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INDUSTRIAL HYGIENE NOISE REPORT

A Comprehensive Noise Survey Associated With Operation of No.1 Colorcoat Line, Tata Steel Colors (UK), Shotton Works

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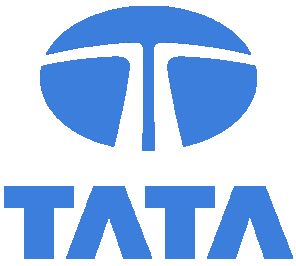

1. INTRODUCTION

As part of a planned programme of Industrial Hygiene services to Tata Steel Colors (UK), a request was made to update noise exposure information associated with operation of No.1 Colorcoat Line at Shotton Works. Subsequently, a comprehensive survey was carried out during typical processing of 0.58mm gauge plastisol material between the 21st and 23rd of October, 2013. The objectives of the survey were to:-

i) undertake an assessment in accordance with the Control of Noise at Work Regulations (CNAWR) 2005;

ii) evaluate the daily personal exposures ($L_{EP,d}$s) of production Team Members;

iii) describe the acoustic environment associated with the operation of No.1 Colorcoat Line and associated machinery, in terms of the equivalent continuous noise levels, statistical distribution analyses and frequency analyses;

iv) map the line and review the existing designated hearing protection zones;

v) check the suitability of the hearing protection devices approved for use on No.1 Colorcoat Line;

vi) provide the basis for a Noise Management Action Plan which describes the programme of control measures recommended to reduce noise exposures so far as is reasonably practicable.

2. METHOD/SURVEY EQUIPMENT USED

Information concerning the variation in noise levels to which production line Team Members were exposed was obtained from the issue of Bruel & Kjaer type 4443 personal dosemeters, for work tasks typical of routine production. This information, in conjunction with sound level meter recordings, was used to evaluate Daily Personal Noise Exposures ($L_{EP,ds}$) due to team-working duties over a 12-hour shift period.

Detailed statistical distribution and frequency analysis data obtained from samples of typical operation at various manned locations in the vicinity of the line, permitted the equivalent continuous noise levels (L_{eq}s), the fast response maxima (L_{FMAX}), peak levels (L_{CPK}) and percentiles (L_{F10}, L_{F50} & L_{F90}) to be evaluated. Measurement instrumentation used for this purpose was a Bruel & Kjaer type 2260 Modular Precision Sound Analyser, in combination with Bruel & Kjaer Type 4231 Sound Level Calibrator.

Comparison of the frequency distribution analysis and the attenuation data provided by the manufacturers enabled an indication of the effectiveness of the hearing protection devices worn by line operators, to be obtained. This calculation was performed according to the guidance provided in the HSE publication L108 “Controlling Noise At Work”.

Appendix 2 gives a glossary of the technical terms and units used in this report.

3. RESULTS

Figures 1 & 2 show a pictorial quick reference to noise levels recorded at regularly manned, or visited locations on No.1 Colorcoat Line.

Tables 1 summarises operative $L_{EP,d}$s and evaluated for Team Members undertaking those routine production tasks undertaken on No.1 Colorcoat Line.

Tables 2 - 5 summarise the statistical distribution analyses and octave band frequency analyses for samples recorded at locations on and around the No.1 Colorcoat Line.

Table 6 shows a summary of the calculated effectiveness of the hearing protection devices approved for issue on the colorcoat lines and associated with areas, with reference to the frequency distribution spectra obtained from recorded samples.

4. PROCESS DESCRIPTIONS IN TERMS OF NOISE EXPOSURE

4.1 Entry and Exit-end Operations

It is at the entry and exit ends of the line where high intensity impact noises occur as a result of the cyclical movement of coils, manipulation of the ends, cutting of the strip, stitching, edge-trimming, banding and the manual/automatic discarding of off-cuts.

At the entry-end are the facilities for handling and introducing the coiled strip substrate to the line, in conjunction with the shears, stitching and accumulator units, which provide continuity to the process. Use of the entry cutting machine - where the quality of the lead edge of the ongoing coil and tail end of the last coil are squared-off with several impacts from the shears - immediately followed by the crashing impacts associated with skip deposition of the off-cuts which provide the greatest source of noise exposure. Depending on the gauge of material processed, these operations may be repeated many times during a typical shift by two Team Members, operating outside of the acoustic control cabin.

At the exit, the strip is also cut across its width with the exit, flying shears before recoiling. The exit or delivery end is permanently manned by three Team Members and exit coil handling procedures are also performed external to the control room.

4.2 Pre-treatment Section

Production between the entry and coating sections is maintained as continuous in nature by the entry accumulator. This part of the line is seldom manned, except for periodic checks and persons accessing the entry process. Noise levels remain fairly constant in this part of the line.

4.3 Coating Section

The coating section of the line is manned permanently, by three Coater Operators. Work tasks involve periodic checks of coating quality and general cleaning down operations to enable colour/product and roller changes. During such operations (which may be between one and eight clean-downs per shift) operators are exposed to continuous noise sources - such as processing motors and LEV systems, as well as task-related sources such as pumps, trolley jacks, crane hoist motors and the tray washing machine for brief periods. Between those tasks, the three operators remain housed in an acoustic control room directly in front of the top-coat applicators.

The single Paint Kitchen operator ensures scheduled paints have the correct viscosity and are sufficiently stirred prior to use on the line. Movement of containers to and from the line is via the use of a fork-lift truck.

5. EXISTING NOISE CONTROL MEASURES

Existing noise control is dependent upon the a combination of current engineering measures, attenuation by distance, acoustic control pulpits and in particular, the correct wearing of approved hearing protective devices in designated areas of the line.

5.1 Hearing Protection Zones & Hearing Protection Issue

A blanket, local hearing conservation policy has designated all production areas of No.1 Colorcoat Line as a hearing protection zone with dispensation given to the coater rooms so that Coater Operators are not encumbered by the hearing protection/helmet combination when undertaking cleaning down operations.

Shotton has standard issue ear defender muffs - Peltor Optime II 520P3E, Protector Zone 2 and Protector EC10 – approved for all areas, however, a specific type – Centurion Baltic and Aegean muffs - have been assigned for attachment to the helmet/visor ensemble required in the adjacent galvanising area where there may be exchange of personnel. Disposable plugs, namely the “3M EAR Push In” type, was observed to be worn by Entry Operatives.

It is those muff-type and disposable plug devices that have been evaluated for compatibility against the frequency characteristics of the acoustic environment associated with No.1 Colorcoat Line operations, in this report. EMTEC Noisebreaker personal moulded plugs have also been included as their optional use has been recommended in Section 8 of this report.

6. NOISE LEGISLATION

6.1 The Requirements of the Control of Noise At Work Regulations (CNAWR) 2005

The specific duties required, with regards to the protection of employees from the health and safety risks associated with exposure to noise at work, are detailed in the Control of Noise at Work Regulations (CNAWR) 2005. CNAWR place a general duty on the employer to reduce the risk of hearing damage from exposure to noise to the lowest level reasonably practicable.

Two noise levels are defined in CNAWR, where appropriate action is required to be taken:-

i) a lower Exposure Action Value (EAV) - $L_{EP,d}$ of 80 dBA and peak sound pressure (L_{PK}) of 135dBC;

ii) an upper EAV -$L_{EP,d}$ of 85 dBA and (L_{PK}) of 137 dBC;

and an Exposure Limit Value (ELV) -$L_{EP,d}$ of 87 dBA and (L_{PK}) of 140 dBC which, when **taking into account the attenuation** provided by hearing protection, **must never be exceeded**.

Regulations for controlling noise place the following duties:-

i) to eliminate risks from noise exposure completely where it is reasonably practicable to do so;

ii) where elimination is not reasonably practicable, reduce those risks to the lowest level reasonably practicable;

iii) whenever exposure is likely to exceed the upper EAV, introduce a formal programme of measures designed to reduce exposure which do not include hearing protection;

iv) not to expose anyone above the ELV.

Those specific actions required by the CNAWR 2005 are summarised and tabulated in Appendix 1 of this report.

6.2 Requirements for Control Cabins/Pulpits or Rooms

The minimum requirement for the acoustic environment inside any cabin, pulpit or control room is that it should permit shift-long occupancy without the risk of hearing damage. Where occupants are required to spend time in a noise environment external to the cabin, it is desirable that the interior helps to limit the total noise exposure to below 85dBA. This requires the noise level within to be significantly below 85 dBA, i.e. 75 - 80 dBA. Even lower noise levels are desirable in certain cabins/pulpits or control rooms where task performance requires a high degree of concentration, speech or telephone communication. The maximum interior noise limits which all cabins, sound havens and control rooms should satisfy for comfort and communication criteria are summarised in Tata Steel Information and Procedural Document 108c - Guidelines for the provision of sound insulated cabins and control rooms.

7. CONCLUSIONS

7.1 Daily Personal Exposures ($L_{EP,d}$s)

a) $L_{EP'd}$s for all line operatives monitored were between the lower and upper CNAWR Exposure Action Levels (EAVs). This means that those requirements of the CNAWR relevant to exposure beyond the upper EAV are not invoked, but maintained as a prudent assumption of risk and best practice. In view of the relationship between noise-induced hearing loss and the ototoxic action of certain solvents, as well as the potential for rotation of colorcoat line duties, a prudent course of action would be to ensure inclusion of coater room and paint kitchen operatives in the audiometric screening programme.

7.1.1 Entry End Operators

b) $L_{EP'd}$s evaluated for the entry-end Team Members were below the CNAWR upper EAV.

c) Much of the noise contributing to the exposure experienced by entry Team Members is due to short duration, high energy impacts associated with movement, location and cutting of the coil strip when introduced to the line and, in particular, transfer and deposition of strip off-cuts into the skip.

7.1.2 Coater Operators

d) During a period in which cleaning down operations were carried out, coater room operations raised exposures to reach and exceed 85 dBA. However, these operations are sufficiently interspersed with processing spells inside the coater room to evaluate shift exposures well below the upper EAV.

e) The exposure for the Paint Kitchen Operator was also evaluated at the lower EAV.

7.1.3 Exit End Operators

f) $L_{EP'd}$s for exit operators were consistent at 83 dBA and therefore below the upper EAV. This exposure included several occasions in which the flying sheers was in operation.

g) The $L_{EP'd}$ for the designated driver, operating mainly the exit crane, equalled the lower EAV.

7.2 Sampled Noise Measurements

7.2.1 Entry End & Pre-treatment Operations

h) Entry coil-on operations – including operation of the cutting shears and stitcher - in a full production coil cycle at the entry pay-off reels, produced short-duration, high intensity impulses between 93 and 105 dBA and peaks approaching 134 dBA. The L_{Aeq}, however, remained below 85 dBA.

i) At all landing levels external to the control room, noise levels remained below 80dBA, except during operation of the shears (87 - 105 dBA).

j) Processing between entry control and the entry accumulator produced steady-state noise levels between 80 dBA and 85 dBA. At the tension level, these noise levels were elevated to between 86 dBA and 88 dBA, with the highest level recorded for this unit being on the drive side of the entry bridle.

k) Progress along the line to the pre-treatment section - containing the chemical coater, chem.-coater oven, upper walkway hot rinse/redundant tanks and the horizontal strip traverse to No.3 bridle – noise levels resumed at levels well below the legislated 85 dBA. These areas are primarily unmanned except, for transient personnel and the Roll Grinding Operator's station adjacent to the lathe. At that location, with the lathes's LEV operational, the noise level was a continuous 81 dBA.

7.2.2 Coating and Curing Sections

l) Whilst processing, noise levels on the interiors of all three coater rooms were in the range 79-83 dBA. Activities associated with cleaning-down and roller-changing operations (positioning of drums and pumps; operation of trolley jacks, handling of trays, operation of the tray washing machine and crane hoists) raised L_{Aeq}s and exposures inside the main coaters to reach 85 dBA.

m) Operation of the trolley jack in the lower coater produced a noise level of 94 dBA. Although not operating continuously, a few minutes operating at close quarters to this facility is likely to raise noise exposures in an area where hearing protection is not usually worn. The high noise level is due to a silencer being out of service because it became heavily contaminated with paint. Replacement of the silencer and enclosure as protection from accidental paint spillages and splashes, would reduce the noise levels experienced during cleaning-down significantly.

n) Crane hoist mechanisms used during roller changes also produced noise levels greater than 90 dBA (93 dBA) for their brief period of operation.

o) On the second-level walkway, at the operator side of the primer oven, noise levels increased from 84 dBA to 86 dBA from entry to exit ends. On the drive side, where the fan drive motors and LEV systems operate, noise levels were raised to between 84 dBA and 90 dBA adjacent to the exhauster fans.

p) On both sides of the primer quench, continuous noise levels were also 90 dBA. The air-knife fan adjacent to the post-quench deflector turn-down roll generated a continuous noise level of 99 dBA. This was the highest processing noise level recorded on the line.

q) On the ground-level walkway, at the operator side of the finish oven, noise levels increased from 86 dBA to 88 dBA from entry to exit ends. On the drive side, where the fan drive motors and LEV systems operate, noise levels were raised to range between 86 dBA at the air seal and 90 dBA adjacent to the exhauster fans.

r) All around the embosser and finish quench, noise levels were maintained between 87-88 dBA.

s) These measurements justify the continued designation of the curing, embosser and quench sections - at all levels - as a hearing protection zone.

7.2.3 Exit End Operations

t) Coil changing operations at the exit end of the line generated noise levels between 82 dBA and 90 dBA, with an overall L_{eq} below 85 dBA.

u) At the rear the exit re-coilers – adjacent to the hydraulic and accumulator pumps - noise levels were 85dBA and 87dBA, respectively.

v) Structural alterations to the interior fabric of the exit control/inspection room were ongoing at the time of this assessment. This may have allowed the ingress of external plant noise, accounting for the slightly raised level internally during processing.

w) During strip processing on the interior of exit control/inspection room, noise levels were 76 dBA. Repeated impacts associated with operation of the flying shears, for a few minutes, several times during a shift, elevated noise levels to an L_{eq} of 94 dBA, including a maximum level of 105 dBA.

x) These measurements justify the continued designation of the remainder of the line, from the entry seals of the primer/finish finish oven to the re-coilers, as a hearing protection zone. A hearing protection zone should also be maintained within the exit/control inspection room during the operation of the flying shears.

7.3 Control Rooms

y) Noise levels in the control pulpits (<65 dBA) provide suitable noise refuge during processing and satisfy those comfort and communication criteria specified in Information and Procedural Document 108c.

7.4 Hearing Protection

z) Calculations carried out according to HSE guidance show that, when worn correctly, those general use hearing protectors - Peltor Optime II 520P3E, Centurion, Protector EC10 and Protector Zone 2 muffs - reduce the equivalent continuous noise levels, generated by **all sampled noise sources**, to below 87 dBA at the ear.

aa) EMTEC Noisebreaker personal moulded plugs have been included as an option to protect coater room operatives during cleaning-down operations and the regular use of machinery generating noise levels above 90 dBA.

bb) 3M EAR Push In plugs were the hearing protective devices of choice for the Entry End Operator monitored. Although the calculated attenuation figures show that they are very effective on paper, practically they are not always inserted correctly.

7.5 Hearing Protection Zones & Noise Warning Notices

cc) These measurements justify maintaining the local bay area containing the whole of No.1 Colorcoat Line as a hearing protection zone.

dd) All access-ways serving No.1 Colorcoat Line as the “safer” walkway access and egress, have been clearly marked with warning notices.

ee) For the purpose of future zoning of the green walkway on the operator side of the line, the noise level does not reach 85 dBA in the packing area of the bay or until immediately after the entry accumulator, when approaching from the entry-end.

8. RECOMMENDATIONS

8.1 Noise Management Action Plan

As the $L_{EP'd}$ evaluated No.1 Colorcoat Line Team Members were between the lower and the upper EAVs, certain duties imposed by the CNAWR 2005 are invoked. These include the general duty to reduce further the risk of hearing damage by means other than the use of hearing protection.

Recommended actions in order to achieve this should identify:-

8.1.1 Immediate Actions - Based on Current Operating Practices

The priorities for action should be to:-

a) ensure that all Team Members, Maintenance Engineers, Management and contractors dedicated to No.1 Colorcoat Line and associated areas have approved hearing protection that is in good functional condition. The approved devices for all are the Optime II 520P3E, Protector EC10 and Protector Zone 2 helmet-mounted muffs.

b) as a prudent assumption of increased risk - in terms of the measured elevated noise levels associated with cleaning-down duties and in view of the relationship between noise-induced hearing loss and the ototoxic action of certain solvents - consideration should be given to the issue of appropriate hearing protection devices to Coater Room Operators in order to provide them with a minimal level of protection without hindering comfort and communication in cleaning down activities.

c) ensure that arrangements are in place for regular training updates for **all** operatives in the awareness of noise exposure risks, the importance of continuous and correct wearing of hearing protection - as well as the procedures for reporting defects and obtaining replacement sets.

d) ensure that approved hearing protection is worn by **all** who enter designated hearing protection zones, **however brief the visit**.

e) undertake a tour of the No.1 Colorcoat Line and associated plant areas to ensure that access-ways, doors and approach boundaries to all areas, designated as hearing protection zones, have the approved noise hazard signs - correctly positioned so as to warn those entering that the wearing of ear defenders is mandatory, **however brief the visit**.

8.1.2 Longer-term Actions

The actions for noise reduction should include the following longer-term recommendations to ensure continued compliance with the CNAWR 2005 as a duty to reduce the dependency placed upon the provision of hearing protection for control.

a) Practicable priorities to reduce noise at source by engineering means should be identified and the likely improvement that can be achieved by such measures specified.

b) Trolley jack silencers should be replaced, enclosed and maintained in order to reduce the noise generated by their periodic operation and to prevent further contamination.

c) The interior of the exit control/inspection room should be isolated as far as quality inspection will allow, to continuous plant noise and, in particular from the action of the flying shears.

d) Emphasis should be placed on engineering means to reduce noise generated by the post primer quench air-knife, particularly with regard to the discharge of high velocity air associated with its use.

e) A documented positive purchase and hire policy should be drafted for the Tata Steel Colors (UK) business, which demonstrates that noise is a consideration when purchasing or hiring new equipment and machinery or undertaking refurbishment. This should involve insisting on a statement from all contractors tendering for supply of new plant/machinery that their equipment will not generate noise levels in excess of 85dBA at workstations or any point in the vicinity.

f) Arrangements for confirming the provision of health surveillance to all Coater Operators (as the occupation has been identified in this report as having the potential for exposure to ototoxic solvents), under the terms of the CNAWR 2005.

g) Team Members, shift and day maintenance support (as a precautionary measure), as well as any contractors dedicated for long periods of their regular shift pattern external to cabins **on the No.1 Colorcoat Line**, should continue participation in the audiometric screening programme provided by the Occupational Health Department.

h) Regular tours or audits of the No.1 Colorcoat Line should be undertaken to ensure that all measures and work practices implemented for the control of noise are utilised and followed. It should also be ensured that access-ways, doors and approaches to those areas, designated as hearing protection zones, have the approved noise hazard signs, correctly positioned and that individuals entering those areas are wearing approved hearing protection as required, however brief the visit.

8.2 Assessment Review

i) This assessment should be reviewed if there is any change to the work process, shift patterns, plant throughput used or the introduction of further control measures. The HSE recommendation is that - even if no changes warrant such a review - the need for review should be checked following a period of two years.

A. Jenkins

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TABLE 1

A SUMMARY OF THE $L_{EP'D}$ EVALUATED FOR TEAM MEMBERS ENGAGED ON NO.1 COLORCOAT LINE

Occupation	Date	Noise Level (dB)	
		Daily Personal Noise Exposure ($L_{AEP,d}$)	Peak Noise Level (L_{Cpk})
Team Leader	24/10/13	81	125
Entry Operator 1	24/10/13	84	134
Entry Operator 2	24/10/13	81	132
Exit Operator 1 (Inspection)	24/10/13	83	130
Exit Operator 2	24/10/13	83	128
Crane Driver	25/10/13	80	130
Coater Operator 1	25/10/13	82	131
Coater Operator 2	25/10/13	82	133
Paint Kitchen Operator	25/10/13	80	128
CNAWR 2005 Lower EAV		**80**	**135**
CNAWR 2005 Upper EAV		**85**	**137**

FIGURE 1

A PICTORIAL QUICK REFERENCE GUIDE TO NOISE LEVELS MEASURED AT REGULARLY MANNED OR VISITED LOCATIONS AND OPERATIONS ON No.1 COLORCOAT LINE SHOTTON WORKS

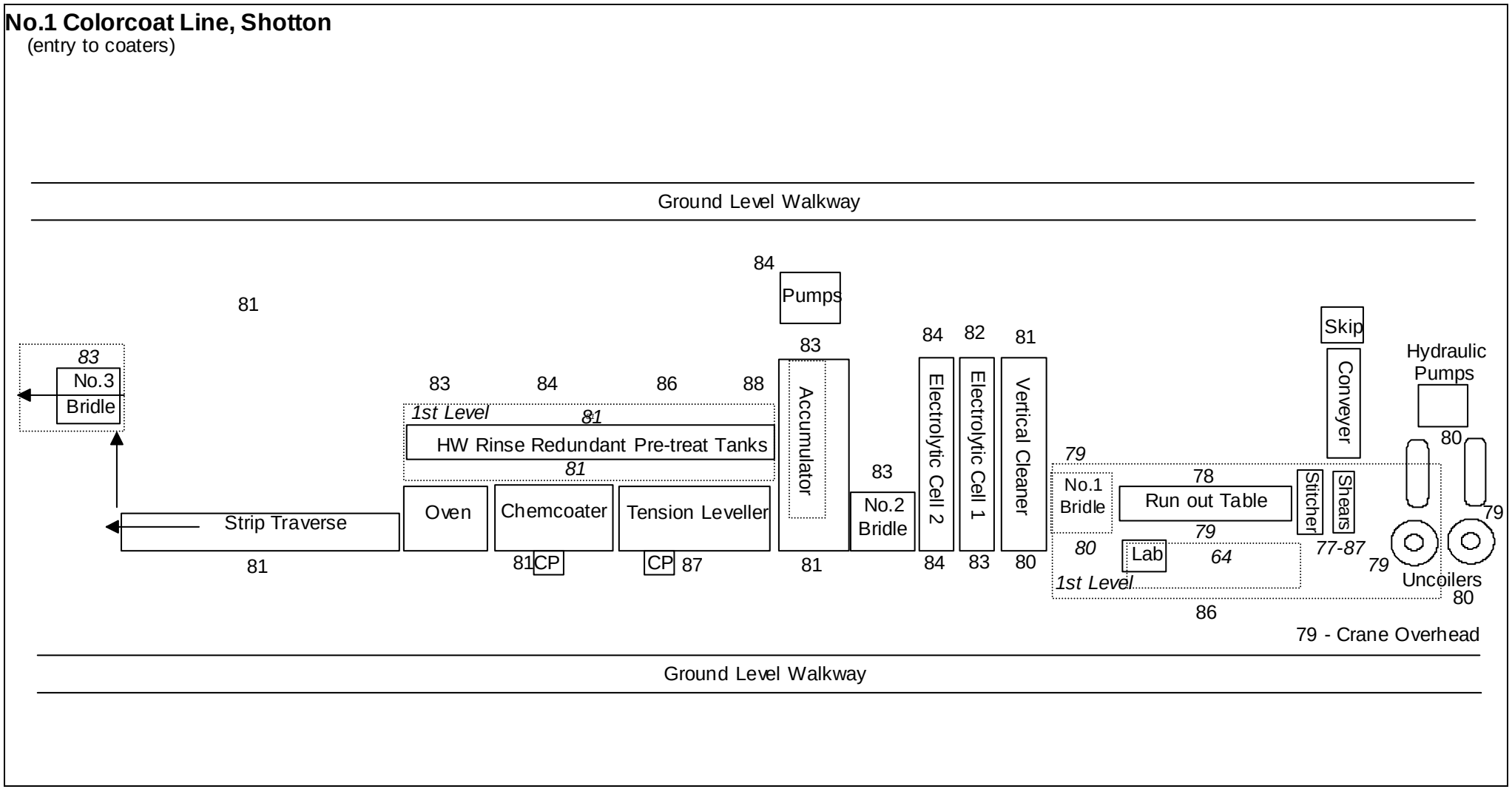

FIGURE 2

A PICTORIAL QUICK REFERENCE GUIDE TO NOISE LEVELS MEASURED AT REGULARLY MANNED OR VISITED LOCATIONS AND OPERATIONS ON No.1 COLORCOAT LINE SHOTTON WORKS

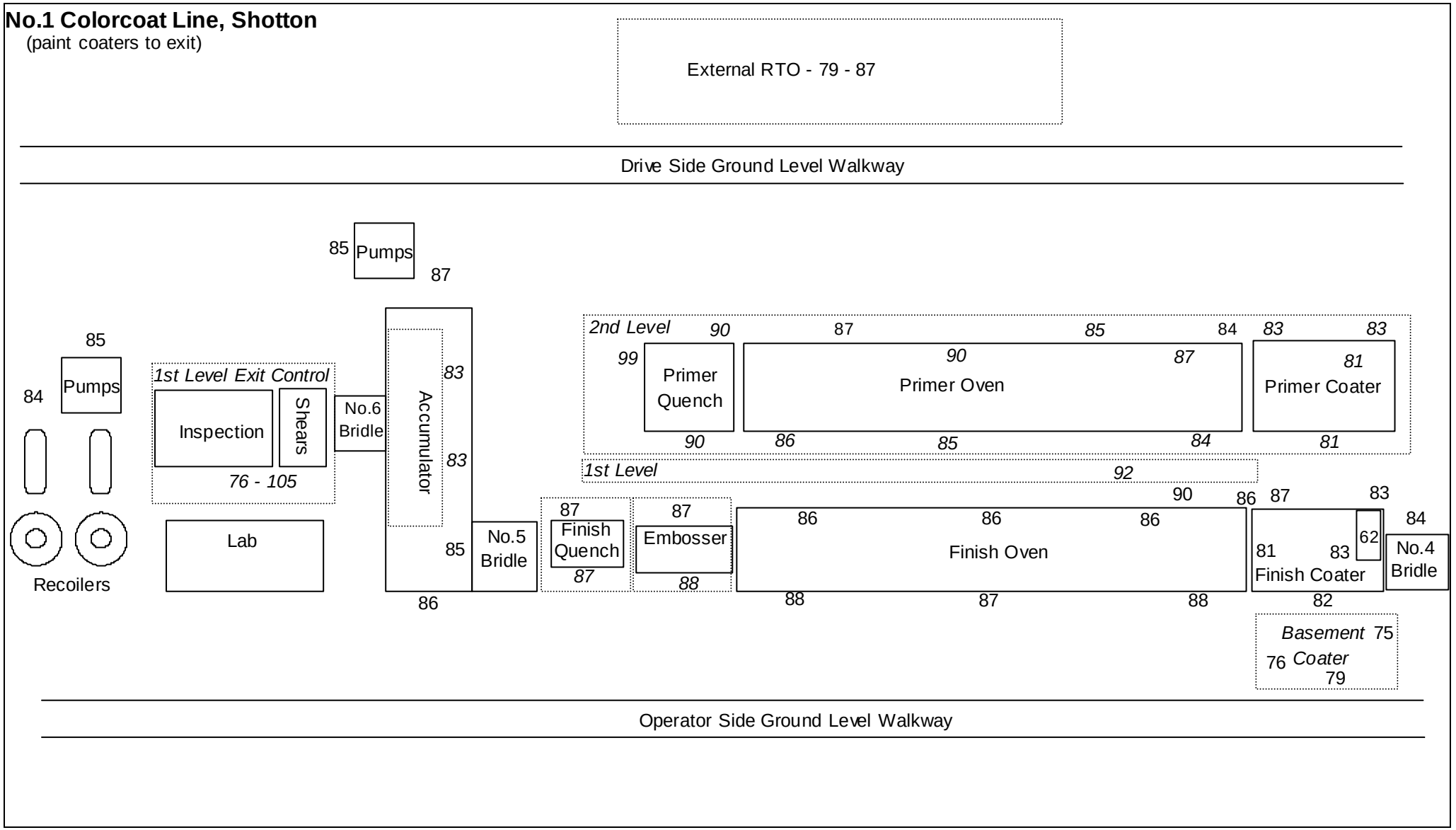

TABLE 2

A SUMMARY OF THE L_{Aeq}S, STATISTICAL DISTRIBUTION AND OCTAVE BAND FREQUENCY ANALYSES RECORDED AT VARIOUS LOCATIONS AND ACTIVITIES ON THE ENTRY PROCESSING SECTION OF NO.1 COLORCOAT LINE

Location/Activity	Noise Level [dB]													
	L_{Aeq}	L_{AFMax}	L_{Cpk}	Percentiles			Octave Band Frequency Analysis (Hz)							
				L_{AF10}	L_{AF50}	L_{AF90}	63	125	250	500	1k	2k	4k	8k
Entry Section														
Pay of Reel Motors	78	80	97	78	78	77	76	78	76	76	73	69	65	58
Between Pay Off Reels Operator Side	79	80	97	79	79	78	74	77	77	77	73	71	64	57
Coil Handling Operations Entry End	80	93	109	81	78	77	77	77	80	78	74	72	67	60
Overhead Crane Entry End	79													
1st Walkway Level - Above Pay Off Reels	78	82	98	79	78	77	77	77	78	77	72	68	63	56
Inside Entry Control Room	64													
Lab Facility Below Entry Control Room	76													
1st Walkway Level - Shears - Operator Side	77	78	96	78	77	77	76	74	77	76	71	69	64	57
Adjacent to Operation of Entry Shears	87	102	115	91	79	77	76	77	81	84	83	79	78	75
Rear of line, in line with Entry Stitcher/Shears	78	79	96	78	78	78	77	76	77	77	73	69	66	61
Run Out Table Operator Side	79													
Run Out Table - Drive Side	78	79	96	78	78	78	78	76	78	76	73	70	66	59
No.1 Bridle - Operator Side	80													
No.1 Bridle Drive Side	79	80	98	79	79	78	78	76	78	78	73	70	67	61
Ground Level, Vertical Caustic Cleaner - Operator Side	80													
Ground Level ,Vertical Caustic Cleaner - Drive Side	80	84	99	80	80	79	78	77	77	78	74	72	70	68
Vertical Caustic Cleaner - 2nd Level Entry Steering Unit	79													
Vertical Caustic Cleaner Upper Levels	78 - 80													
No.1 Electrolytic Cell - Operator Side	84	84	101	84	84	83	78	78	80	82	78	77	72	62
No.1 Electrolytic Cell - Drive Side	82	83	100	82	82	81	78	78	79	80	76	74	69	62
No.2 Electrolytic Cell - Operator Side	82	83	100	83	82	82	79	78	79	81	77	75	69	60
No.2 Electrolytic Cell - Drive Side	84	85	102	84	84	83	80	79	80	82	78	77	72	63
Entry Accumulator - Operator Side	81	82	99	82	81	81	79	78	80	80	76	74	69	59
Entry Accumulator - Drive Side	83	88	100	84	83	82	78	77	81	80	78	76	71	62
Entry Accumulator - Hydraulic Pumps	84	84	102	84	84	83	82	80	82	81	78	76	72	68
Tension Leveller Control Desk	87	88	103	88	87	87	78	79	81	83	82	82	77	69
Tension Leveller Entry Bridle Motors- Drive Side	88	89	104	88	88	87	81	80	84	88	81	80	76	69
Tension Leveller – Exit Bridle Motors Drive Side	86	86	103	86	86	85	81	82	82	84	80	79	74	67

TABLE 3

A SUMMARY OF THE L_{Aeq}S, STATISTICAL DISTRIBUTION AND OCTAVE BAND FREQUENCY ANALYSES RECORDED AT VARIOUS LOCATIONS AND ACTIVITIES ON THE PREATMENT AND PRIMER COATER SECTIONS OF NO.1 COLORCOAT LINE

Location/Activity	Noise Level [dB]													
	L_{Aeq}	L_{AFMax}	L_{Cpk}	Percentiles			Octave Band Frequency Analysis (Hz)							
				L_{AF10}	L_{AF50}	L_{AF90}	63	125	250	500	1k	2k	4k	8k
Pre-treatment Section														
Pre-treatment Chemical Coater	81	83	101	82	81	81	80	78	79	80	76	73	69	67
Drive Motors Drive Side Pre-treatment Chemical Coater	84	88	106	86	84	82	78	79	82	82	78	76	75	74
Chemical-coater Oven - Drive Side	83	85	103	84	83	82	80	78	83	81	77	75	71	69
Strip Traverse Between Pre-treatment and Coating Section	81	82	99	82	81	80	78	77	78	82	75	71	64	56
Strip Traverse Between Pre-treatment and Coating Section - Drive Side	80	82	101	81	80	80	81	77	78	79	75	72	67	57
1st Walkway Level Redundant Pre-treatment Tanks	81	87	103	81	80	80	81	78	79	81	75	71	66	57
Roll Grinding Area LEV Fan Operational	81													
No.3 Bridle Rollers - Drive Side	83	87	102	83	83	82	81	78	81	83	78	71	71	68
Primer Coater Operations														
Inside Primer Coater Room	81													
Walkway Adjacent to Primer Oven - Entry Third	84	85	103	85	84	84	81	82	84	84	79	73	67	61
Walkway Adjacent to Primer Oven - Mid Section	85	88	103	86	85	85	82	77	84	85	79	74	70	63
Walkway Adjacent to Primer Oven - Exit Third	86	87	104	87	86	85	81	77	84	87	80	74	69	60
Primer Oven Entry Air Seal	82	84	102	83	82	82	82	81	82	82	77	71	67	64
Fan Motors Analyser Rear Zone 1 Primer Oven	84	87	105	85	84	83	89	83	82	83	79	75	72	67
Recess Rear Zone 1/2 Primer Oven Rotel Motors	87	88	105	87	87	86	80	82	87	85	80	75	76	76
Motors Rear of Zone 3/2 Primer Oven	85	86	104	85	85	85	81	83	84	84	79	75	76	71
Exhaust Fan Rear Zone 3 Primer Oven	90	92	110	91	90	90	91	90	87	88	85	83	78	73
Recess Rear Zone 3 Primer Oven	85	86	104	85	85	85	86	79	82	85	79	75	73	64
Adjacent to Primer Quench	90	91	107	90	90	89	83	81	87	91	83	78	74	67
Deflector Roll Post Prime Quench (Air Knife Fan)	99	101	115	100	99	99	82	86	90	100	92	88	84	79
Primer Quench Drive Side	90	92	108	91	90	89	79	81	87	92	84	79	75	67

TABLE 4

A SUMMARY OF THE L_{Aeq}s, STATISTICAL DISTRIBUTION AND OCTAVE BAND FREQUENCY ANALYSES RECORDED AT VARIOUS LOCATIONS AND ACTIVITIES ON THE FINISH COATER SECTION OF NO.1 COLORCOAT LINE

Location/Activity	Noise Level [dB]													
	L_{Aeq}	L_{AFMax}	L_{Cpk}	Percentiles			Octave Band Frequency Analysis (Hz)							
				L_{AF10}	L_{AF50}	L_{AF90}	63	125	250	500	1k	2k	4k	8k
Finish Coater Operations														
No.4 Bridle Drive Side	84	86	104	84	84	83	80	80	80	86	77	72	69	65
Inside Process Control Room	62	81	113	61	60	60	69	68	62	60	56	55	55	55
Ground Level Operator Side Main Coater Room	82													
Finish Coater Room Top Head	83													
Finish Coater Room Bottom Head	82													
Clean-down - Operation of Pump	84													
Clean-down Operation of Trolley Jack	94													
Clean-down - Operation of Tray Washer	76													
Clean-down Overall L_{Aeq}	85													
Coater Room Changing Rollers - Use of Hoist	93													
Drive Motors Rear Main Finish Coater Room	81	82	102	82	81	81	81	80	81	81	76	71	66	61
Main Coater Room Extraction Fans	83	86	105	84	83	82	84	82	84	82	77	73	68	64
Basement Coater Room Top Head	79													
Basement Coater Room Bottom Head	77													
Finish Oven Entry Third	88	89	106	88	88	87	79	83	86	88	82	76	70	64
Finish Oven Mid Section	87	89	105	88	87	87	77	80	87	88	81	75	70	62
Finish Oven Exit Third	88	90	105	89	88	88	78	80	85	89	82	77	72	65
Finish Oven Entry Air Seal	86	88	106	87	86	86	86	84	84	87	81	76	72	69
Finish Oven Zone 1 Motors	90	91	108	90	90	89	86	84	88	88	85	81	77	75
Finish Oven Recess Between Z1 & Z2	86	87	105	86	86	86	86	82	82	84	80	77	78	73
Finish Oven Recess Between Z3 & Z4	86	87	104	87	86	86	82	82	82	85	79	78	77	73
Recess Final Zone of Finish Oven	86	87	105	87	86	86	81	86	83	86	81	76	72	65
Embosser/Finish Quench Drive Side	87	88	104	87	87	86	78	80	84	88	81	76	70	63
Walkway Immediately Drive Side of Finish Quench	87	88	104	87	87	87	79	80	84	88	81	76	71	65
Elevated Platform Adjacent to Embosser Enclosure	88	89	106	88	88	87	80	78	85	89	81	76	70	62
Elevated Walkway Adjacent to Finish Quench	87	88	104	87	87	86	80	79	84	88	81	76	72	65
Mid Level Walkway Adjacent to Finish Oven Entry Half	92	96	111	94	92	87	84	87	94	92	87	81	74	67

TABLE 5

A SUMMARY OF THE L_{Aeq}S, STATISTICAL DISTRIBUTION AND OCTAVE BAND FREQUENCY ANALYSES RECORDED AT VARIOUS LOCATIONS AND ACTIVITIES AT THE EXIT END OF NO.1 COLORCOAT LINE

Location/Activity	Noise Level [dB]													
	L_{Aeq}	L_{AFMax}	L_{Cpk}	Percentiles			Octave Band Frequency Analysis (Hz)							
				L_{AF10}	L_{AF50}	L_{AF90}	63	125	250	500	1k	2k	4k	8k
Exit End Operations														
Exit Accumulator	86	87	104	87	86	85	78	79	82	87	80	74	69	61
Below Exit Accumulator	85	88	102	85	84	84	78	79	82	85	78	73	68	61
Exit Accumulator Pumps	85	86	103	85	85	84	78	78	82	86	79	73	68	60
Exit Accumulator Drive Side	87	88	105	87	87	86	79	82	84	88	80	75	70	64
Exit Hydraulic Pumps	85	86	103	85	85	84	79	77	85	85	79	74	70	66
Inside Exit Control Inspection Room Processing	76													
Operation of Auto Shears 17 cuts	95	106	119	99	90	77	79	83	87	91	92	87	80	72
Coil Interchange Exit End Drive Side	84	90	105	85	84	83	76	78	82	83	79	73	70	64
Operation of Forklift 3m	82													
External to Building RTO Exhauster Fan	87													
Walkthrough RTO	79													

TABLE 6

THE CALCULATED EFFECTIVENESS OF APPROVED HEARING PROTECTION DEVICES, WITH REFERENCE TO THE FREQUENCY DISTRIBUTION SPECTRA OBTAINED FROM SAMPLES RECORDED IN THE VICINITY OF THE NO.1 COLORCOAT LINE

Location/Activity	Noise Level [dBA]															
	Unprotected Ear		Peltor Optime II H520P3E (helmet)		Centurion Aegean		Centurion Baltic		Protector Zone 2 (general line issue)		Protector EC10		EMTEC Molded Plugs		3M EAR Push-In	
	L_{eq}	L_{AFMax}	L_{eq}	L_{FMax}	L_{eq}	L_{FMax}	L_{eq}	L_{FMax}	L_{eq}	L_{FMax}	L_{eq}	L_{FMax}	L_{eq}	L_{FMax}	L_{eq}	L_{FMax}
Tension Leveller Entry Bridle Drive Side	88	89	65	68	68	71	72	75	66	69	66	69	72	75	< 60	< 60
Exhaust Fan Rear Zone 3 Primer Oven	90	92	70	75	71	75	75	79	71	76	70	75	75	79	< 60	62
Adjacent to Primer Quench	90	91	68	71	71	74	75	78	69	72	69	72	75	78	< 60	62
Deflector Roll Post Prime Quench (Air Knife Fan)	99	101	74	78	80	83	83	87	77	80	76	80	84	87	67	71
Primer Quench Drive Side	90	92	68	72	72	75	75	78	69	73	70	73	76	79	< 60	62
Mid Level Walkway Adjacent to Finish Oven Entry Half	92	96	73	79	74	80	78	84	73	78	74	79	78	84	62	67
Clean-down Operation of Trolley Jack	94		72	74	75	77	79	81	73	75	73	75	79	81	65	65
Coater Room Changing Rollers Use of Hoist	93		71	73	74	76	78	80	72	74	72	74	78	80	64	64
Finish Oven Entry Third	88	89	67	70	69	72	73	76	68	71	68	71	73	76	< 60	< 60
Finish Oven Exit Third	88	90	66	70	69	73	73	76	67	71	67	71	74	77	< 60	60
Finish Oven Zone 1 Motors	90	91	68	72	70	73	74	77	69	72	69	72	74	77	< 60	61
Elevated Platform Adjacent to Embosser Enclosure	88	89	66	69	69	72	73	76	67	70	67	70	73	76	< 60	< 60
Operation of Auto Shears 17 cuts	95	106	69	80	72	82	76	87	71	82	71	82	78	89	63	75

APPENDIX 1

A SUMMARY OF THE REQUIREMENTS OF THE CNAWR 2005

Action Required Where Exposure is likely to be:-	Below Lower EAV	Lower EAV	Upper EAV	ELV
Employer's Duties :	$L_{EP,d}$ <80 dB(A)	$L_{EP,d}$ 80 dB(A) & 112 Pa	$L_{EP,d}$ 85 dB(A) & 140 Pa	$L_{EP,d}$ 87 dB(A) & 200 Pa
General duty to reduce risk of hearing damage to the lowest level reasonably practicable	*	*	*	*
Risk eliminated at source or reduced to a minimum	*	*	*	*
Assessment of noise exposure to be made by a competent person. Record to be kept until a new one is made	*	*	*	*
Measure Exposure			*	*
Limit Exposure				*
Reduce Noise exposure to as far as is reasonably practicable by means other than ear defenders	*	*	*	*
Programme of control measures			*	*
Provide adequate information, instruction and training about risks to hearing, about what employees should do to minimise risk, how they can obtain ear defenders if they are exposed between the two action levels and their obligations under the Regulations.	*	*	*	*
Mark out hearing protection zones			*	*
As far as is reasonably practicable, ensure that ear defenders are :-				
- provided to employees who request them		*	*	*
- provided to and used by all exposed			*	*
- maintained and repaired		*	*	*
As far as is reasonably practicable, ensure that :-				
- all equipment (other than hearing protection) provided for the reduction of noise exposure is used & maintained			*	*
Employees Duties:				
Employees should, as far as is reasonably practicable :-				
- use ear defenders			*	*
- use any other protective equipment provided to reduce noise exposure			*	*
- report any defects discovered to their employer			*	*
Provide Health Surveillance			Regularly	

APPENDIX 2

GLOSSARY OF TERMS USED IN THIS REPORT

A-Weighting	The ear is more sensitive to noise frequencies in the middle of the audible range. Noise measurements are often **A-weighted** to reflect for this sensitivity and the response of the human ear to noise.
Attenuation	Noise reduction, measured in decibels
Audiometry	A method of assessing the degree of hearing loss in person
C-Weighting	Weighting of the audible frequencies used for measurement of peak sound pressure levels. C-weighting has an almost flat (or linear) response across the audible range.
($L_{EP,d}$)	Daily personal noise exposure. A measure of the average noise energy a person is exposed to during a working day.
Decibel (dB)	The units of sound level and noise exposure measurement. dBA and dBC are A- & C-weighted noise levels, respectively.
L_{eq}	The noise level, which would deliver the same amount of sound energy as the actual varying noise over the time period of the measurement. The L_{Aeq} is the A-weighted $L_{eq.}$
Frequency Analysis	Analysis in Hz (cycles per second) of sound into its frequency components usually into octave bands. The upper frequency limit of each band is twice the lower frequency limit. Octave bands are sometimes devided into three sub bands called 1/3 Octave bands.
L_{FMax}	Maximum value of the sound pressure level measured using the fast response mode
L_{pk}	Peak Pressure Level. The maximum value reached by the sound pressure at any instant during the time period of the measurement, usually with C-weighting $L_{Cpk.}$
Statistical Distribution Percentiles L10, L50, L90	Information concerning the distribution of the noise level within the sample time. eg. L_{A10} is the A-weighted sound level exceeded for 10 % of the measurement period.
Pascals (Pa)	Units of Sound Pressure in Newtons per metre squared (N/m^2)