

## DELPHI SL-1 SOUND SPECIFICATION for **Suppliers**

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'Supplier's Sound Data Form and Certification Sheet' can be found at:

[http://osg.delphiauto.net/industrialhygiene/documents/noise/SL1\\_Sound\\_Specification - Appendix F.doc](http://osg.delphiauto.net/industrialhygiene/documents/noise/SL1_Sound_Specification_-_Appendix_F.doc)

'Supplier Waiver Request and Authorization to Ship Form' can be found at:

[http://osg.delphiauto.net/industrialhygiene/documents/noise/SL1\\_Sound\\_Specification - Appendix G-1.doc](http://osg.delphiauto.net/industrialhygiene/documents/noise/SL1_Sound_Specification_-_Appendix_G-1.doc)

## 1.0 **SCOPE**

This specification establishes:

- 1.1 Sound Level limits for all **NEW**, and **REBUILT** machinery, power tools and equipment that will be sent, used, operated and stored in Delphi's wholly owned, leased and majority joint ventured sites located globally (Section 4)
- 1.2 Measurement procedures, scope, measurement instrumentation requirements, machine operating conditions, and the format for reporting machine certification data (Sections 4 and 5)
- 1.3 Supplier responsibilities (Section 6).

## 2.0 **PURPOSE**

The purpose of this Specification is to:

- 2.1 Ensure the purchase and installation of new and rebuilt machinery, power tools, and equipment supports the Delphi Corporation Process of providing employees with a safe work environment.
- 2.2 Ensure that sound levels generated by equipment external to a Delphi facility do not have an adverse effect on the external facility environment.
- 2.3 Ensure that feasible means of engineering are applied to equipment with unacceptable noise levels prior to purchase and installation.

## 3.0 **TECHNICAL REQUIREMENTS**

### 3.1 **REFERENCE LEVELS**

- 3.1.1 Sound levels shall be measured in A-weighted decibels (dBA).
- 3.1.2 Sound power levels shall be expressed in decibels (dB).
- 3.1.3 Time-weighted average (TWA) sound exposure levels shall be expressed in A-weighted decibels and referenced to an 8-hour steady state equivalent.
- 3.1.4 Ultrasonic sound pressure levels, sound power levels, and/or time-weighted average (TWA) sound exposure levels shall be an unweighted (linear) measurement.

### 3.2 **INTEGRATING EXCHANGE RATE**

- 3.2.1 The integrating "exchange rate" used for determining the time-weighted average of non-steady-state sound levels shall be **3 dB**.

### 3.3 **LOWER LIMIT THRESHOLD CUTOFF SOUND LEVEL**

- 3.3.1 All integrated sound level measurements shall be made with **NO** lower limit threshold cutoff. If the sound measurement device does not allow for a 'no threshold' cutoff the threshold shall not exceed 70 dB. The machine builder / re-builder shall record "**NONE**" in the "Lower Limit Threshold Cutoff" box on the last page of Supplier's Sound Data Form and Certification Sheet (Appendix F).

### 3.4 **CRITERION SOUND LEVEL**

- 3.4.1 All integrated steady-state and cyclic sound level measurements shall be made relative to a 90 dBA 8-hour time-weighted average criterion sound level, or the country-specific criterion if it is more stringent.

### 3.5 **MEASUREMENT INSTRUMENTATION**

All sound level measurement instrumentation used in the collection of sound level data for machine certification (including the microphone) in accordance with this Specification shall:

- be **Type 2 or better**. (except for ultrasonic sound measurements)
- be **Type 1** or better when measuring the presence of ultrasonic sound generated by equipment and/or processes
- meet the performance requirements of the latest **ANSI** or **IEC** standard governing the use of the appropriate sound measurement device.

## **4.0 MEASUREMENT PROCEDURE, SOUND LEVEL LIMITS, and REPORTING OF DATA**

### **4.1 MEASUREMENT PROCEDURE - SCOPE AND APPLICATION**

- 4.1.1 All **NEW** and **REBUILT** machinery, power tools and equipment that will be sent, used, operated and stored in Delphi's wholly owned, leased and majority joint ventured sites located globally shall be tested in accordance with the measurement procedure outlined in **Appendix A** of this Specification. Equipment-specific measurement procedures are outlined in Section 5.0 of this Specification.
- 4.1.2 Measurements shall be made with the equipment operating at **no load** and under **ALL ANTICIPATED** and **ACTUAL** production load conditions (materials, tooling, parts production rates, speeds, etc.). The Purchaser will provide a reasonable quantity of parts and/or related tooling if these are unique to Delphi.
- 4.1.3 Suppliers shall submit sound level data as soon as it becomes available for final machine acceptance and authorization to ship. Delphi may choose to verify sound level data during the equipment run-off process.
- 4.1.4 Where it is impractical to set up and test a complete machine at the Supplier's facility, arrangements shall be made to perform the test at the Purchaser's facility. Under this circumstance, shipment of the equipment does not relieve the Supplier(s) of the responsibility for meeting the quoted sound level limits.

### **4.2 PREVIOUSLY CERTIFIED EQUIPMENT**

- 4.2.1 Suppliers who have provided like equipment that has been previously certified for this or another Delphi facility may submit that sound level data (Appendices F and G-1) with their quotation.

### **4.2 SOUND LEVEL LIMITS**

- 4.2.1 The 8-hour time-weighted average (TWA) A-weighted sound level shall not exceed **80 dBA** at **ANY** of the designated measurement locations on the machine measurement envelope and in the Operator's Hearing Zone, during the operating time of the machine.
- 4.2.2 Impulse sound pressure levels shall not exceed the unweighted true peak value of **130 dB** at **ANY** measurement location on the machine measurement envelope or in the operator's hearing zone, during the operating time of the machine.

### **4.3 COMPLETE MACHINE / EQUIPMENT (TOTAL) SYSTEM**

- 4.3.1 A Supplier providing a complete machine/equipment (total) system shall comply with the **80 dBA** Specification limit for the complete machine/equipment system, not individual components. Tooling and material handling related noise must be included when evaluating compliance with this specification.
- 4.3.2 Where individual components are purchased separately by the Purchaser or machine builder, to be assembled at the Purchaser's site into a complete machine (total system), the individual component sound level limits specified and measured for the individual components shall not exceed an 8-hour time-weighted average (TWA) A-weighted sound level of 80 dB(A) at ANY measurement location on the complete machine (total system) measurement envelope and in the operator's hearing zone during the operating time of the complete machine. (See Appendix B for an example of combining of separate sound levels into a total or "combined" sound level by "dB Addition.")

- 4.3.3 In situations where a complete machine is to be installed in an otherwise low sound level area or run for extended shift periods, a complete machine (total system) specification limit of less than 80 dBA 8-hour time-weighted average may be specified by the Purchaser.

#### 4.4 **AIRBORNE UPPER SONIC AND ULTRASONIC ACOUSTIC NOISE**

- 4.4.1 Exposure to high frequency noise above 10 kHz (upper sonic), when sufficiently intense, appears to result in a syndrome involving manifestations of nausea, headache, tinnitus, pain, dizziness and fatigue, and a perceived squeal type sound. A major factor in whether or not the symptoms will be manifested appears to be the hearing acuity of the exposed person. Also, research suggests that high frequency noise at and above 20 kHz may have possible hearing loss ramifications from the sub-harmonics of those frequencies.

Where upper sonic and/or ultrasonic acoustic noise is present, the permissible ultrasound exposure levels stated in Table 4.2.5 shall apply. The data in **RED** is excerpted from the American Conference of Governmental Industrial Hygiene 2009 *TLVs and BEIs* publication.

**PERMISSIBLE ULTRASOUND EXPOSURE LEVELS\***

Mid-Frequency of Third-Octave Band (kHz)	One-Third Octave-Band Level (dB) re 20 $\mu$ Pa
10	105 (Ceiling) 88 TWA
12.5	105 (Ceiling) 89 TWA
16	105 (Ceiling) 92 TWA
20	105 (Ceiling) 94 TWA
25	110 (Ceiling)
31.5	115 (Ceiling)
40	115 (Ceiling)
50	115 (Ceiling)

Sections 3.1.4 and 3.5 define instrumentation for measurement of Ultrasound. A Type 1 SL meter shall be used.

Note: Subjective annoyance and discomfort may occur in some individuals at levels between 75 and 105 dB for frequencies between 10-20 kHz, especially if they are tonal in nature. Levels for third-octaves above 20 kHz are measured in air but assume direct human contact with water or other medium.

#### 4.5 **REPORTING OF SOUND LEVEL DATA**

- 4.5.1 All sound level measurement data shall be submitted on the **Supplier's Sound Data Form and Certification Sheet** (Appendix F). The submittal process requires that a Supplier's representative 'certify', with their signature, that the data is current, accurate, and valid (Section C of Appendix F).

### 5.0 **EQUIPMENT-SPECIFIC MEASUREMENT PROCEDURES and SOUND LEVEL LIMITS**

The measurement procedures and sound level limits specified in Section 5.0 apply to **NEW** and **REBUILT** machinery, power tools, and equipment, that will be sent, used, operated and stored in Delphi's wholly owned, leased and majority joint ventured sites located globally.

#### 5.1 **AIR MOVING DEVICES**

- 5.1.1 The sound power level of air moving devices shall be measured in accordance with the appropriate Air Movement and Control Association (AMCA) Standard 300-67, "Test Code for Sound Rating".

Air moving devices (AMD) consist of:

- (1) Central Station Air Conditioning and Heating and Ventilating Units
- (2) Centrifugal Fans
- (3) Industrial, Axial and Propeller Fans
- (4) Power Roof and Wall Ventilators

(5) Steam and Hot Water Unit Heaters

- 5.1.2 **SOUND POWER LEVEL LIMITS.** At the specified operating conditions, inlet, discharge and housing radiated sound power levels shall not exceed a combined total of  $L_w = 87$  dB (A) Re.  $10^{-12}$  watt.

5.2 **ENGINEERED AIR MOVING SYSTEMS**

- 5.2.1 **Sound Level Limits.** The designers of engineered air moving systems shall insure that the sound level measured due to the operation of the system, including all appurtenances and accessories, shall not exceed 80 dBA TWA at any point 1.5 meters (5 feet) above any in-plant operating floor or operator occupied platform.

5.3 **PNEUMATIC EQUIPMENT**

- 5.3.1 The sound level of pneumatic equipment shall be measured and reported in accordance with ANSI S5.1 (Latest revision), "Test Code for the Measurement of Sound from Pneumatic Equipment."
- 5.3.2 **Air Compressor Sound Level Limits Compressors** - shall not exceed 80 dB (A) TWA at any location on the envelope as defined in ANSI S5.1. (Latest revision)
- 5.3.3 **Pneumatic Tool Sound Level Limits** - shall not exceed 80 dB (A) TWA at any of the microphone positions specified in ANSI S5.1. All measurements shall be taken with the tool operating at the air pressure of the manufacturer's specified rating in a free running, no load condition. Tools containing clutches or impact generating devices are also to be tested in the stalled or nearly stalled mode.

5.4 **COMPUTER AND BUSINESS EQUIPMENT**

- 5.4.1 The sound level of computers and business equipment shall be measured and reported in accordance with ANSI S1.29, "Method for the Measurement and Designation of Noise Emitted by Computer and Business Equipment."
- 5.4.2 **Sound Level Limits**
- 5.4.2.1 **General Office Area.** The sound level at the operator's position, as defined in ANSI S1.29, shall not exceed 60 dB (A) when equipment is operating in that mode which produces the highest A-weighted sound level.
- 5.4.2.2 **Data Processing Room.** The sound level at any permanent operator position, as defined in ANSI S1.29, shall not exceed 70 dB (A) when equipment is operating in that mode which produces the highest A-weighted sound level.

5.5 **COMMUNITY SOUND LIMITS**

External plant equipment/systems, upon being installed, shall meet the following specification limits:

- 5.5.1 A level 3 dB less than the minimum criteria limit stipulated in the local Community or State noise ordinance which specifies receiving land sound levels; or
- 5.5.2 A 65 dBA daytime (0700-2200 Hr. and a 55 dBA nighttime (2200-0700 Hr.) one (1) hour TWA at the plant property line, in the absence of a local Community or State noise ordinance which specifies receiving land sound levels.
- 5.5.3 Pure tones generated by the system must be 10 dB or more below the applicable criterion level

6.0 **SUPPLIER RESPONSIBILITIES**

6.1 **DELPHI REQUEST FOR QUOTE (RFQ)**

- 6.1.1 It is expected that machinery, power tool, and equipment suppliers fully embrace Delphi's commitment to the health and safety of its employees and will actively pursue the innovation and implementation of Design-In for Health and Safety measures that will help Delphi achieve the commitment of an employee work environment free of unacceptable sound levels.

To this end, it is expected that feasible sound level controls, whether by elimination, substitution, and/or engineering will be an integral part of the safety design and build of equipment -- not an optional add-on at an additional (and often premium) charge. The fulfillment of this expectation on the part of the Machinery / Machine Tool / Equipment builder will be a major consideration in the Supplier selection process.

- 6.1.2 If, after a thorough analysis of feasible engineering noise controls is completed difficulty is anticipated in complying with the specification limit, an exploratory meeting should be set up with Purchasing, Project Engineering, and Plant Safety. Feasible engineering controls and design concepts should be investigated, discussed and evaluated at this meeting.

## 6.2 **SUPPLIER QUOTATION**

- 6.2.1 If application of state-of-the-art technology will not be sufficient to reduce the sound level to the SL-1 limit, the best achievable sound level though the use of feasible engineering controls shall be specified.
- 6.2.2 If feasible sound level controls are not an integral part of the equipment design and build, but rather an "add-on" measure, then **ALL** items and costs required to meet the specification limit shall be grouped in a separate section of the quotation titled "NOISE CONTROL". Items and costs must be itemized and sufficiently detailed to permit a complete evaluation by the purchaser.
- 6.2.3 The Supplier shall insure that sufficient time is scheduled at machine runoff to certify sound levels of the equipment and make any additional engineering corrections deemed necessary by the purchaser.

## 6.3 **ENGINEERING DESIGNS**

- 6.3.1 Equipment engineering designs submitted to the Delphi project engineer for approval shall include quoted and agreed upon feasible sound level controls.

## 6.4 **SOUND LEVEL MEASUREMENTS**

- 6.4.1 Sound level measurements shall be the responsibility of the Supplier. It is the Supplier's responsibility to acquire and use the industrial measurement standard specified for the equipment being purchased.

## 6.5 **SOUND LEVEL DATA SUBMITTAL PROCESS**

- 6.5.1 A copy of the **Supplier's Sound Data Form and Certification Sheet**, Appendix F (Delphi Form# 1676) shall be provided to the Delphi project engineer prior to buy-off and shipping. The project engineer will distribute copies to the Purchasing agent and the Design-In EH&S Engineer and/or Plant Safety Engineer for review. A copy of the final Appendix F and G-1 forms shall be furnished with the equipment manual(s).

## 6.6 **EQUIPMENT RUN-OFF**

- 6.6.1 If the parts and/or tooling necessary to duplicate production conditions at runoff are unique to the purchaser, the purchaser shall provide a reasonable quantity of parts and/or necessary tooling to duplicate production conditions.
- If actual loading is not possible, loading shall be accomplished by simulation. Details of the load simulating device and loading techniques shall be specified and approved by the purchaser.
- 6.6.2 The process engineer or designated representative should verify sound data of equipment during machine runoff at the Supplier's test site prior to shipment.
- 6.6.3 If certification of sound data is not conducted at the Supplier's facility during equipment run-off, certification **SHALL** be conducted after the equipment is installed and prior to complete release of the Supplier from his contractual agreement. Shipment of the equipment does not release the Supplier from his responsibility to meet the specified sound limitations.

- 6.6.4 Documentation of purchased equipment, using the Specification, must include; description of the technique(s), noise levels and costs. Where appropriate, photographs, sketches, diagrams or other visual representations, and material specifications should be included.

## 7.0 **DELPHI 'AUTHORIZATION TO SHIP' and SUPPLIER 'WAIVER REQUEST' PROCESS**

Equipment sound level **MEETS** the Quoted & Accepted Specification Limit:

- 7.1 If the equipment sound level **meets** the Quoted & Accepted Specification Limit the Supplier shall notify the Delphi project engineer and provide him / her with a copy of the **SUPPLIER'S SOUND DATA FORM and CERTIFICATION SHEET** (Appendix F). The project engineer will return a signed **AUTHORIZATION TO SHIP** form (Appendix G-1) to the Supplier which should be kept with the Delphi purchase order.

Equipment sound level **EXCEEDS** Quoted & Accepted Specification Limit:

- 7.2 If the equipment sound level **exceeds** the Quoted & Accepted Specification Limit the Supplier should contact the Delphi project engineer and provide a detailed explanation of the current controls installed and sounds level obtained.
- 7.3 After consultation with the appropriate Delphi staff the project engineer will contact the Supplier to initiate one of two actions:
- 1) Authorize the Supplier to ship the equipment "AS IS" releasing the Supplier from meeting the Quoted and Accepted Specification Limit. The Supplier must first submit a signed **Waiver Request** to the project engineer using the 'Supplier Waiver Request and Authorization to Ship' Form (Appendix G-1). The Supplier must include Appendix F sound level data and a detailing of the feasible engineering controls currently designed into and/or installed on the machine / equipment.
  - 2) Authorize the Supplier to ship the equipment "AS IS" with the understanding that the Supplier is not released from meeting the Quoted and Accepted Specification Limit, i.e., additional noise controls will be applied at the Delphi facility. The Supplier shall provide a detailing of feasible engineering controls options that may be applied to reduce the sound level to the applicable limit.
- 7.4 In either case the Purchaser will return a signed and completed 'Supplier Waiver Request and Authorization to Ship' form to the Supplier for the purpose of providing formal notification.

## 8.0 **DEFINITIONS**

**Rebuilt** - refers to ALL machinery, power tools and equipment that is refurbished, upgraded, etc., in place of purchasing new equipment

## 9.0 **REFERENCES**

Sound and Vibration (Magazine) for a listing of Product Source; <http://www.sandv.com/home.htm>

ANSI Noise Specifications, [http://global.ihs.com/standards.cfm?selected\\_org=ANSI&RID=OV&MID=5280](http://global.ihs.com/standards.cfm?selected_org=ANSI&RID=OV&MID=5280)

**ANSI S1.4 Revision / Edition: 83**, Various Degrees Of Accuracy Are Required For The Practical Measurement Of Sounds Of Various Kinds For Different Purposes. Hence, This Standard Specifies Minimum Requirements For Three Basic Types Of Sound Level Meters

**ANSI C63.2 Revision / Edition: 96**, Electromagnetic Noise And Field Strength, 10 Khz To 40 Ghz Specifications

**ANSI S5.1 Revision / Edition: 71**, Test Code For The Measurement Of Sound from Pneumatic Equipment

**ANSI S1.29 Revision / Edition: 79**, Method For The Measurement & Designation Of Noise



**ANSI S12.9 Revision / Edition: 88**, American National Standard Quantities And Procedures For Description And Measurement Of Environmental Sound, Part 4; Noise Assessment And Prediction Of Long-Term Community Response

## 10.0 REVISION RECORD

Reason for Revision	Issue Date	Person Responsible
Created SL1 Sound Specification for Suppliers Extracted App F and G-1 and added URL links	11/2/09	Carmen Pompeii

## APPENDIX A

### MEASUREMENT PROCEDURE for SOUND LEVEL CERTIFICATION OF MACHINERY, POWER TOOLS AND EQUIPMENT

#### A1.0 Measurement Envelope and Designated Measurement Locations

The measurement locations, as designated in this DELPHI CORPORATION MEASUREMENT PROCEDURE are adopted from the "NMTBA Noise Measurement Techniques," Second Edition, January, 1976. as follows:

- A1.1 Measurements shall be taken in the hearing zone(s) of designated operator(s) and at the designated measurement locations on the machine measurement envelope.
- A1.2 The machine measurement envelope shall be located 1 meter (~ 3 feet) from the projected floor plan of the machine. Designated measurement locations shall be located on the machine measurement envelope at a height of 1.5 meters (~ 5 feet) above the "work access" floor level.
- A1.2.1 No measurement location shall be more than 3.0 meters ( $\approx$  10 feet) from an adjacent measurement location(s).
- A1.2.2 A Minimum of four (4) measurements shall be taken on the Measurement Envelope around the machine/equipment. These measurements will include the location(s) with the highest sound level.

An example of a Machine/Measurement Envelope Sketch is shown on the reverse side (page A-2) of this Appendix.

#### A2.0 Measurement Procedure

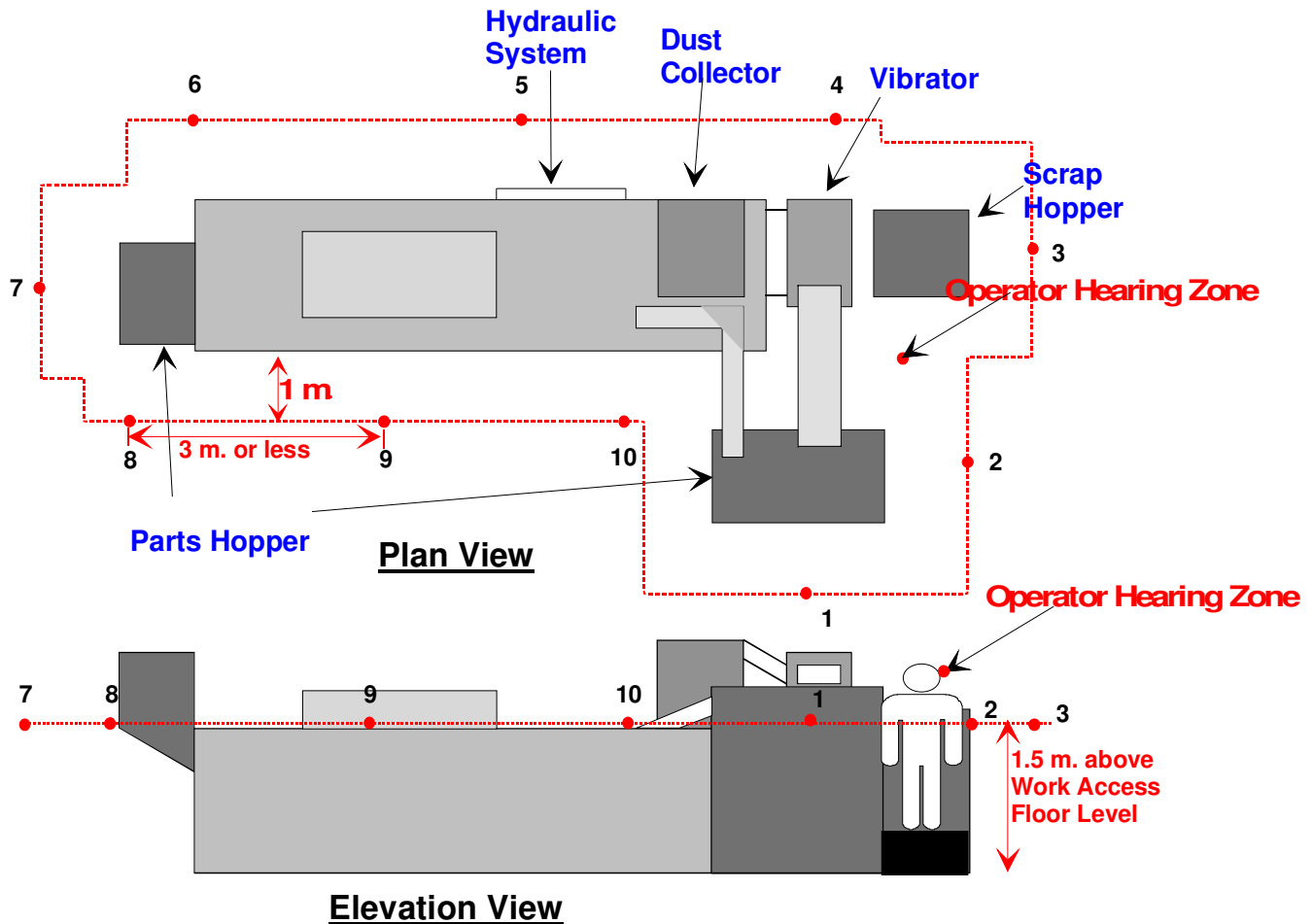
Measurements shall be made with the equipment operating at no load and under **ALL ANTICIPATED ACTUAL PRODUCTION LOAD CONDITIONS** (materials, tooling, production rates, etc.) as specified in Sections 4 and 5 of the Delphi Corporation Sound Level Specification for the Purchase of Machinery, Power tools and Equipment. The Purchaser will provide a reasonable quantity of parts and/or related tooling if these are unique to the purchaser.

- A2.1 Select and setup measurement instrumentation in accordance with the requirements specified in Section 3 - TECHNICAL REQUIREMENTS, of this specification document.
- A2.2 At each of the measurement locations established per the requirements of Sections A1.1 and A1.2, determine the A-weighted 8-Hour Time-Weighted Average Sound Level (TWA) due to the background ambient sound in the test area.
- If the background ambient sound level measurement is equal to or greater than ( $\geq$ ) 10 dB below measured level when machine is operating, no correction for background is necessary.
  - If the background ambient sound level measurement is less than ( $<$ ) 10 dB below measured level when machine is operating, sound levels measured when the machine is operating should be corrected for background. (Reference Appendix B)
- A2.3 At each of the measurement locations established per the requirements of Sections A1.1 and A1.2, determine the A-weighted 8-Hour Time-Weighted Average Sound Level (TWA).
- If machine noise is cyclic or intermittent, data at each measurement location shall be gathered over a time period of sufficient length (three to four complete machine cycles) to insure that **the TWA reported and certified is representative of an 8-hour continuous operation of the machine.**
  - The microphone of the sound measurement equipment shall have a unobstructed "view" of the machine/power tool/equipment. Any barriers, obstacles, etc. not an integral part of the machine must be removed before testing.
- A2.4 Record sound level measurements from Sections 2.2 and 2.3 on the **Supplier's Sound Data Form and Certification Sheet** (Appendix F).

## EXAMPLE OF MACHINE MEASUREMENT ENVELOPE SKETCH

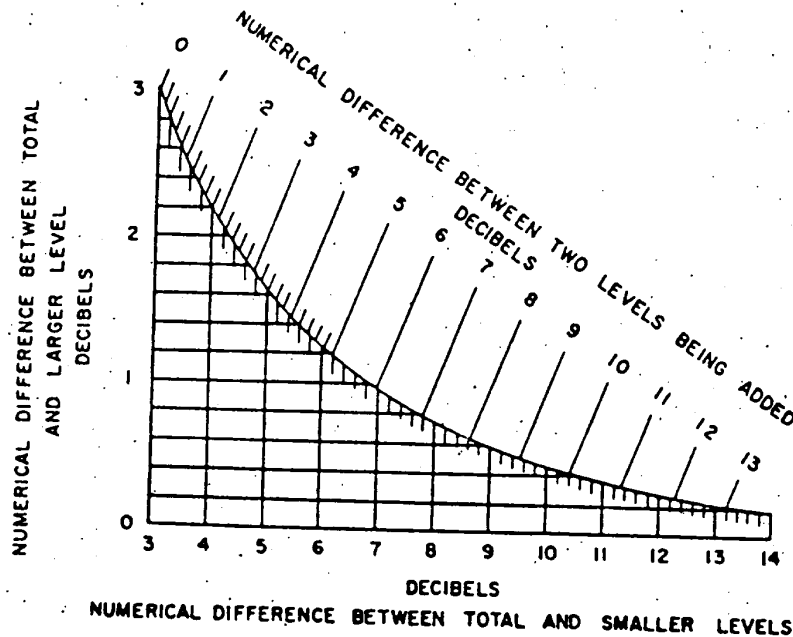
Note: Although 10 designated measurement locations are shown on the measurement envelope in the example below, the actual number of locations used in a given machine runoff may be greater than, or less than, 10.

A measurement **SHALL ALWAYS** be taken at the Operator's Position(s) (Operator Hearing Zone) in addition to measurements taken on the Machine Measurement Envelope.



Equipment with Measurement Locations

## APPENDIX B CHART FOR ADDITION & SUBTRACTION OF DB SOUND LEVELS



### Example: dB Addition

At a given measurement location, the following sound levels were measured for two machines (Machine A & Machine B) when the two machines were operated separately.

- Machine A (On) - Machine B (Off)  $L_{A(\text{measured})} = 85 \text{ dBA}$
- Machine A (Off) - Machine B (On)  $L_{B(\text{measured})} = 83 \text{ dBA}$

If both machines are operated at the same time, what will be the combined sound level measured?

$$\Delta L = [L_A - L_B]_{\text{ABSOLUTE VALUE}} = 85 \text{ dBA} - 83 \text{ dBA} = 2 \text{ dBA}$$

Refer to diagonal numbers on chart (NUMERICAL DIFFERENCE BETWEEN TWO LEVELS BEING ADDED) -- Go to the number 2 "Line" intercept on the curve, Project horizontally to the left vertical axis, and read (NUMERICAL DIFFERENCE BETWEEN TOTAL AND LARGER LEVEL) -- which in this case is about 2.1 dB.

Since the "Larger Level" measured was 85 dBA, the "Total Level" will be:

$$L_{\text{total}} = 85 \text{ dBA} + 2.1 \text{ dBA} = 87.1 \text{ dBA}$$

### Example: dB Subtraction

At a given measurement location, the following sound levels were measured with the machine operating under normal production load conditions, and with the machine turned off (background / ambient)

- Machine Operating (i.e. On)  $L_{\text{machine On}} = 82 \text{ dBA}$
- Machine Not Operating (i.e. Off) -- Background/Ambient  $L_{\text{Background/Ambient}} = 78 \text{ dBA}$

What is the sound level generated by the machine?

$$\Delta L = [L_{\text{machine On}} - L_{\text{Background/Ambient}}]_{\text{ABSOLUTE VALUE}} = 82 \text{ dBA} - 78 \text{ dBA} = 4 \text{ dBA}$$

Since the measured sound level dropped more than 3 dB when the machine was turned off, the background/ambient sound level of 78 dBA must be smaller than the sound level generated by the machine. [Note: the level measured with the machine ON is a combination of the level due to the machine and the sound level due to background/ambient (i.e. the "Total" Level).

Refer to horizontal numbers on chart (NUMERICAL DIFFERENCE BETWEEN TOTAL AND SMALLER LEVELS). Go to the number 4 vertical line intercept on the curve, project horizontally to the left vertical axis, and read (NUMERICAL DIFFERENCE BETWEEN TOTAL AND LARGER LEVEL) -- which in this case is 2.2 dB.

Since the "Total" Level is the sound level measured with the machine operating (i.e.  $L_{(Machine\ On)}$ ),  $L_{machine}$  which must be the "Larger Level is:

$$L_{machine} = L_{total} - 2.2\text{ dB} = 82\text{ dBA} - 2.2\text{ dBA} = 79.8\text{ dBA}$$

Note: In this case, a machine which by direct measurement would seem to have failed to meet the Delphi Corporation Specification Limit of 80 dBA, does meet that limit when the high ambient background is subtracted out.

**Difference between  
measured and ambient:**

**82 - 78 = 4 dBA**

**Value subtracted from  
measured level:**

**2.2 dBA**

**Sound generated by  
equipment:**

**82 - 2.2 = 79.8 dBA**

<b>Difference Between Measured Level and Ambient Level (dBA)</b>	<b>Value to be Subtracted from the Measured Level (dBA)</b>
0.5	9.6
1.0	6.9
1.5	5.3
2.0	4.3
2.5	3.6
3.0	3.0
3.5	2.6
<b>4.0</b>	<b>2.2</b>
4.5	1.9
5.0	1.7
5.5	1.4
6.0	1.3
6.5	1.1
7.0	1.0
7.5	0.9
8.0	0.7
8.5	0.7
9.0	0.6
9.5	0.5
10.0	0.1

**APPENDIX C            Obsolete and Deleted**

**APPENDIX D            Obsolete and Deleted**

**APPENDIX E            Obsolete and Deleted**

**APPENDIX F            DELPHI SUPPLIER'S SOUND DATA FORM AND CERTIFICATION SHEET**

<http://osg.delphiauto.net/industrialhygiene/documents/noise/SL1 Sound Specification - Appendix F.doc>

**APPENDIX G-1        SUPPLIER WAIVER REQUEST AND AUTHORIZATION TO SHIP FORM**

<http://osg.delphiauto.net/industrialhygiene/documents/noise/SL1 Sound Specification - Appendix G-1.doc>

## **APPENDIX H**

### **SL 1.0 Supplement**

#### **DESIGN-IN SOUND LEVEL CONTROLS**

Sound control should be by design and process selection, compatible with operating and maintenance requirements. The source of the noise should be addressed before any consideration is given for enclosures.

The following Sound Level Controls have been used in industry to reduce machine/process generated noise. The application feasibility of a given control must, however, be evaluated on a specific case basis. Application feasibility of a control measure or technique is not inferred by its' being listed in the following.

Noise control solutions which cause production problems or inefficiencies must be defined and accepted by the purchasing facility before build.

Noise Controls must comply with Delphi Corporation's Safety & Fire Specifications.

#### **H1.0 MACHINE DESIGN**

- H1.1 Compressed air must be controlled. Process selection should minimize the need for air blow-offs, air probes, and air gauges. All blow-offs should be designed with adequate air capacity and physical clearance to permit use of a silence nozzle, timed to operate only when required and operate under the minimum pressure needed to perform the work.
- H1.2 Air movement dictated by the process such as drying, cooling, or chip removal, shall be designed as a complete system by the Supplier and shall be controlled in such a manner as to minimize noise.
- H1.3 Compressed air usage for part movement or orientation is greatly discouraged and must have special approval.
- H1.4 All air exhausts must be adequately muffled or plumbed to a suitable man folding chamber.
- H1.5 Equipment acceleration and deceleration must be designed to minimize part and machine noise.
- H1.6 Where machine operation generates significant noise and vibration, the Supplier shall recommend and design suitable vibration isolation mounts. Consult Manufacturing Engineer for approval.
- H1.7 In moving metallic parts, minimize part to part contact and uncontrolled gravity drops.

#### **H2.0 SOUND ENCLOSURES**

- H2.1 Sound enclosures are not considered a desirable solution to noise control problems and should be used as a last resort. All possible efforts should be made to eliminate the noise source. Where enclosures are necessary, the following points must be followed:
  - H2.1.1 All enclosures shall be built with adequate strength to withstand usage in a manufacturing environment, and withstand three (3) teardown and re-assemble cycles. It should be noted that plant personnel will be working around, and sometimes, on enclosures. Care must be taken to provide enclosures that will not present a safety hazard.
  - H2.1.2 All enclosures must provide complete accessibility to all pertinent points of the equipment within and for parts removal or housekeeping purposes.
  - H2.1.3 All enclosures that must be disassembled for maintenance or clean-out will be joined by hinges and latches rather than fasteners requiring tools for disassembly.
  - H2.1.4 Enclosures must adhere to any required fire safety regulations.
  - H2.1.5 Enclosures with heavy side or top panels (75 pounds or more) which have to be removed for maintenance must have eyebolts installed for hoist lift
  - H2.1.6 All sound control materials shall be approved. All panels containing porous acoustical material shall be covered with a vapor barrier to prevent absorption of oil or water.

- H2.1.7 Enclosures shall have provisions for adequate ventilation if required, to prevent a build-up of fumes, mists, or heat.
- H2.1.8 Enclosures where personnel are expected to work shall be adequately lighted.
- H2.1.9 Permanent openings in the enclosure will be kept to a minimum in quantity and size, and designed - where possible - to prevent a "line-of-sight" opening from inside to outside.
- H2.1.10 Sound enclosures with doors for personnel or materials shall be equipped with proper locking latches and seals around openings.
- H2.1.11 Enclosures shall be designed so that there will be no restrictions in productivity.

### **H3.0 VIBRATORY FEEDERS AND VIBRATORS**

- H3.1 The use of vibratory feeders particularly with metallic or hard parts should be avoided when the application exceeds the specification limits. Alternate methods of conveyance should be considered, such as mechanical movers, belts, magnetics, etc... If vibrators are used, they should be electromagnetic. Air vibrators are prohibited.
- H3.2 If vibrator feeders are used in conjunction with metal parts or other noise producing parts, urethane or other suitable damped materials should be used in constructing feeder components contacting the fed parts. This is preferred to enclosing feeders to contain noise.
- H3.3 Solid urethane bowls are encouraged. The lining of tracks and bowls with urethane coatings is not acceptable.
- H3.4 Wear plates or part orientation devices inserted into the bowl to enhance feeding or feeder life does not in any way free the Vendor from meeting the noise specifications. All inserts must be secured in such a manner that they will not work loose or cause distortion when tightened.

### **H4.0 BINS AND HOPPERS**

- H4.1 Bins and hoppers used in conjunction with metallic or hard parts should be lined with a damped material such as urethane or rubber. Metal mesh containers are another method.