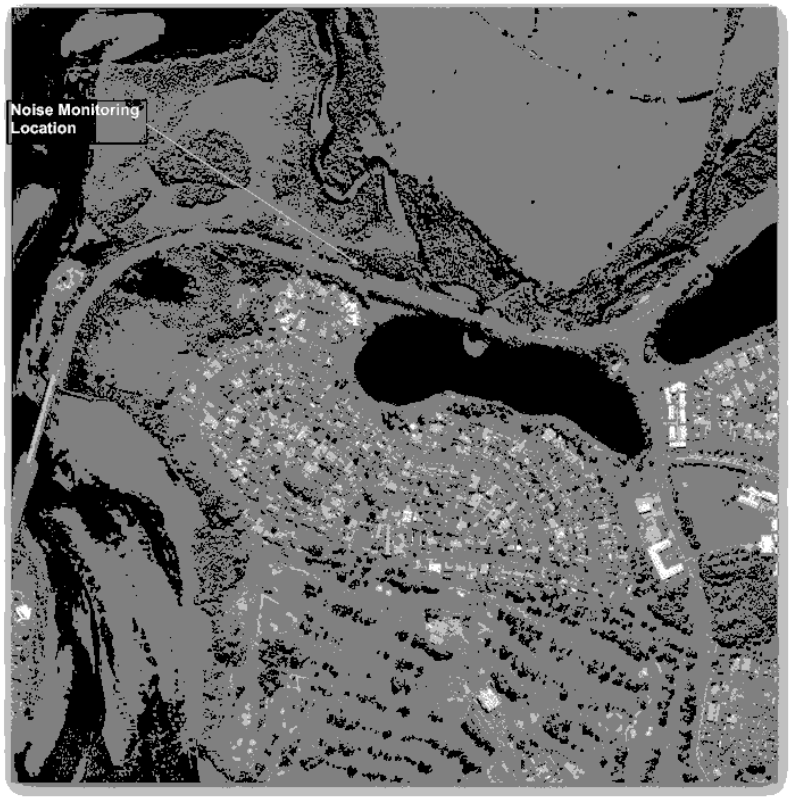


2.4 Angels Beach Drive Ballina (80 km/hr zone north of Bangalow Road)

Date	30/10/13	Road Surface 1	Asphalt
Start Time	2:34pm	Road Surface 2	na
End Time	4:34pm	Centre to SLM (m)	7
Temp (°C)	29 - 27	**Description of surrounding area**	
Humidity (%RH)	46 - 52	Suburban residential generally 200m, small estate approx 30m from edge of carriageway, wetlands, farming, main road servicing Ballina - Lennox Head – Byron coast and western part of east Ballina.	
Wind Direction	North		
Wind Speed (m/s)	2 - 3		
Posted Speed Limit (km/h)	80		
Estimated Vehicle Speed (km/h)	80		

Notes

Good traffic flows to give sufficient data.
Tyre noise dominant on modern cars.



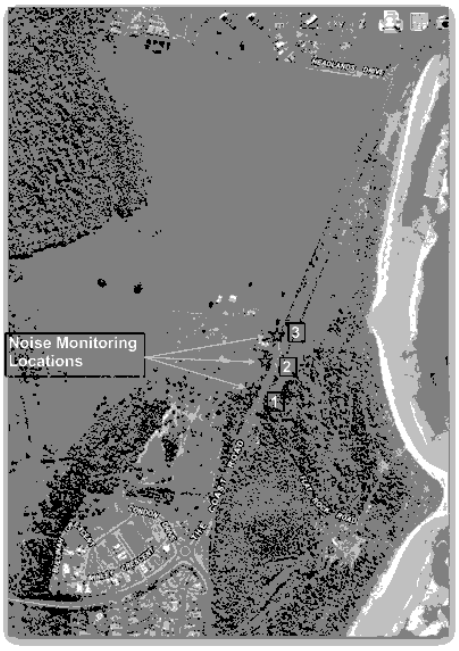
2.5 The Coast Road Flat Rock (80 km/hr zone north of Condon Drive)

Date	26/09/13	Road Surface 1	14/7 sprayed bitumen
Start Time	2:47pm	Road Surface 2	14/7 sprayed bitumen
End Time	3:42pm	Centre to SLM (m)	7
Temp (°C)		**Description of surrounding area**	
Humidity (%RH)		Farmland , beach reserve, main road Ballina - Lennox Head – Byron.	
Wind Direction			
Wind Speed (m/s)			
Posted Speed Limit (km/h)	50		
Estimated Vehicle Speed (km/h)	40 - 55		

Date	01/11/13	Road Surface 3	14/7 sprayed bitumen
Start Time	12:07pm	Centre to SLM (m)	7
End Time	1:37pm		
Temp (°C)	26		
Humidity (%RH)	48		
Wind Direction	na		
Wind Speed (m/s)	<0.5		

Notes

3 locations over 2 days



2.6 Martin Street (Between Tamar Street and Crane Street)

Date	01/10/13	Road Surface 1	10/7 sprayed bitumen
Start Time	12:57pm	Road Surface 2	na
End Time	2:27pm	Centre to SLM (m)	12
Temp (°C)	31	**Description of surrounding area**	
Humidity (%RH)	40	Urban/ commercial/ residential / schools , local traffic	
Wind Direction	SW		
Wind Speed (m/s)	1 - 2		
Posted Speed Limit (km/h)	50		
Estimated Vehicle Speed (km/h)	30 - 45		

Notes

Generally traffic slower than posted speed limit of 50km/h - raised pedestrian crosswalk at Crane Street intersection.
Good traffic flows to give sufficient data.
School holidays.

3 RESULTS

3.1 Tanamera Drive Alstonville

Road Surface	LAeq dB (A)	Comment
Asphalt	63.5	Difference in noise level – quite noticeable Residents near road surface change would notice sudden increase of 5 decibels as vehicles travelled from north to south.
10/7 Sprayed Bitumen	68.8	
Difference (decibels)	5.2	

3.2 Cherry Street Ballina (north of Swift Street)

Road Surface	LAeq dB (A)	Comment
Concrete	61.4	Difference in noise level – noticeable
14/7 Sprayed Bitumen	64.7	
Difference (decibels)	3.3	

Individual 15 min Periods	1	2	3	4	5	Average (Extraneous Noises Deleted)
Concrete	61.0	62.4	61.4	62.4	61.2	61.4
14/7 Sprayed Bitumen	64.6	65.2	64.8	65.6	65.1	64.7
Difference (decibels)	3.6	2.8	3.4	3.2	3.9	3.3
Cars	413	391	494	598	698	
Heavy Vehicles	9	10	11	17	19	
% Heavy Vehicles	2	3	2	3	3	

3.3 Byron Bay Road Lennox Head (80 km/hr zone north of Ballina Street)

Road Surface	LAeq dB (A)	Comment
Asphalt	65.4	Difference in noise level – quite noticeable Residents near road surface change would notice sudden increase of 6.5 decibels as vehicles travelled from south to north.
10/7 Sprayed Bitumen	71.9	
Difference (decibels)	6.5	

3.4 Angels Beach Drive Ballina (80 km/hr zone north of Bangalow Road)

Road Surface	LAeq dB (A)	Vehicles per Hour	Comment
Asphalt	73.8	1243	Tyre noise more noticeable in modern cars (less engine noise). Mainly engine noise for trucks and buses

3.5 The Coast Road Flat Rock (80 km/hr zone north of Condon Drive)

Road Surface	LAeq dB (A)	Vehicles per Hour	Comment
14/7 L1 26/09	74.6	852	Tyre noise more noticeable in modern cars (less engine noise). Mainly engine noise for trucks and buses
14/7 L2 26/09	74.2	852	
14/7 L3 01/11	75.5	861	

3.5.1 Comparison of Road Surface Noise Levels Angels Beach Drive and The Coast Road

Individual 15 min Periods		1	2	3	4	5	6	7	8
Angels Beach Drive Ballina	LAeq,15min	**73.7**	**72.9**	**73.5**	**74.1**	**74.0**	**73.8**	**74.1**	**74.2**
750m north of North Creek Bridge	Cars	283	256	262	316	365	316	313	325
80Km/hr Zone	Heavy Vehicles	11	6	10	9	6	3	1	3
	% Heavy	3.7	2.3	3.7	2.8	1.6	0.9	0.3	0.9
	Total	294	262	272	325	371	319	314	328

The Coast Road Flat Rock	LAeq,15min	**75.9**	**75.0**	**76.1**	**74.7**	**75.6**	**75.5**
650m north of Condon Drive	Cars	231	196	236	192	227	183
80Km/hr Zone	Heavy Vehicle	6	4	5	2	6	3
	% Heavy	2.5	2.0	2.1	1.0	2.6	1.6
	Total	237	200	241	194	233	186

Coast Road - Same Traffic Volume as Angels Beach Rd	LAeq,15min	**76.8**	**76.2**	**76.6**	**76.9**	**77.7**	**77.8**

Difference (decibels)		3.0	3.3	3.0	2.9	3.6	4.1
Logarithmic Average (decibels)	**3.3**						

Notes

Coast Road traffic volume (01/11/13) was proportionally adjusted to allow for direct comparison of the same traffic flows on each surface. The Coast Road surface is generally 3 – 4 decibels higher than the Angels Beach Drive surface. The increase in noise level is considered to be noticeable.

3.5 Martin Street (Between Tamar Street and Crane Street)

Road Surface	LAeq dB (A)	Vehicles per Hour	Comment
10/7 Sprayed Bitumen	58.0	903	Mainly tyre noise on modern cars. Some engine noise on older cars.

Individual 15 min Periods	1	2	3	4	5	6
LAeq,15min	57.4	58.3	57.8	58.7	58.2	57.3
Cars	165	147	218	248	274	295
Heavy Vehicles	0	0	2	2	2	2
Total	165	147	220	250	276	297
% Heavy	0	0.0	0.9	0.8	0.7	0.7

4 TEST PROCEDURE

4.1 Instrumentation

Table 4.1 Instrumentation for Noise Monitoring

Instrument	Serial #	Calibration Date
Brüel and Kjær 2250L Sound Level Meter	2602785	November 2011
Brüel and Kjær 2250 Sound Level Meter	2449940	April 2012
Brüel and Kjær Acoustical Calibrator model 4231	2263303	June 2013

The sound level meters used during the noise survey conform to Australian Standard 1259 "Acoustics - Sound Level Meters", (1990) as type 1 precision sound level meters and have an accuracy suitable for both field and laboratory use.

The meters' calibrations were checked before and after the measurement periods with a Brüel and Kjær acoustical calibrator model 4231. No significant system drift occurred over the measurement periods.

The sound level meters and calibrator have been checked, adjusted and aligned to conform to the Brüel and Kjær factory specifications and issued with conformance certificates. The internal test equipment used is traceable to the National Measurement Laboratory at CSIRO, Lindfield, NSW.

4.2 Measurement Procedures

Measurements were made in accordance with the procedures laid down in:

1. Australian Standard AS 2702 -1984: '*Acoustics – Methods for the Measurement of Road Traffic Noise Levels.'*

2. Australian Standard AS 1055 – 1997 "*Acoustics – Description and Measurement of Environmental noise*.

Measurements at sites 1, 2, 3 and 6 were conducted with two logging sound level meters to record simultaneously the noise from passing vehicles on the two different road surfaces. Measurements at sites 4 and 5 were conducted with 1 sound level meter. Markers were used on the sound level meter during some of the noise monitoring to identify other acoustical events for later calculations and evaluations. The surface description was supplied by Ballina Shire Council.

The sound level meters were set at a height of 1.5 metres and located near the kerb. The distance from the kerb was determined by several factors:

- Width of carriageway
- Setback to buildings
- Nearby reflective surfaces
- Kerbside obstructions to sound level meter (parked vehicles)

Data that was affected by extraneous noises were deleted from calculations.

5 PERCEPTION OF CHANGES IN SOUND LEVELS

While there are variations in individual perception of the strength of a sound, studies have shown that to a good approximation the following subjective changes in sound pressure level.

Subjective Effect of Changes in Sound Pressure Level

Change in Sound level (decibels)	Change in Power		Change in Apparent Loudness
	Decrease	Increase	
3	1/2	2	Just perceptible
5	1/3	3	Clearly perceptible
10	1/10	10	Half or twice as loud
20	1/100	100	Much quieter or louder

Reproduced from: Engineering Noise Control Theory and Practise – Third Edition. David A Bies and Colin H HansenT

The sound is perceived twice as loud if the sound level increases by 10 dB. Similarly, a 20 dB increase in the sound level is perceived as four times as loud by the normal human ear.

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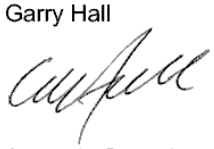


Acoustic Consultant
Ambience Audio Services

APPENDIX A

Definitions of Terms

Sound pressure level (L_p): A measurable quantity of the size or amplitude of the pressure fluctuations (sound waves) above and below normal atmospheric pressure compared to a reference pressure. Sound pressure levels are measured in decibels whereas sound pressure is measured in pascals (N/m^2).

Decibels (dB): a ratio of energy flows. When used for sound measurement, it is the ratio between a measured quantity of sound pressure and an agreed reference sound pressure. The dB scale is logarithmic and uses the threshold of hearing of 20 μPa (micro pascals) as the reference pressure. This reference level is defined as 0 dB.

Frequency (Hz): The number of pressure variations per second (cycles per second) is called the **frequency** of sound and is measured in **Hertz (Hz)**. The rumble of distant thunder has a low frequency, while a whistle has a high frequency. The normal range of hearing for a healthy young person extends from approximately 20Hz up to 20 000 Hz (20 kHz) while the range from the lowest to highest note on a piano is approximately 27.5 Hz to 4.2 kHz.

Spectral characteristics: The frequency content of noise.

"A" frequency weighting: The method of frequency weighting the electrical signal within a noise-measuring instrument to give a very approximate simulate to the human perception of loudness. The symbols for the noise parameters often include the letter "A" (e.g., L_{Aeq}, dBA) to indicate that frequency weighting has been included in the measurement.

Fast, Slow and Impulse time weightings: Standardised root-mean-square (rms) averaging times to help define fluctuating noise levels. Impulsive noises have high peak levels with a very short duration (e.g., gun shot), or a sequence of such peaks. The 'Slow' time weighting averages the fluctuations over a one second time base whilst the 'Fast' time weighting averages the fluctuations over a one-eighth of a second time base. Environmental assessment standards usually specify the time weighting (**F**, **S**, or **I**) to be used.

L_{Aeq}: The A-weighted equivalent continuous noise level. A widely used noise descriptor which provides an average of the energy of a constant level of noise which is the same as the varying noise signal being measured. The time in minutes, which the measurement was sampled, is indicated with a subscripted number e.g. $L_{Aeq,\ 15\ minute}$ is a 15-minute sample.

L_{AN}: The A-weighted sound pressure level that is exceeded for N per cent of the time over which a given sound is measured. e.g. **L_{A90}** is the A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured.

L_{A90} is commonly used to describe the **background noise level** for community noise assessments.

Ambient noise: The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

Extraneous noise: Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by events such as concerts or sporting events. Normal daily traffic is not to be considered extraneous.

Background noise: The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor, fast time weighting.

References:

Measuring Sound Brüel and Kjær Sound & Vibration Measurements A/S September 1984

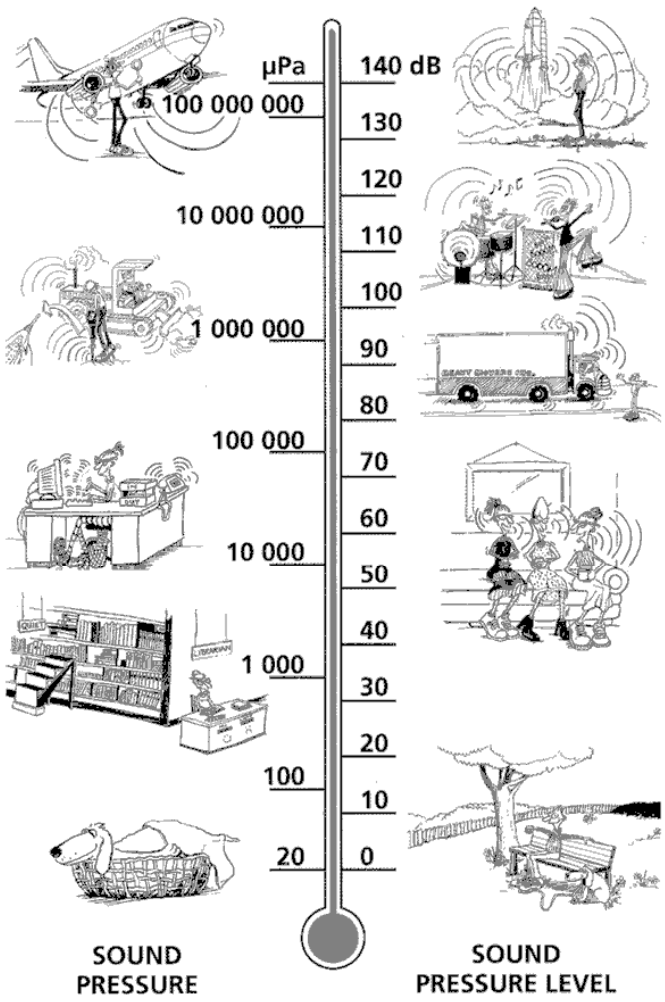
Environmental Noise Brüel and Kjær Sound & Vibration Measurements A/S 2000, 2001

New South Wales Industrial Noise Policy NSW Environment Protection Authority January 2000

Australian Standard AS 3671 – 1989 *Acoustics – Road traffic noise intrusion – Building siting and construction.*

APPENDIX B

Comparison of Sound Pressure Levels



Our hearing covers a wide range of sound pressures – a ratio of over a million to one. The dB scale makes the numbers manageable.

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Environmental Noise Brüel and Kjær Sound & Vibration Measurements A/S 2000, 2001