



**defra**

Department for Environment  
Food and Rural Affairs

# Update of noise database for prediction of noise on construction and open sites

**Phase 3: Noise measurement data for  
construction plant used on quarries**

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## **APPENDIX I – RESULTS DATABASE**

## **1.0 INTRODUCTION**

- 1.1 Hepworth Acoustics Ltd was commissioned by the Department for Environment, Food and Rural Affairs (Defra) to update a database of noise emissions from equipment used on construction and open sites. The existing construction plant noise database is contained in Annex C, Part 1 of British Standard 5228 'Noise and vibration control on construction and open sites'.
- 1.2 This report forms Phase 3 of the study. The objective of the Phase 3 study is to obtain measurements of noise from typical construction-type plant that is currently used on quarries in the UK and to prepare a database of the information. The database is to include octave band noise levels.

## **2.0 BACKGROUND TO THE STUDY**

- 2.1 It is often necessary to evaluate the potential impact of noise from proposed construction and open sites in order to assess potential environmental impact and evaluate requirements for noise mitigation.
- 2.2 In the UK the likely noise levels must be calculated in accordance with the guidance set out in BS 5228 'Noise and vibration control on construction and open sites' which is a code of practice approved by the Secretary of State under the Control of Pollution Act.
- 2.3 Part 1 of BS 5228 includes best practice guidelines for minimising noise impact and describes methods of calculating noise levels from construction and open sites. To assist in the calculations, the standard includes tables of noise emission data for a wide range of construction plant and activities in Annex C. However the majority of the plant noise data in Annex C of BS 5228 is based on research commissioned by the Construction Industry Research and Information Association that was published in 1977. Therefore the majority of information in the current database relates to 1970s machinery and working practices.
- 2.4 Moreover, although Part 5 of BS 5228 deals with quarries, there is no specific data on noise emissions of construction-type machines used in quarries within the Annex C database.
- 2.5 Hence there is a need to obtain noise measurement data in respect of typical construction plant that is currently deployed on quarry sites.

### 3.0 NOISE MEASUREMENTS & DATA ANALYSIS

#### Approach

- 3.1 In Phase 1 of the study it was concluded that data was required for plant in actual use on construction and open sites rather than results from standardised type testing under Schedule 6 of the Noise Emission in the Environment by Equipment for use Outdoor Regulations. This would obtain real life noise levels and would include all noise sources such as horns, reversing sirens, rattling of excavator buckets, impact noises, etc. A method statement for carrying out the noise measurements and data analysis was agreed with the Defra project manager prior to implementation.

#### Surveys

- 3.2 The surveys for Phase 3 of the project were carried out by Hepworth Acoustics in February and March 2006. The plant noise measurements were undertaken on a number of quarries, mainly in Cheshire, Derbyshire, and North Wales.

#### Results

- 3.3 The results of the noise measurements are presented in Appendix II. The results of the sound pressure readings, which were taken at various distances (generally between 10 – 30 metres), have been normalised to a distance of 10 metres, as was done for the existing database in Annex C of BS 5228.
- 3.4 The results are presented as un-weighted octave band sound pressure levels together with overall A-weighted activity sound pressure values. As in the current database in Annex C of BS 5228,  $L_{eq}$  data was used for stationary or quasi-stationary plant/activities and  $L_{max}$  values were used for pass-bys of vehicles.
- 3.5 During the Phase 3 study approximately 300 individual plant noise measurements were taken. However, the aim has been to minimise the number of individual data entries within the database as far as possible. Thus, where appropriate and following discussion with Defra, multiple results for individual plant items have been

presented as (log) average  $L_{eqs}$  for quasi-stationary plant and (log) average  $L_{max}$  values for plant on haul routes.

- 3.6 The results have been separated in to hard rock quarries [Table 1(a)], other quarries [Table 1(b)] and general activities (lorry movements, water pumps) [Table1(c)].
- 3.7 As in the current database in Annex C of BS 5228, machines are identified by engine power and weight only. It should be noted that engine power is quoted in kW not bhp. Weights for machines, relate to the usual weight references used in the quarrying industry i.e. weights for machines such as excavators, wheeled loaders, etc are the actual weights of the machines whereas weights for dump trucks are the load capacity weights.

## 4.0 COMMENTS AND OBSERVATIONS

4.1 Our observations and comments on the findings of the study are set out below.

### **Hard Rock Quarries**

4.2 Our definition of hard rock quarries is quarries where blasting is required. The data was obtained from a number of quarries, mainly limestone quarries in Derbyshire and North Wales. The data has been presented in a logical order in Table 1(a) commencing with drilling of shot firing holes.

4.3 There may still be some old, open drill rigs in use at some quarries but there has been a general move towards the use of modern enclosed mobile drilling rigs with a cabin for the driver/operator. The latter type were in use at the quarries we visited. The drill rigs are used to drill holes for shot firing (blasting). Typical hole diameters are 100-150mm with depths typically of 10-15 metres.

4.4 The blasted rock is then transported to the crushing plant. On large sites this involves a large hydraulic tracked face shovel, or wheeled loader, loading large capacity (>50t) rigid bodied dump trucks. On smaller sites articulated dump trucks may be used.

4.5 On some sites, oversized rocks may have to be broken up near to the face by a rock breaker mounted on to a hydraulic tracked excavator. Alternatively a tracked semi-mobile crusher may be used.

4.6 The rock is then loaded by the dump trucks into the feed system of the fixed processing plant. The fixed processing plant does not form part of this study but may involve just crushing and screening (grading) of stone, or the manufacture of 'added value products' involving lime processing, asphalt coating plant, mortar plant, cement manufacturing, block works, etc.

4.7 The crushed stone, or processed material, is then loaded on to road lorries. Some noise measurements of road lorries leaving the weighbridge are included in Table 1(c). These are generally at low speed because speeds limits are usually in place on quarry access roads.



### **Other Quarries**

- 4.8 'Other quarries' comprise quarries or pits where blasting is not necessary and the mineral is simply dug out of the ground such as sand, gravel, clay, etc. Our measurement data was obtained from a number of pits (primarily sand and gravel workings) in Cheshire and North Wales and the results are shown in Table 1(b).
- 4.9 Sand/gravel workings involve the extraction of the material followed by transport to the loading area or fixed processing plant. Within the industry there has been a general move away from dredging of sands and gravel to dry working. Once any top soils have been removed, this simply involves the use of one, or more, face shovels (wheeled loaders) extracting material from the toe of the working face. At some sand and gravel workings a semi-mobile vibrating screen/stockpiler may be used near to the quarry face.
- 4.10 The excavated material is then transported to the processing/lorry loading area usually by a field conveyor system. The conveyor belts themselves do not generate any significant noise (as long as the rollers are greased regularly) but there may be some localised noise from conveyor drive units.
- 4.11 At some workings (e.g. sand, gravel, clay for construction works) the excavated material may simply be loaded in to road lorries and taken away. At others there may be some fixed processing plant which varies greatly between quarries (in terms of size, age, purpose, design). Fixed processing plant does not form part of this study but may involve washing, screening (grading), drying, of the material for foundry use, glass industry, etc.
- 4.12 During our surveys there were generally no soil stripping operations taking place (this is typically undertaken by contractors in the summer) but there is adequate noise data for small excavators, bulldozers, etc, undertaking preparatory earthworks in the results for the Phase 2 study.

## **5.0 SUMMARY AND CONCLUSIONS**

- 5.1 Hepworth Acoustics have produced a database for construction-type equipment used on quarries. The database was obtained from measurements undertaken on a number of hard rock and other quarries. The database includes octave band noise data.
- 5.2 In our judgement (and as recommended in Part 1 of BS 5228) when calculating noise from proposed open sites (such as new quarries or extensions to existing quarries) the best approach is to actually measure noise emissions from the exact type of plant that is to be used. However, in many cases it may not be practical to do so and in such circumstances use of the new database for environmental noise calculations will give greater accuracy than relying on 'type test' noise emission data quoted by plant manufacturers.

**APPENDIX I- DATA TABLES**

Table 1(a) - Hard Rock Quarries

Ref No.	Equipment	Power rating kW	Equipment size, weight (mass), capacity	Octave Band Sound Pressure Levels @10m (Hz)								A-weighted Sound Pressure Level L <sub>Aeq</sub> dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
<b>Drilling Blast Holes</b>												
1	Tracked Mobile Drilling rig	317	20t / 125mm dia	86	92	85	88	84	83	78	77	<b>90</b>
2	Tracked Mobile Drilling rig	270	23t / 110mm dia	94	95	90	91	87	85	80	73	<b>92</b>
3	Tracked Mobile Drilling rig	186	16t	77	83	82	84	85	85	84	79	<b>91</b>
4	Tracked Mobile Drilling rig	321	-	83	84	79	85	82	79	75	71	<b>87</b>
<b>Face Shovel Loading Dumptrucks</b>												
5	Tracked hydraulic excavator (mainly engine noise)	400	82t	90	85	79	80	78	75	70	62	<b>83</b>
6	Tracked hydraulic excavator	235	47t	95	93	89	89	86	82	76	74	<b>91</b>
7	Wheeled loader	597	94t	88	88	87	85	86	83	77	70	<b>90</b>
7	Wheeled loader	466	82t	88	93	84	84	83	81	79	69	<b>88</b>
8	Wheeled loader	370	50t	89	87	84	82	81	81	72	65	<b>86</b>
9	Wheeled loader	364	56t	91	94	90	86	86	83	77	69	<b>91</b>
10	Wheeled loader	325	58t	89	87	85	83	84	80	75	71	<b>88</b>
<b>Breaking Boulders/Oversized Material</b>												
11	Excavator mounted rock breaker	125	29t	91	89	85	89	87	87	84	80	<b>93</b>
12	Excavator mounted rock breaker	102	23t	86	86	83	78	80	78	76	71	<b>85</b>
13	Excavator mounted rock breaker	100	22t	85	88	85	89	92	88	86	81	<b>95</b>
14	Tracked Semi-Mobile Crusher	310	90t	91	91	88	87	85	83	78	68	<b>90</b>
15	Tracked Semi-Mobile Crusher	250	38t	98	98	97	94	91	88	82	72	<b>96</b>
<b>Dumptrucks on Haul Roads</b>												
16	Rigid Dump Truck Ж	699	90t	86	89	88	88	86	83	76	70	<b>91Ж</b>
17	Rigid Dump Truck Ж	567	64t	99	95	87	86	84	83	77	73	<b>90Ж</b>
18	Rigid Dump Truck Ж	544	60t	95	97	89	85	83	83	76	75	<b>90Ж</b>
19	Rigid Dump Truck Ж	517	63t	90	91	88	85	83	82	77	73	<b>89Ж</b>
20	Rigid Dump Truck Ж	517	60t	96	97	90	84	84	84	74	76	<b>90Ж</b>
21	Rigid Dump Truck Ж	362	41t	92	91	86	85	84	85	77	77	<b>90Ж</b>
22	Articulated Dump Truck Ж	309	40t	100	97	88	84	82	80	77	68	<b>89Ж</b>

Ж Drive-by maximum sound pressure levels in L<sub>max</sub> (Octave Bands) and L<sub>Amax</sub> (Overall Level)

<b>Dumptruck Discharging into Hopper</b>												
23	Rigid Dump Truck	544	60t	88	82	77	79	80	79	73	67	<b>85</b>
24	Rigid Dump Truck	362	40t	89	84	80	82	80	78	72	64	<b>85</b>
<b>Lorries being loaded from silo</b>												
25	Lorry	310 - 350	32t - 36t	80	79	74	76	76	76	73	65	<b>82</b>
<b>Loading Chippings into Dumptrucks</b>												
26	Wheeled Loader	320	45t	89	90	86	82	83	77	75	64	<b>87</b>
27	Wheeled Loader	221	30t	91	81	73	71	71	72	62	59	<b>77</b>

Table 1(b) - Other Quarries (i.e. Sand and Gravel)

Ref No.	Equipment	Power rating kW	Equipment size, weight (mass), capacity	Octave Band Sound Pressure Levels @10m (Hz)								A-weighted Sound Pressure Level L <sub>Aeq</sub> dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
<b>Face Shovel Extracting/Loading Dumptrucks</b>												
1	Tracked hydraulic excavator	184	37t	82	87	82	77	72	70	66	59	80
2	Tracked hydraulic excavator	74	19t	82	75	72	73	71	70	66	58	76
3	Wheeled loader	198	29t	88	84	81	84	76	70	68	61	83
4	Wheeled loader	193	31t	87	87	85	75	76	74	69	62	82
<b>Face Shovel Loading Hopper</b>												
5	Wheeled loader	232	39t	84	88	81	74	74	71	66	65	80
<b>General Wheeled Loader Operations</b>												
6	Loading Sand to Lorry	221	30t	93	78	73	72	76	83	71	57	85
7	Loading Sand to Lorry	198	29t	81	79	75	77	71	65	61	53	77
8	Loading Sand to Lorry	193	23t	85	83	76	76	75	72	72	61	80
9	Loading Sand to Lorry	180	21t	90	79	71	69	71	67	61	55	75
10	Loading Gravel to Lorry	193	23t	89	86	87	77	78	77	73	68	85
11	Loading Dumptruck with Pebbles	232	39t	92	84	84	80	79	78	75	72	85
12	Loading Dumptruck with Pebbles	184	23t	87	84	82	77	76	74	70	65	82
13	Picking Up Sand from Stockpile	175	23t	89	80	82	73	70	69	64	57	78
<b>Semi-mobile Screen/Stockpiler</b>												
14	Screen stockpiler	56	15t	93	86	79	78	75	71	69	62	81
15	Screen stockpiler	51	17t	84	82	79	79	74	74	71	64	81
<b>Transport of Material</b>												
16	Wheeled loader Ж	193	31t	83	89	92	80	71	69	64	58	85Ж
17	Wheeled loader Ж	184	23t	77	83	91	75	75	72	65	59	84Ж
18	Articulated Dump Truck Ж	309	37t	87	85	83	81	78	74	71	66	83Ж
19	Articulated Dump Truck Ж	239	23t	98	94	89	85	79	79	70	65	87Ж
<b>Field Conveyor System</b>												
20	Conveyor drive unit	42	-	71	69	68	71	75	67	63	57	77
21	Conveyor drive unit	37	-	73	75	73	73	70	68	66	59	76
22	Feed Hopper Conveyor drive unit	6	-	71	68	62	63	66	62	58	51	69
23	Field conveyor (Rollers)	-	-	58	52	52	43	43	42	47	47	53

Ж Drive-by maximum sound pressure levels in L<sub>max</sub> (Octave Bands) and L<sub>Amax</sub> (Overall Level)

Table 1(c) - General

Ref No.	Equipment	Power rating kW	Equipment size, weight (mass), capacity	Octave Band Sound Pressure Levels @10m (Hz)								A-weighted Sound Pressure Level L <sub>Aeq</sub> dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
<b>Pumping Surface Water</b>												
1	Diesel water pump	136	-	81	83	77	75	76	75	69	63	81
2	Diesel water pump	25	-	81	71	67	62	65	65	63	59	71
3	Electric water pump	37	-	67	65	65	64	63	63	60	54	69
<b>Lorry Movements on Access Road</b>												
4	Lorry	350	44t	82	80	78	75	76	78	75	69	83
5	Lorry	350	36t	92	82	77	76	77	72	68	63	80
6	Lorry	343	29t	92	82	76	78	77	76	74	68	83
7	Lorry	313	44t	87	79	77	74	73	73	70	64	79
8	Lorry	313	40t	81	79	79	83	84	81	76	70	88
9	Lorry	313	32t	99	82	81	76	78	74	71	66	82
10	Lorry	310	32t	91	79	77	74	71	69	64	61	77
11	Lorry	306	44t	96	79	75	79	82	80	72	67	86
12	Lorry	298	44t	96	80	75	75	74	72	67	60	79
13	Lorry	283	44t	84	80	76	74	73	70	67	61	78
14	Lorry	254	32t	93	79	76	74	73	72	69	66	79
15	Lorry	242	32t	86	94	81	77	80	77	75	69	85
16	Lorry	235	26t	86	81	74	76	73	72	69	60	79
17	Lorry	233	32t	91	78	74	70	72	74	66	59	78
18	Lorry	216	32t	85	78	83	82	86	80	73	69	88
19	Lorry	201	26t	87	76	73	81	79	75	68	62	83
20	Lorry	160	18t	91	76	79	78	80	76	70	64	83