Scenario 1 – Haul Truck

Known:

1. Dose for complete 10-hour shift is 150%
2. Driver operates with window down due to broken A/C
3. Dump site is near crusher
4. Driver spent 90 minutes at dump site
5. Operator ear sound levels at dump site:
   - 90 dB(A) with window up
   - 100 dB(A) with window down

Scenario 1 – Haul Truck

	Allowable Time (PEL)	
L_p, dB(A)	Hours	Minutes
90	8	480
92	6.1	364
94	4.6	276
95	4.0	240
96	3.5	209
98	2.6	158
100	2.0	120

$$\%Dose = T_{actual} / T_{allow}$$

1. Calculate exposure for time at dump site with *windows down*

   L_p = 100 dB(A)

   % Dose = T_{actual}/T_{allow}

   % $Dose_{dmp}$ = 1.5 hrs/2.0 hrs

   % $Dose_{dmp}$ = 75%

- Recall, the full shift dose was 150%
- Half of the full shift dose occurred at the dump site!

<u>Note:</u> During the remaining 8.5 hours of the work shift, 75% dose was accumulated.

Scenario 1 – Haul Truck

	Allowable Time (PEL)	
L_p, dB(A)	Hours	Minutes
90	8	480
92	6.1	364
94	4.6	276
95	4.0	240
96	3.5	209
98	2.6	158
100	2.0	120

2. Calculate exposure for time at dump site with *windows up*

   L_p = 90 dB(A)

   % Dose = T_{actual}/T_{allow}

   % $Dose_{dmp}$ = 1.5 hrs/8.0 hrs

   % $Dose_{dmp}$ = 18.75%

3. Calculate full shift dose with windows up at dump

   % $Dose_{TOT}$ = 75% + 18.75%

   % $Dose_{TOT}$ = 93.75%

Scenario 1 – Haul Truck

Solution:

1. With windows up, the full shift dose would be 93.75%
2. Fix A/C so operator can keep window up
3. Tell the consultant to get lost!
4. Could use a barrier at the dump site as an alternative approach

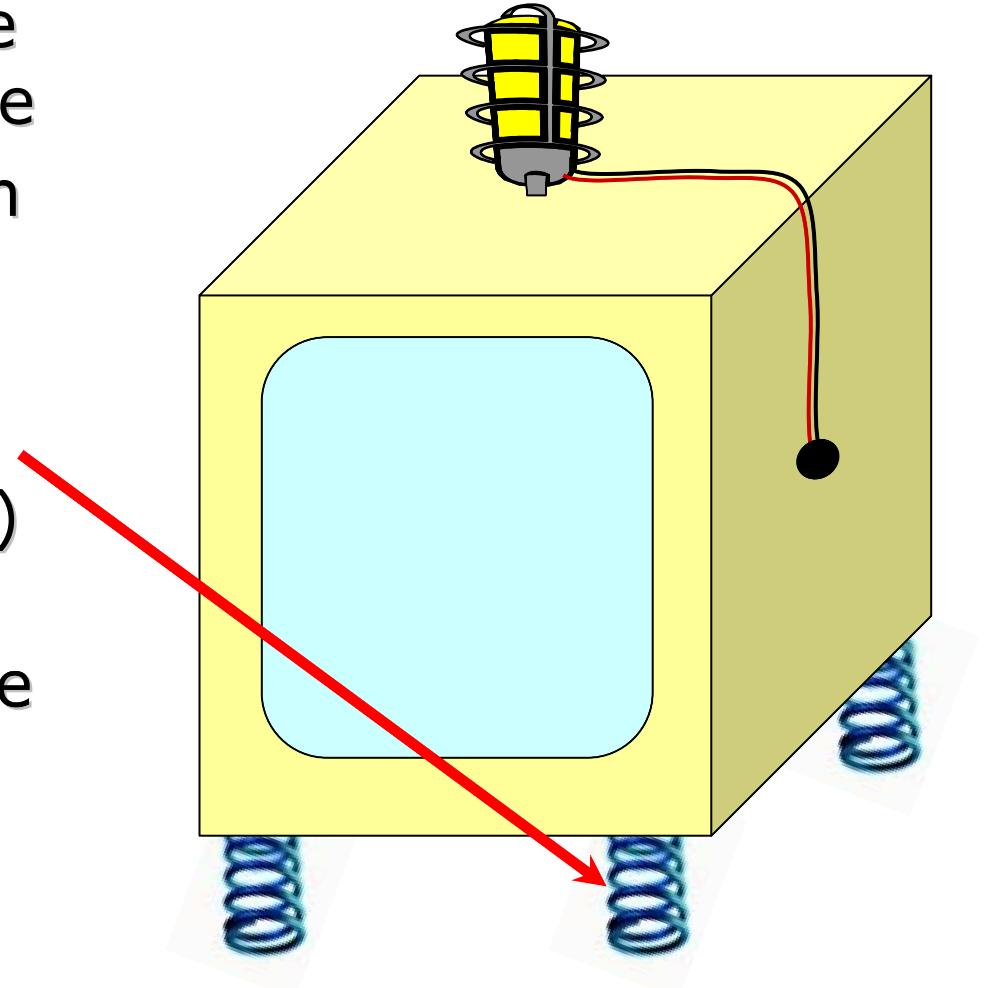
Scenario 2 – Front-end Loader

Known:

1. FEL Operator's full shift dose was 200%
2. One of the isolation mounts for the cab replaced by a steel spacer
3. Door seals have deteriorated
4. No sound absorbing foam in cab
5. One-inch-diameter hole drilled in cab to connect switch for aftermarket light kit

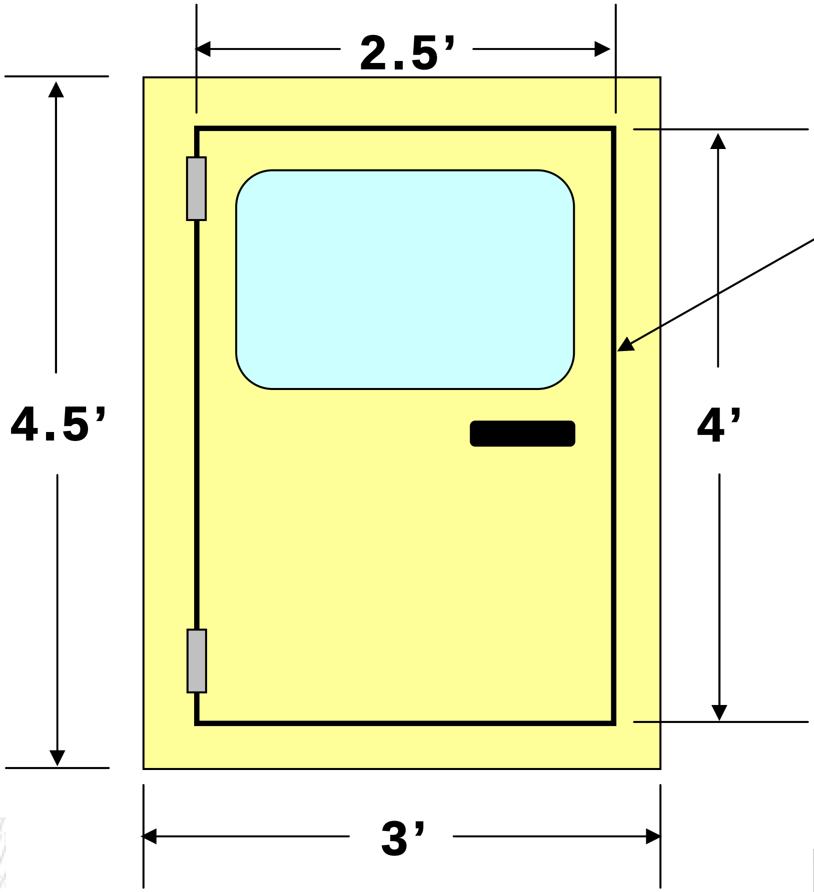
Scenario 2 – Front-end Loader

- Vibration isolators are designed to be flexible
- Trade static deflection for vibration isolation
- Steel spacer is stiff and transmits vibration (shunt path)
- Remove steel spacer and replace it with the proper isolator



Scenario 2 – Front-end Loader

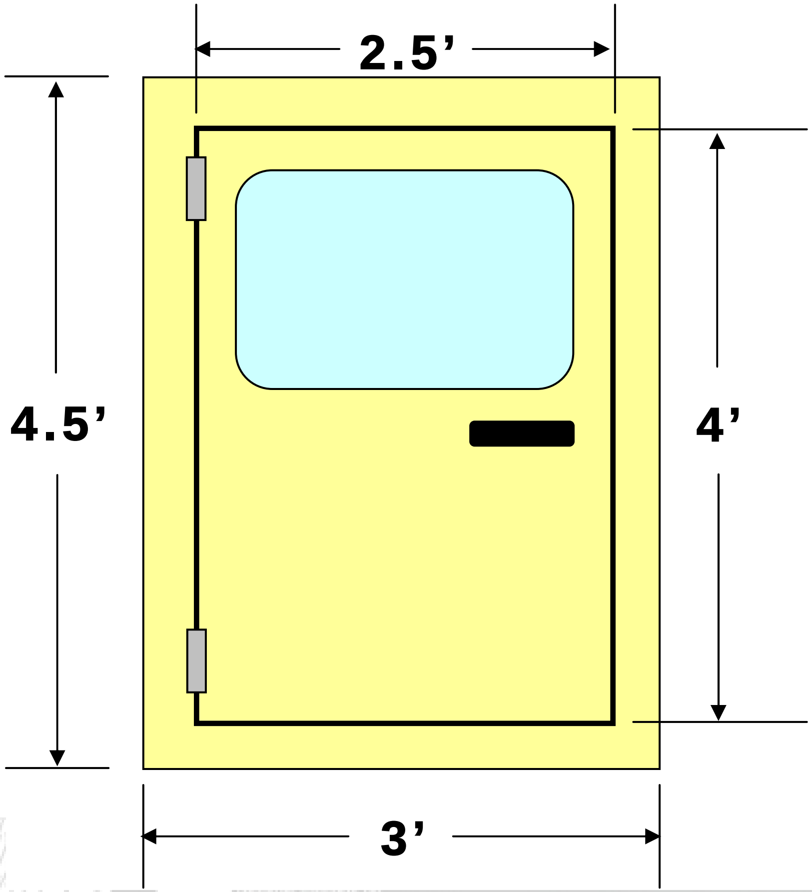
- Door seals must be maintained
- Gaps lower the TL of the cab



Assume we have a 1/8" gap around the door

Scenario 2 – Front-end Loader

- Door seals must be maintained
- Gaps lower the TL of the cab



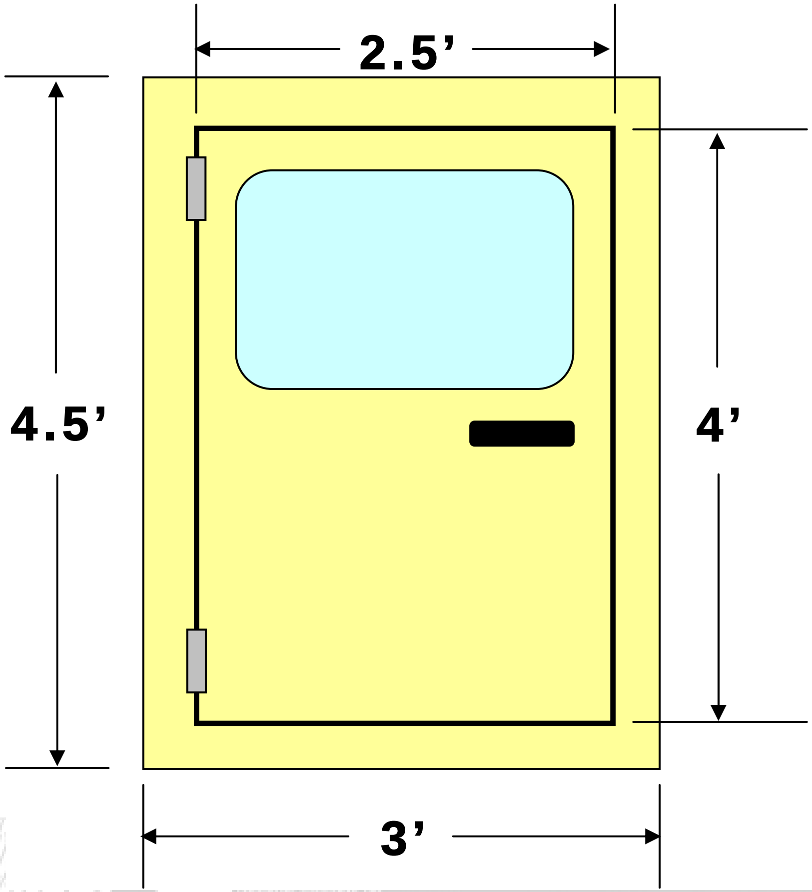
Area of Cab Side:
4.5′ x 2.5′ = 11.25 ft^2

Area of Gap:
2 x 1/8″ x 48″ +
2 x 1/8″ x 30″ = 19.5 in^2
= 0.135 ft^2

Gap area is *only* 1% of surface are for the side

Scenario 2 – Front-end Loader

- Door seals must be maintained
- Gaps lower the TL of the cab



Assume side of cab has TL of *30 dB*

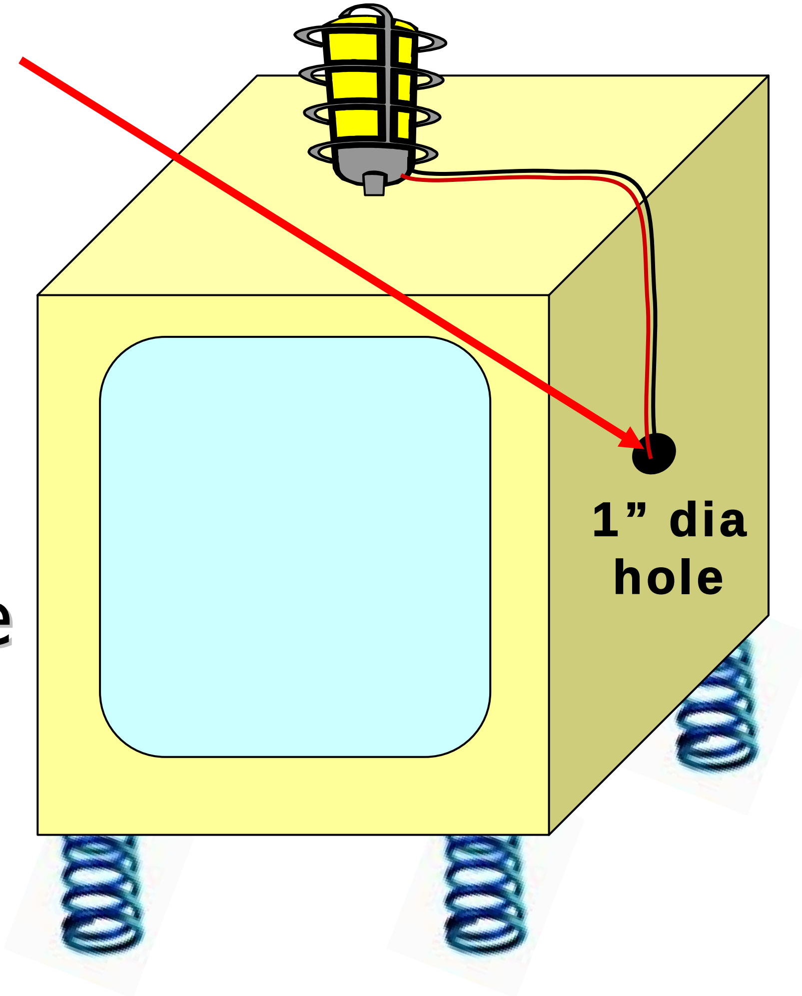
With the 1/8” gap the TL is reduced to *18.9 dB*

Scenario 2 – Front-end Loader

- *Do not use* oversized holes for hydraulic lines, wiring, etc.

Assume the cab side has a TL of *30 dB*

Assume the side with the hole is 3′ x 4.5′



Scenario 2 – Front-end Loader

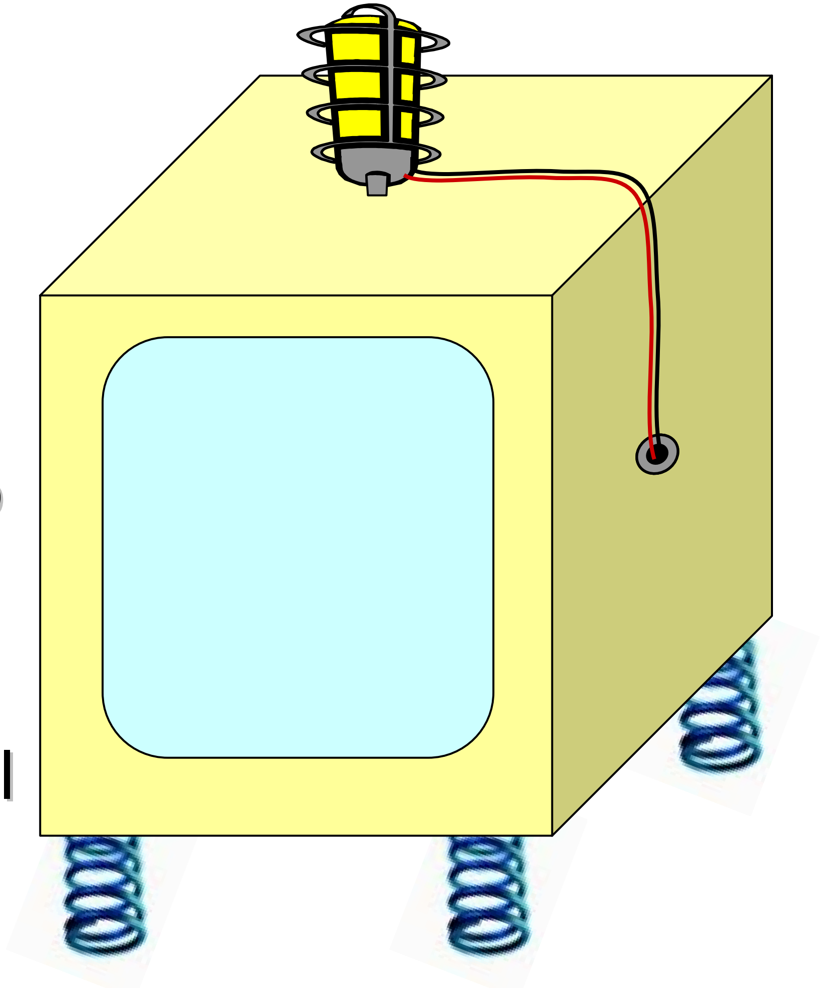
Area of Cab Side: 13.5 ft^2

Area of Hole: 0.0055 ft^2

Area of hole is *only* 0.04% of surface are for the side

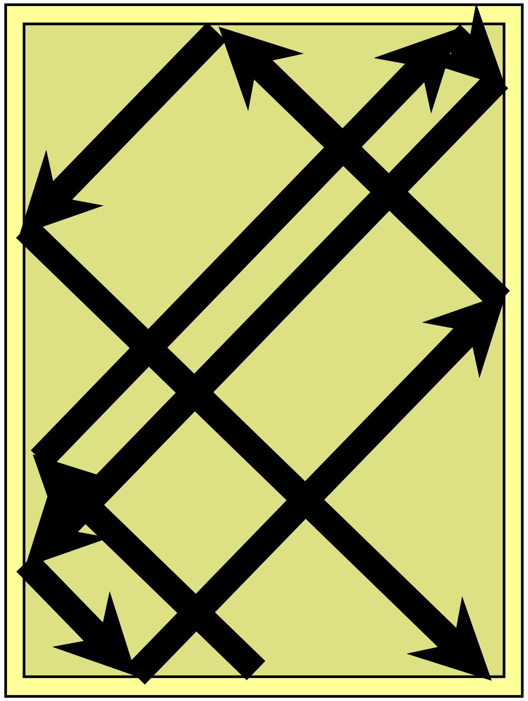
The TL is reduced from 30 dB to 28.5 dB due to the oversized hole

Use silicone or a similar material to fill the opening around the wires

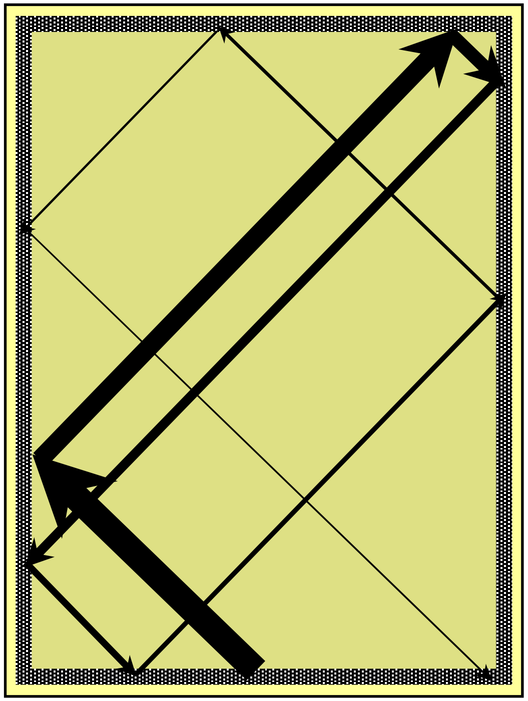


Scenario 2 – Front-end Loader

- Add absorption to reduce build up of reverberant sound



Without absorption



With absorption

***<u>Note:</u>* Prior to adding absorption, seal the cab by eliminating all unnecessary gaps!**

Scenario 3 – Hydraulic Pump

Known:

1. Large hydraulic pump mounted to a steel support structure
2. Sound level was 95 dB(A) ten feet from pump prior to trying noise controls
3. Engineers tried to reduce noise with a well-designed enclosure
4. Enclosure reduced the sound level by only 1 dB(A)

Scenario 3 – Hydraulic Pump

- The enclosure was well-designed
  - Sheet metal construction
  - Lined w/ barrier-absorber
  - Openings sealed with silicone
  - Damping applied to outside of enclosure
- Properly designed enclosures are good at blocking airborne sound

Scenario 3 – Hydraulic Pump

- Structure borne noise is more significant in this case
- Isolate pump and motor from the structure
- Prevent hydraulic lines from lying directly on surfaces that may be good noise radiators

Scenario 4 – Roof Bolter

Known:

1. Operator is overexposed to noise
2. Diesel engine used for propulsion
3. Electrically-powered hydraulic pump used for drilling & bolting

Scenario 4 – Roof Bolter

- Measure RB operator dose while documenting machine operation
- Examine data to determine percentage of dose accumulated while moving machine, drilling, bolting, etc.
- As an alternate method, use measured sound levels and time estimates for each machine function per shift to estimate dose

$$\% \text{ Dose} = T_{exp} / T_{allow} \times 100\%$$

Scenario 4 – Roof Bolter

Machine Functions

Moving Machine	Idle (Elec. Motors & Hyd. Pumps)	Drilling	Bolting

Measurements to perform:

1. Diesel engine only – $L_{p,eng}$
2. Idle – $L_{p,elec+hyd}$
3. Drilling – $L_{p,elec+hyd+drill}$
4. Bolting – $L_{p,elec+hyd+bolt}$

Scenario 4 – Roof Bolter

Example

Allowable Time (PEL)	
L_p, dB(A)	Hours
<90	∞
90	8.0
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0

Operation	L_p, dB(A)	T_{exp}, hrs	T_{allow}, hrs	% Dose
Engine only	88	2	∞	0%
Idle (elec. motor & hyd. pumps)	91	1.5	7	21%
Drilling	93	3.5	5.3	66%
Bolting	94	2	4.6	43%

Scenario 4 – Roof Bolter

- Compare sound levels do determine dominant noise sources
- A 3-dB difference is a 50% difference in terms of sound energy
- If *Source A* is 3 dB higher in sound level than *Source B*, *Source A* contributes *2X* as much sound energy

Scenario 4 – Roof Bolter

Operation	L_p, dB(A)
Engine only	88
Idle (Elec. Motor + Hyd. Pumps)	91
Drilling	93
Bolting	94

3 dB

3 dB

- Electric motor + hydraulic pump generate twice as much sound energy as the diesel engine
- Bolting contributes as much sound energy as the electric motor + hydraulic pump