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PRESENTATION HANDOUT

THIS PRESENTATION WAS GIVEN AT NEOCON IN CHICAGO, 6/17/15

AVOIDING AFTERTHOUGHT ACOUSTICS

PREVENTION AND TREATMENT

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ELECTRO-MEDIA DESIGN, LTD.

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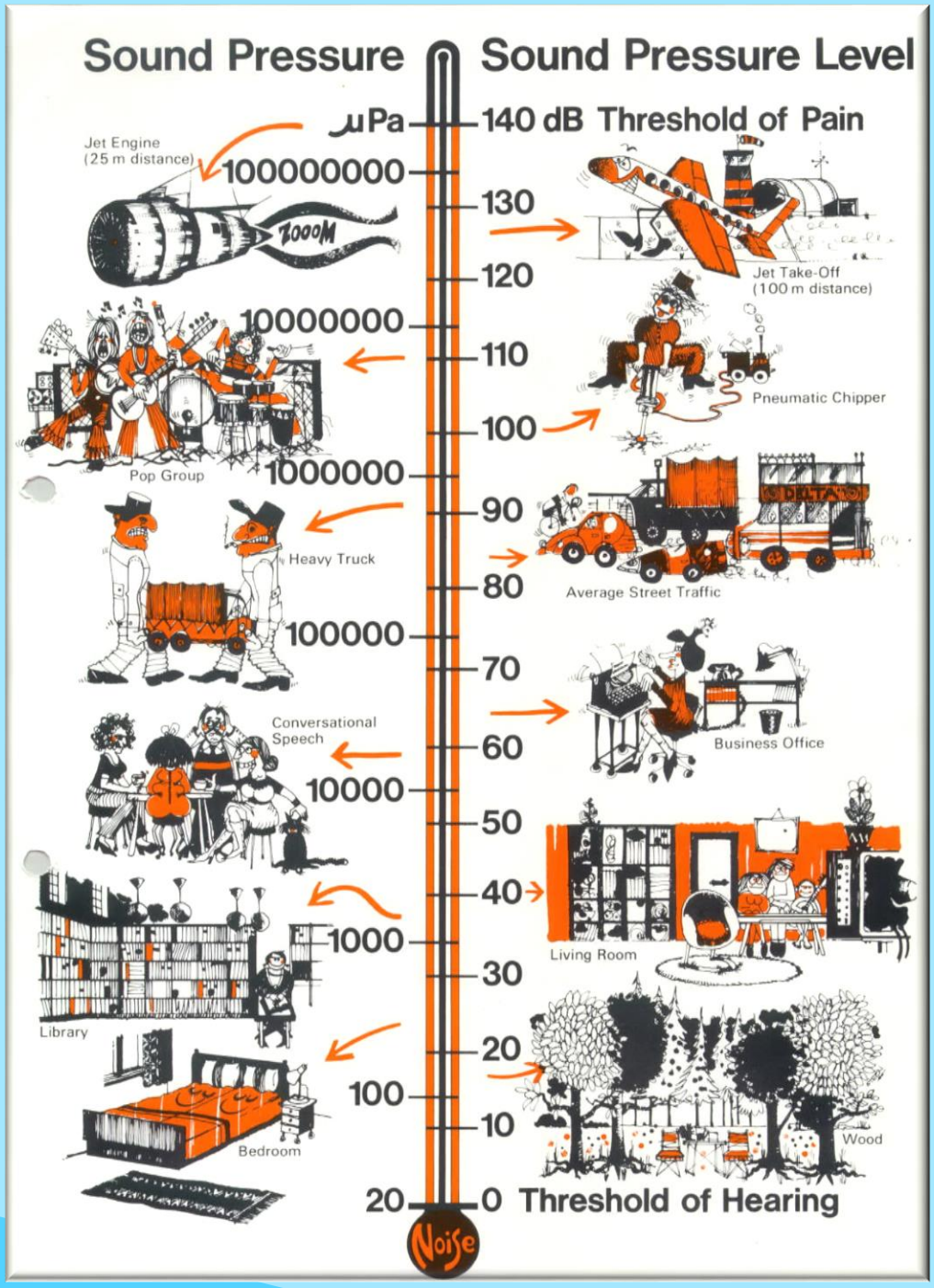
SPL SCALE (dB)

PRESENTATION HANDOUT



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dB MATH

PRESENTATION HANDOUT

Adding and Subtracting dB	
Difference between two noise levels [dB]	Add (subtract) to (from) the higher level [dB]
0	3
0.1 - 0.9	2.5
1.0 - 2.4	2
2.4 - 4.0	1.5
4.1 - 6.0	1
6.1 - 10	0.5
10	0

$$L\,(dB) = 10\log_{10}\left[\sum_{i=1}^{n} 10^{Li/10}\right]$$

Examples:

100 dB + 100 dB = 103 dB

100 dB + 105 dB = 106 dB

100 dB + 110 dB = 110 dB

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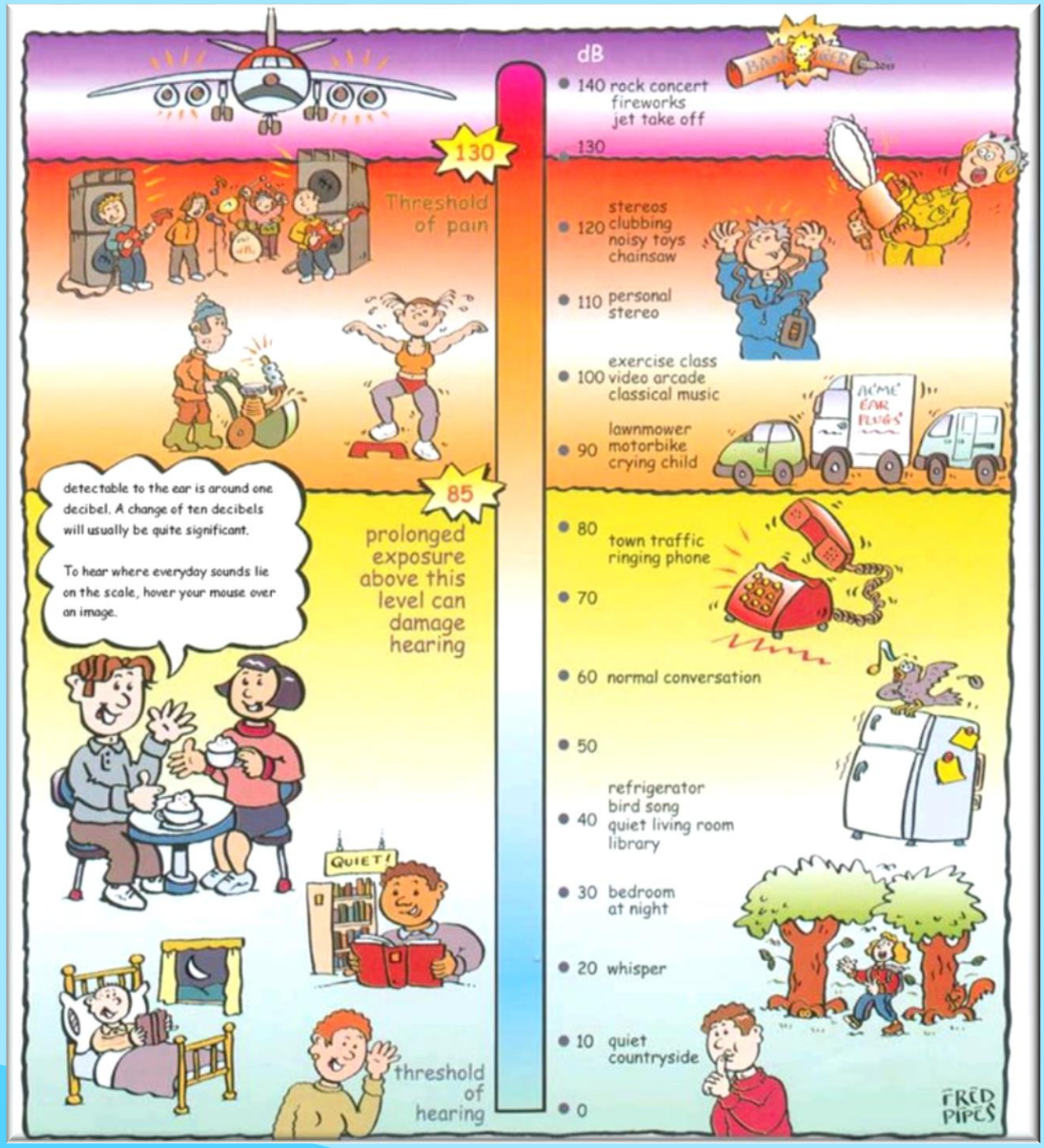
TYPICAL DAILY SOUND LEVELS

PRESENTATION HANDOUT



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TYPICAL dB(A) SOUND LEVELS

PRESENTATION HANDOUT

LOUDNESS COMPARISON CHART (dBA)

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Jet Fly-over at 1000 ft	110	Rock Band
	100	
Gas Lawn Mower at 3 ft	90	Food Blender at 3 ft
		Garbage Disposal at 3 ft
Diesel Truck at 50 ft at 50 mph	80	
Noisy Urban Area, Daytime		Vacuum Cleaner at 10 ft
Gas Lawn Mower at 100 ft	70	
Commercial Area		Normal Speech at 3 ft
Heavy Traffic at 300 ft	60	
		Large Business Office
Quiet Urban, Daytime	50	Dishwasher Next Room
Quiet Urban, Nighttime		
Quiet Suburban, Nighttime	40	Theater, Large Conference Room (Background)
	30	Library
Quiet Rural, Nighttime		Bedroom at Night, Concert Hall (Background)
	20	Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

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NRC

PRESENTATION HANDOUT

Material	NCR
Brick, painted	.00 - .02
Brick, unpainted	.00 - .05
Carpet, indoor-outdoor	.15 - .20
Carpet, heavy on concrete	.20 - .30
Carpet, heavy on foam rubber	.30 - .55
Concrete (smooth), painted	.00 - .05
Concrete (smooth), unpainted	.00 - .20
Concrete (block), painted	.05
Concrete (block), unpainted	.05 - .35
Cork, floor tiles (3/4” thick)	.10 - .15
Cork, wall tiles (1” thick)	.30 - .70
Drapery, light weight (10oz.)	.05 - .15
Drapery, medium weight (14 oz.), velour draped to half	.55
Drapery, heavy weight (10oz.), velour draped to half	.60
Fabric on Gypsum	.05
Fiberglass, 3-1/2” batt	.90 - .95
Fiberglass, 1” semi-rigid	.50 - .75

Material	NCR
Glass	.05 - .10
Gypsum	.05
Linoleum on Concrete	.00 - .05
Marble	.00
Plaster	.05
Plywood	.10 - .15
Polyurethane Foam (1" thick, open cell, reticulated)	.30
Rubber on Concrete	.05
Seating (occupied)	.80 - .85
Seating (unoccupied), metal	.30
Seating (unoccupied), wood	.30
Seating (unoccupied), fabric upholstered	.60
Seating (unoccupied), leather upholstered	.50
"Soundboard" (1/2" thick)	.20
Sprayed Cellulose Fibers (1" thick on concrete)	.50 - .75
Steel	.00 - .10
Terrazzo	.00
Wood	.05 - .15

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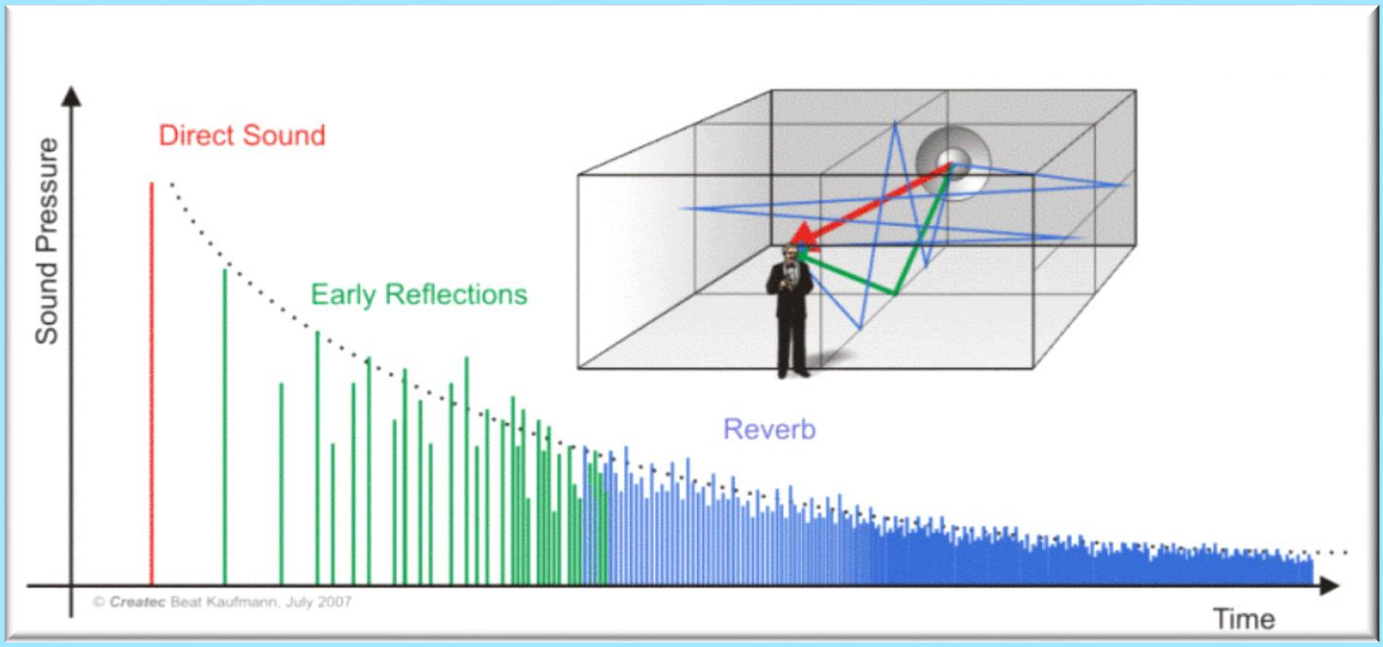
REVERBERATION TIME (RT_{60})

PRESENTATION HANDOUT



$$RT_{60} = \frac{0.049\,V}{\sum(S\,\propto)} \quad \text{(imperial)}$$

$$RT_{60} = \frac{0.161\,V}{\sum(S\,\propto)} \quad \text{(metric)}$$

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NOISE CRITERIA FOR ENCLOSED SPACES

PRESENTATION HANDOUT

Type of Space	Preferred	Alternative			Equivalent
	RC (N)	NC	NCB	NR	dB(A) (u)
Broadcast studios (distant microphone pickup used)	10	10	10	10	18
Concert halls, opera houses, recital halls (listening to faint musical sounds)	15 ~ 18	15 ~ 18	10 ~ 15	18	23 ~ 26
Small auditoriums	25 ~ 30	25 ~ 30	25 ~ 30	30	33 ~ 38
Large auditoriums, large drama theatres (for very good speech articulation)	20 ~ 25	20 ~ 25	15 ~ 20	25	28 ~ 33
TV and broadcast studios (close microphone pickup only)	15 ~ 20	15 ~ 20	15 ~ 25	20	23 ~ 28
Legitimate theatres	20 ~ 25	20 ~ 25	20 ~ 25	25	28 ~ 33
Private residences:					
Bedrooms	25 ~ 30	25 ~ 30	25 ~ 30	30	33 ~ 38
Apartments	30 ~ 40	30 ~ 40	28 ~ 38	40	38 ~ 48
Family rooms and living rooms	30 ~ 40	30 ~ 40	28 ~ 38	40	38 ~ 48
Schools:					
Lecture and classrooms (< 70 m2)	35 ~ 40	35 ~ 40	25 ~ 30	40	43 ~ 48
Lecture and classrooms (> 70 m2)	30 ~ 35	30 ~ 35	25 ~ 30	35	38 ~ 43
Open-plan classrooms	35 ~ 40	35 ~ 40	33 ~ 37	40	43 ~ 48
Hotels/motels:					
Individual rooms or suites	30 ~ 35	30 ~ 35	28 ~ 33	35	38 ~ 43
Meeting/banquet rooms	25 ~ 35	25 ~ 35	25 ~ 35	35	33 ~ 43
Halls, corridors and lobbies	35 ~ 40	35 ~ 40	38 ~ 43	40	43 ~ 48
Service support areas	40 ~ 50	40 ~ 50	38 ~ 48	50	48 ~ 58
Churches:					
Large sanctuary (broadcast)	25 ~ 30	25 ~ 30	15 ~ 20	30	33 ~ 38
Small sanctuary	30 ~ 35	30 ~ 35	30 ~ 35	35	38 ~ 43

(?) Compiled from multiple sources.
(u) A-weighted sound levels are not recommended for use in the design of HVAC systems.

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NOISE CRITERIA FOR ENCLOSED SPACES (CONT)

PRESENTATION HANDOUT

Type of Space	Preferred	Alternative			Equivalent
	RC (N)	NC	NCB	NR	dB(A) (u)
Office buildings:					
Teleconference rooms	20 ~ 25	20 ~ 25	20 ~ 25	25	28 ~ 33
Executive offices	25 ~ 35	25 ~ 35	25 ~ 30	35	33 ~ 43
Small, private offices	35 ~ 40	35 ~ 40	30 ~ 35	40	43 ~ 48
Larger offices, with conference tables	30 ~ 35	30 ~ 35	25 ~ 30	35	38 ~ 43
Large conference rooms	25 ~ 30	25 ~ 30	25 ~ 30	30	33 ~ 38
Small conference rooms	30 ~ 35	30 ~ 35	30 ~ 35	35	38 ~ 43
General secretarial areas	40 ~ 45	40 ~ 45	38 ~ 43	45	48 ~ 53
Open-plan areas	35 ~ 40	35 ~ 40	35 ~ 40	40	43 ~ 48
Business machines/computers	40 ~ 45	40 ~ 45	38 ~ 43	45	48 ~ 53
Public circulation	40 ~ 50	40 ~ 50	38 ~ 48	50	48 ~ 58
Hospitals and clinics:					
Private rooms	25 ~ 30	25 ~ 30	25 ~ 30	30	33 ~ 38
Wards	30 ~ 35	30 ~ 35	30 ~ 35	35	38 ~ 43
Operating rooms	25 ~ 35	25 ~ 35	25 ~ 30	35	33 ~ 43
Laboratories	35 ~ 45	35 ~ 45	33 ~ 43	45	43 ~ 53
Corridors	35 ~ 45	35 ~ 45	33 ~ 43	45	43 ~ 53
Public areas	40 ~ 45	40 ~ 45	38 ~ 43	45	48 ~ 53
Movie theatres	30 ~ 40	30 ~ 40	27 ~ 37	40	38 ~ 48
Courtrooms	30 ~ 35	30 ~ 35	33 ~ 37	35	38 ~ 43
Libraries	35 ~ 40	35 ~ 40	33 ~ 37	40	43 ~ 48
Restaurants	40 ~ 45	40 ~ 45	38 ~ 43	45	48 ~ 53

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NOISE LEVELS dBA / DECIBELS

PRESENTATION HANDOUT

Home	
dBA	**Item**
50	Refrigerator
50-60	Electric Toothbrush
50-75	Washing Machine, Air Conditioner
50-80	Electric Shaver
55	Dish Washer
60	Sewing Machine
60-85	Vacuum Cleaner
60-95	Hair Dryer
65-80	Alarm Clock
70	TV Audio
70-80	Coffee Grinder
70-95	Garbage Disposal
75-85	Flush Toilet
80	Popup Toaster, Doorbell, Ringing Telephone, Whistling Kettle
80-90	Food Mixer / Processor, Garbage Disposal
110	Baby Crying, Squeaky Toy Held Close to the Ear
135	Noisy Squeeze Toys

Recreation	
dBA	**Item**
40	Quite Residential Area
70	Freeway Traffic
85	Heavy Traffic / Noisy Restaurant
90	Truck / Shouted Conversation
95-110	Motorcycle
100	Snowmobile, School Dance / Boom Box
110	Disco, Busy Video Arcade, Symphony Concert, Car Horn
110-120	Rock Concert
112	Personal Cassette Player on High
117	Football Game (Stadium)
120	Band Concert
125	Auto Stereo (Factory Installed)
130	Stock Car Races
143	Bicycle Horn
150	Firecracker
156	Cap Gun
157	Balloon Pop
162	Fireworks (at 3 Feet)
163	Rifle
166	Handgun
170	Shotgun

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NOISE LEVELS
dBA / DECIBELS (CONT)

PRESENTATION HANDOUT

Work	
dBA	**Item**
40	Quite Office / Library
50	Large Office
65-95	Power Lawn Mower
80	Manual Machine / Tools
85	Handsaw
90	Tractor
90-115	Subway
95	Electric Drill
100	Factory Machinery, Woodworking Class
105	Snow Blower
110	Power Saw, Leaf Blower
120	Chain Saw / Hammer on Nail, Pneumatic Drills / Heavy Machine, Jet Plane (at Ramp), Ambulance Siren
125	Chain Saw
130	Jackhammer / Power Drill, Air Raid, Percussion Section at Symphony
140	Airplane Taking Off
150	Jet Engine Taking Off, Artillery Fire at 500 Feet
180	Rocket Launching from Pad

Points of Reference (Measured in dBA or Decibels)	
0	The softest sound a person can hear with normal hearing
10	Normal Breathing
20	Whispering at 5 feet
30	Soft Whisper
50	Rainfall
60	Normal Conversation
110	Shouting in Ear
120	Thunder

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HUD CRITERIA

PRESENTATION HANDOUT

Partition Function Between Dwellings			Luxury Grade I		Average Grade II		Minimum Grade III	
Apt. A		Apt. B	STC	IIC	STC	IIC	STC	IIC
Bedroom	above	Bedroom	55	55	52	52	48	48
Living Room	above	Bedroom 1,2	57	60	54	57	50	53
Kitchen 3	above	Bedroom 1,2	58	65	55	62	52	58
Family Room	above	Bedroom 1,2,4	60	65	56	62	52	58
Corridor	above	Bedroom 1,2	55	65	52	62	48	48
Bedroom	above	Living Room 5	57	55	54	52	50	48
Living Room	above	Living Room	55	55	52	52	48	48
Kitchen	above	Living Room 1,2	55	60	52	57	48	53
Family Room	above	Living Room 1,2,4	58	62	54	60	52	56
Corridor	above	Living Room 1,2	55	60	52	57	48	53
Bedroom	above	Kitchen 1,5	58	52	55	50	52	46
Living Room	above	Kitchen 1,5	55	55	52	52	48	48
Kitchen	above	Kitchen	52	55	50	52	46	48
Bathroom	above	Kitchen 1,2	55	55	52	52	48	48
Family Room	above	Kitchen 1,2,4	55	60	52	58	48	54
Corridor	above	Kitchen 1,2	50	55	48	52	46	48
Bedroom	above	Family Room 1,5	60	50	56	52	48	46
Living Room	above	Family Room 1,4	58	52	54	50	52	48
Kitchen	above	Family Room 1,4	55	55	52	52	48	50
Bedroom	above	Bathroom	52	52	50	50	48	48
Corridor	above	Corridor	50	50	48	48	46	46

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CLOSING THOUGHTS...

PRESENTATION HANDOUT

"An ounce of prevention is worth a pound of cure, especially when dealing with acoustics."

Thank you for your time!

Questions?

For more information contact ***ELECTRO-MEDIA DESIGN, Ltd.***
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This concludes The American Institute of Architects Continuing Education Systems Course

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