

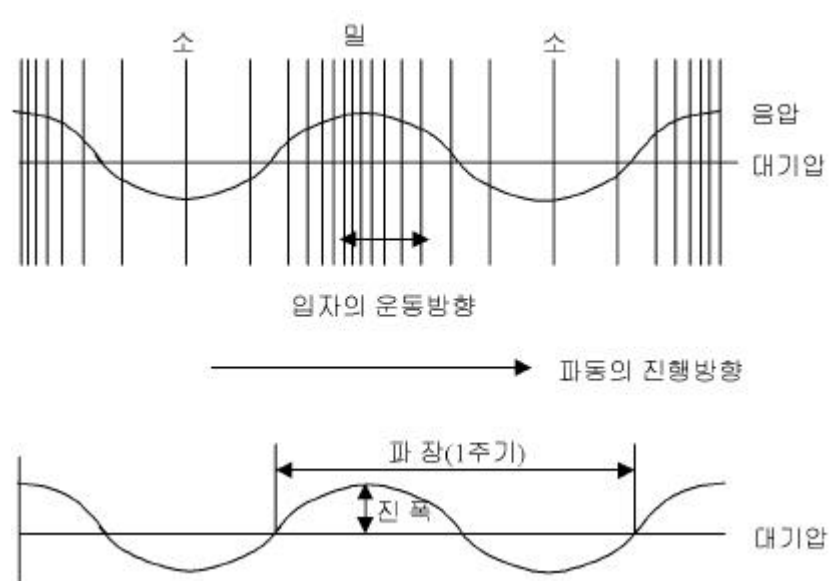
가

1.

(Unwanted sound, Undesirable sound)

( , , )

( )



.1

!

(Frequency, f)  
1 (Cycle) Hz . 4000Hz  
4000 cycle  
16 ~ 20000Hz .

Hz = cycle /sec  
(Velocity, c)

Cair = 340 m/sec  
Cwater = 1433 m/sec  
Cwood = 3962 m/sec  
(Wave length, )  
cycle c=f  
(Amplitude)

1Pascal = 1N/m<sup>2</sup>  
(Pure tone)

(Decibel)

가 W (W0)  
10  
dB = 10log(W/W<sub>0</sub>)

## 1.1

### 1.1.1. (Sound Intensity)

(dB)  
1000Hz 가 10<sup>-12</sup>W/m<sup>2</sup>  
가

$$IL(dB) = 10 \log(I/I_0)$$

$$I : \quad , \text{ W m}^2$$

$$I_0 : \quad , 10^{-12} \text{ W m}^2$$

### 1.1.2 (Sound Pressure Level)

$$I = \frac{P^2}{c}$$

$$P : \quad (\text{N/ m}^2)$$

$$: \quad (1.2 \text{ kg/ m}^3)$$

$$c : 340 \text{ m/sec}$$

$$IL(dB) = 10 \log(I/I_0)$$

$$= 10 \log((P^2/c)/(P_0^2/c))$$

$$= 10 \log(P^2/P_0^2)$$

$$= 20 \log(P/P_0) = SPL$$

$$P_0 = 0.00002 \text{ N/ m}^2 \quad \text{가 } 1000 \text{ Hz}$$

### 1.1.3. (Sound Power Level)

$$PWL = 10 \log(W/W_0)$$

$$W :$$

$$W_0 : \quad , 10^{-12} \text{ watt}$$

1.1.4

S

$$W = I \times S$$

$$10 \log(W / 10^{-12}) = 10 \log(I / 10^{-12}) + 10 \log S$$

$$PWL = SPL + 10 \log S$$

가

가

가      가      6dB

$$S = 4 \cdot r^2$$

$$PWL = SPL + 20 \log r + 11$$

$$SPL = PWL - 20 \log r - 11$$

$$S = 2 \cdot r^2$$

$$PWL = SPL + 20 \log r + 8$$

$$SPL = PWL - 20 \log r - 8$$

가      3dB      .

$$SPL = PWL - 10 \log 2 \quad r = PWL - 10 \log r - 8$$

$$S = r$$

$$SPL = PW_{\text{r}} 10 \log r = PW_{\text{r}} 10 \log r - 5$$

1.2.

Decibel

$$IL(\text{dB}) = 10 \log(I/I_0)$$

$$L = 10 \log(10^{L_1/10} + 10^{L_2/10} + \dots + 10^{L_n/10})$$

1

$$L = 10 \log(1/n(10^{L_1/10} + 10^{L_2/10} + \dots + 10^{L_n/10}))$$



(Hz)	31.5	63	125	250	500	1000	2000	4000	8000
(dB)	80	80	85	88	90	95	88	92	94

①

②

.1		(dB)	
L	L	dB L	L (LR)
L	L	L	L : L
		가	dB
0.0	0.1		3.0
0.2	0.3		2.9
0.4	0.5		2.6
0.6	0.7		2.7
0.8	0.9		2.6
1.0	1.2		2.5
1.3	1.4		2.4
1.5	1.6		2.3
1.7	1.9		2.2
2.0	2.1		2.1
2.2	2.4		2.0
2.5	2.7		1.9
2.8	3.0		1.8
3.1	3.3		1.7
3.4	3.6		1.6
3.7	4.0		1.5
4.1	4.3		1.4
4.4	4.7		1.3
4.8	5.1		1.2
5.2	5.6		1.1
5.7	6.1		1.0
6.2	6.6		0.9
6.7	7.2		0.8
7.3	7.9		0.7
8.0	8.6		0.6
8.7	9.6		0.5
9.7	10.7		0.4
10.8	12.2		0.3
12.3	14.5		0.2
14.6	19.3		0.1
19.4			0.0
1	: L	L	가
2	:		L
3	: L	L	L
(LR = L + L )			

1.3.

가

가

31.5, 63, 125, 250 ...2000, 4000,

8000Hz

(Lower Band Limit,  $f_1$ )

(Upper Band Limit,  $f_2$ )

$$f_2 = 2f_1$$

$$f_c = (f_1 f_2)^{1/2} = (2f_1^2)^{1/2} = \sqrt{2}f_1$$

$$1/2$$

$$1/3$$

$$1/3$$

$$f_2 = 2^{1/3} f_1$$

$$f_c = (f_1 f_2)^{1/2} = (2^{1/3} f_1^2)^{1/2} = \sqrt[6]{2} f_1$$

2  $f_c, f_1, f_2$

Octave Band	Third-Octave Band
$f_2 = 2f_1$	$f_2 = 2^{1/3} f_1$
$f_1 = f_c / \sqrt{2}$	$f_1 = f_c / \sqrt[6]{2}$
$f_2 = f_c \sqrt{2}$	$f_2 = f_c \sqrt[6]{2}$
$f_c = \sqrt{f_1 f_2}$	

14. A, B, C

		1/ 3	
	22.4	25	22.4
31.5		31.5	28
	45	40	35.5
		50	45
63		63	56
	90	80	71
		100	90
125		125	112
	180	160	140
		200	180
250		250	224
	355	315	280
		400	355
500		500	450
	710	630	560
		800	710
1000		1000	900
	1400	1250	1120
		1600	1400
2000		2000	1800
	2800	2500	2240
		3150	2800
4000		4000	3550
	5600	5000	4500
		6300	5600
8000		8000	7100
	11200	10000	9000
			11200



가

1000Hz 40 (Phon)

40 1000Hz 40dB

1 40

1000Hz 40dB 50Hz 65dB, 4000Hz 32dB

가

A, B, C

가 A

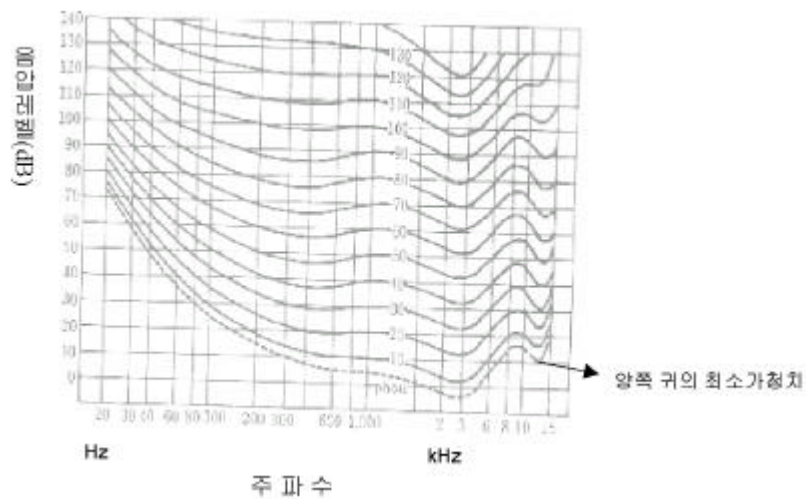
가 A

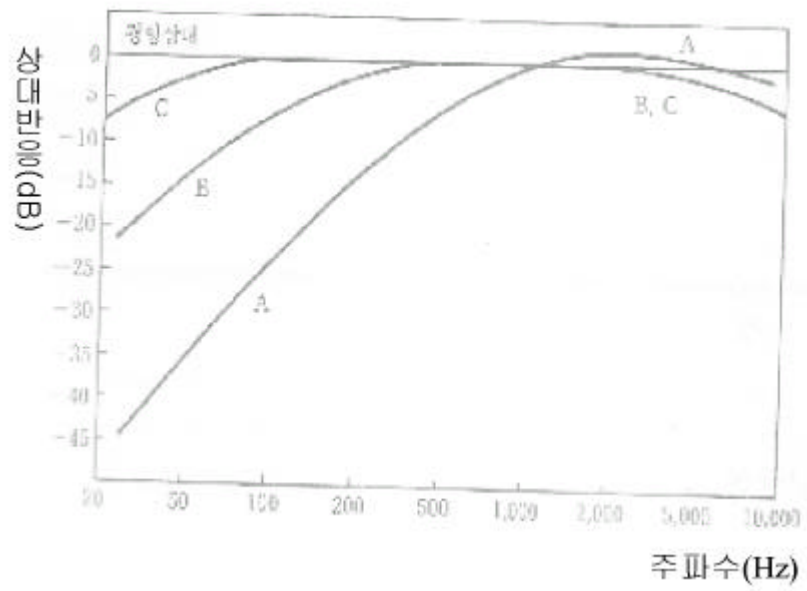
가 (Sound Level Meter)

A, C

A C

가





. 2 A, B, C

. 4 A, B, C

(HZ)	A (dB)	B (dB)	C (dB)
31.5	- 39.4	- 17.1	- 3.0
63	- 26.2	- 9.3	- 0.8
125	- 16.1	- 4.2	- 0.2
250	- 8.6	- 1.3	0
500	- 3.2	- 0.3	0
1,000	0	0	0
2,000	+ 1.2	- 0.1	- 0.2
4,000	+ 1.0	- 0.7	- 0.8
8,000	- 1.1	- 2.9	- 3.0

: ANSI, 1995

2. 가

가

ISO Standard

OSHA

가 8

가

85dB

, 85dB

, 85dB

85dB

OSHA

가

가

85dB

Level Meter)

(Noise Dosimeter)

(

가

가

(Leq)

(Dose)

(Sound

가

1

)  
 . 1 120dB  
 ( ) 1  
 . , 가 ,  
 가 , 가  
 , .

## 2.1.

### 2.1.1.

-29 ~ 60

가 .

### 2.1.2.

### 2.1.3.

10000feet

$$C = 10 \log \left[ \left( \frac{460+t}{528} \right)^{0.5} (30/B) \right]$$

C = , dB

t = F

B = inchHg

### 2.1.4.

2m/sec

5m/sec .

2.1.6. Calibration

Calibration

Calibration

### 2.2.1. (Walkaround Survey)

2.2.1. (Walkaround Survey)

가 . 가 가 가  
가 가 .

2.2.2. (Workshift Sampling) 가  
가  
8 .

• 가 ( , , )

•  
•  
•

•  
•  
•  
•  
•  
•

• 가(  
, ,  
)

•  
•

2.3 가

2.3.1 가

ANSI Standard S 14- 1971 S 14- 1983

•  
, , ,  
,  
•  
A, B, C .

가  
(leq) Leq 가

- Spot Check
- 
- 가
- 
- 가

Hearing Zone . Hearing Zone  
60cm ,

A  
(slow)  
가 (Leq) .  
가  
가

$$Leq T = 10 \log \left( \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{P_A^2(t)}{P_0^2} dt \right)$$

T = 실측시간  $t_2 - t_1$   
 $P_A(t)$  = A 특성 음압  
 $P_0$  = 기준음압

가

Leq

$$Leq = 10 \log \left[ \frac{1}{n} (10^{L_1/10} + 10^{L_2/10} + \dots + 10^{L_n/10}) \right]$$

$$Leq T = 10 \log \left[ (n_1 \times 10^{L_1/10} + n_2 \times 10^{L_2/10} + \dots + n_n \times 10^{L_n/10}) / 480 \right]$$

$L_1 =$

$n_n =$  ( )

가

6

가

1

6

가

.

2.3.2

가

(Noise Dosimeter) ANSI S1-25-1978

가

. 8

가

Dose(%)

가

dB(A)

.

Hearing Zone

.

A

(slow)

Threshold Rate

가

A

, setting

가

.

OSHA

80dB

ISO

75dB

.

.

Exchange Rate( )

가

.

가

2 가

3dB

가



5dB 가 2 가  
 OSHA 5dB , ISO, , NIOSH,  
 EPA 3dB , 4dB .

2 8hr- TWA 5dB .

.5 Threshold Rate

		80dB Threshold	90dB Threshold
		Rate	Rate
90dB	8	100%	100%
89dB	8	87%	0%
85dB	8	50%	0%
80dB	8	25%	0%
79dB	8	0%	0%
90dB	4	62.5%	50%
80dB	4		
90dB	7	98.4%	87.5%
89dB	1		
90dB	8	165.3%	100%

Criterion Level

8 가 90dB Setting .

가

8 가 8

가

.

$$TWA = 16.61 \log(D/100) + 90$$

$$TWA = 16.61 \log(D/ (12.5 \times T)) + 90$$

$$TWA = 8 \text{ 가 (dB(A))}$$

$$D = (\%)$$

$$T =$$

2.4.

①

가  
(UCL, LCL) 가  
.  
.

② 85dB (A)  
85dB

, OSHA

③

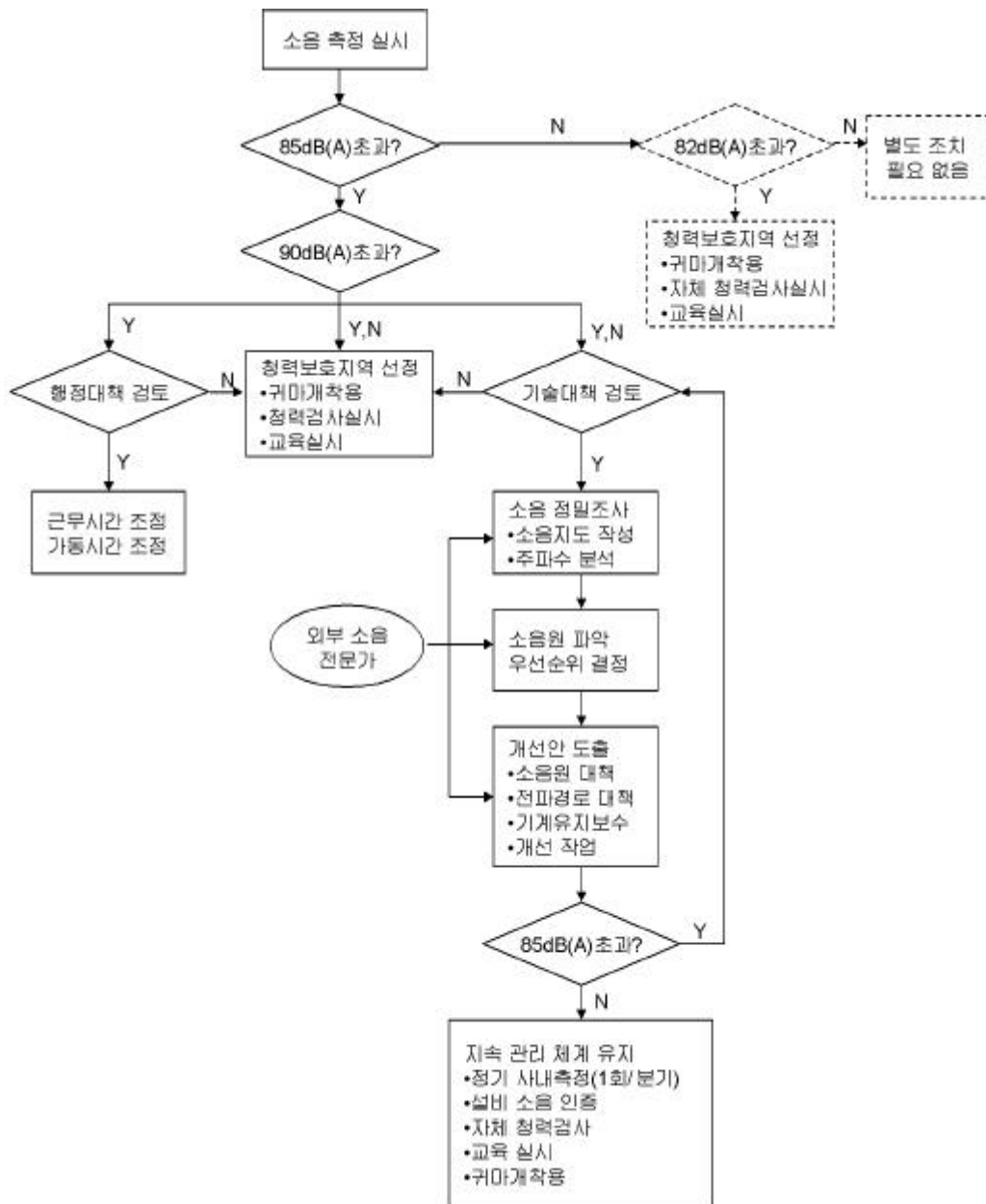
85dB

.6 ACGIH TLV

		1	ACGIH TLV (dB (A ))	(dB (A ))
		24 16 8 4 2 1	80 82 85 88 91 94	90 95 100 105
		30 15 7.5 3.75 1.88 0.94	97 100 103 106 109 112	110 115  *115dB
		28.12 14.06 7.03 3.52 1.76 0.88 0.44 0.22 0.11	115 118 121 124 127 130 133 136 139	
	가		$C/T_1 + C/T_2 + \dots + C/T_n$ C : T : 가 가 10	8 가 Dose 가
	가		80 140dB 63dB 가  140dB	1 100 140dB 1000 130dB 10000 120dB * 140dB

3.

3.1.

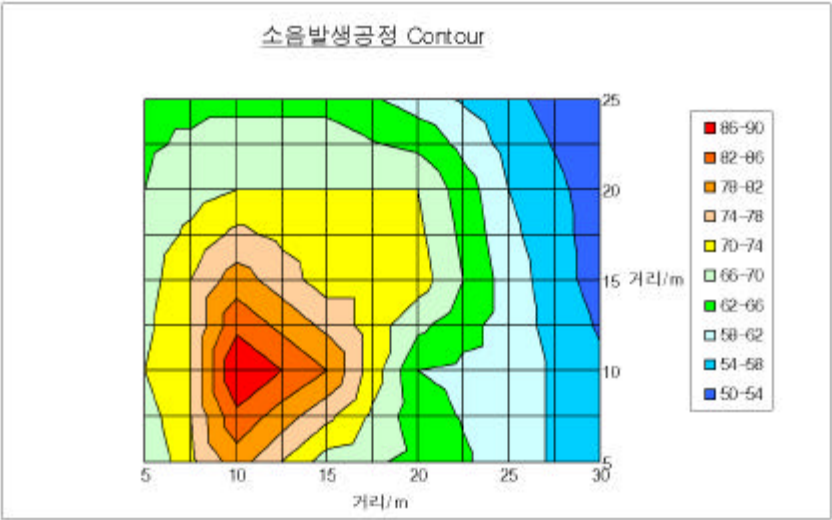


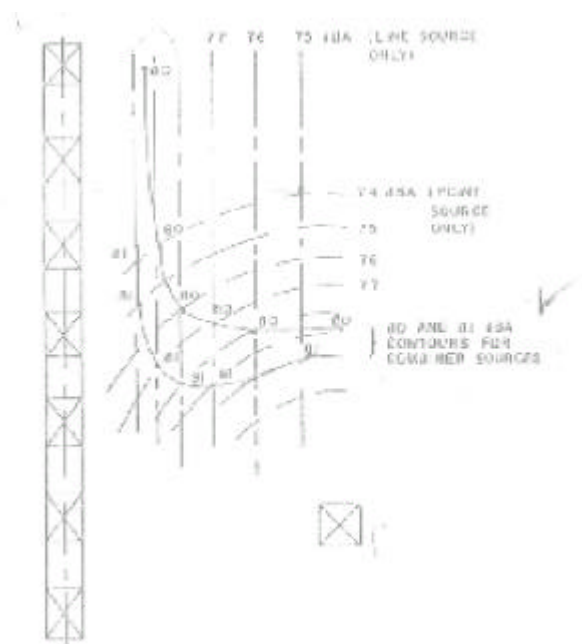
3.2.

85dB(A) 가 OSHA Action Level  
85dB(A)

3.2.1.

(Noise Contour)

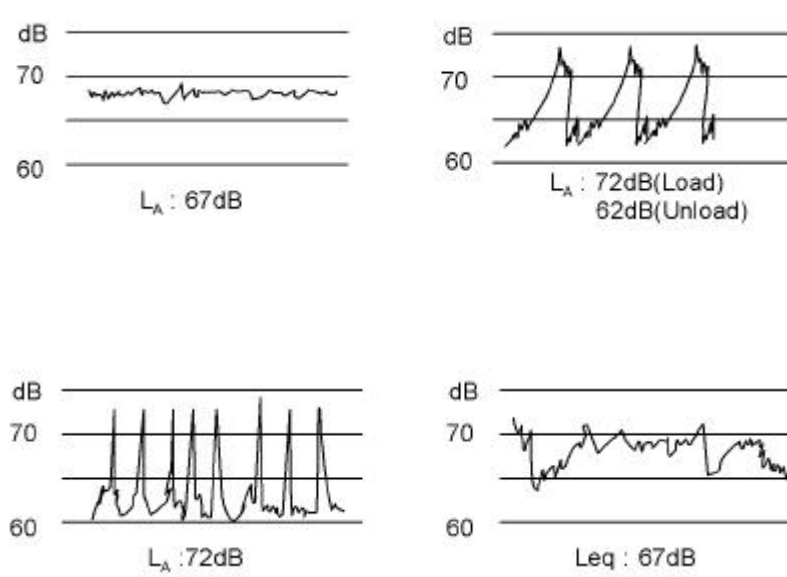




. 4

- : 15cm ( 20cm )
- : 30cm ( 50cm )
- : 100cm

- :
- :
- :
- : 가



Filter Octave Band Filter 1/3 Octave Band

3.2.2

가

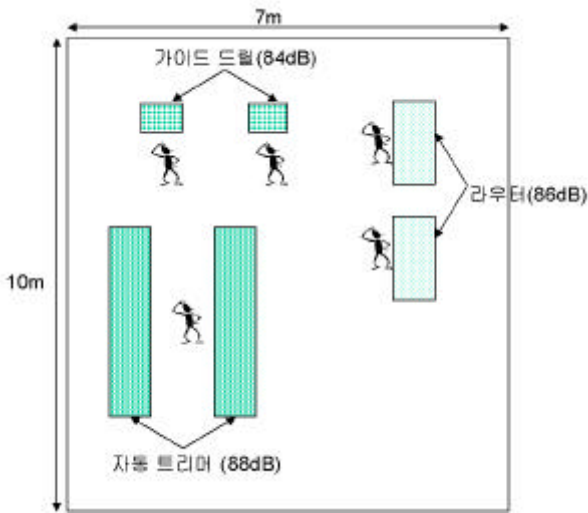
3.2.3. 가

가

가



가



85dB

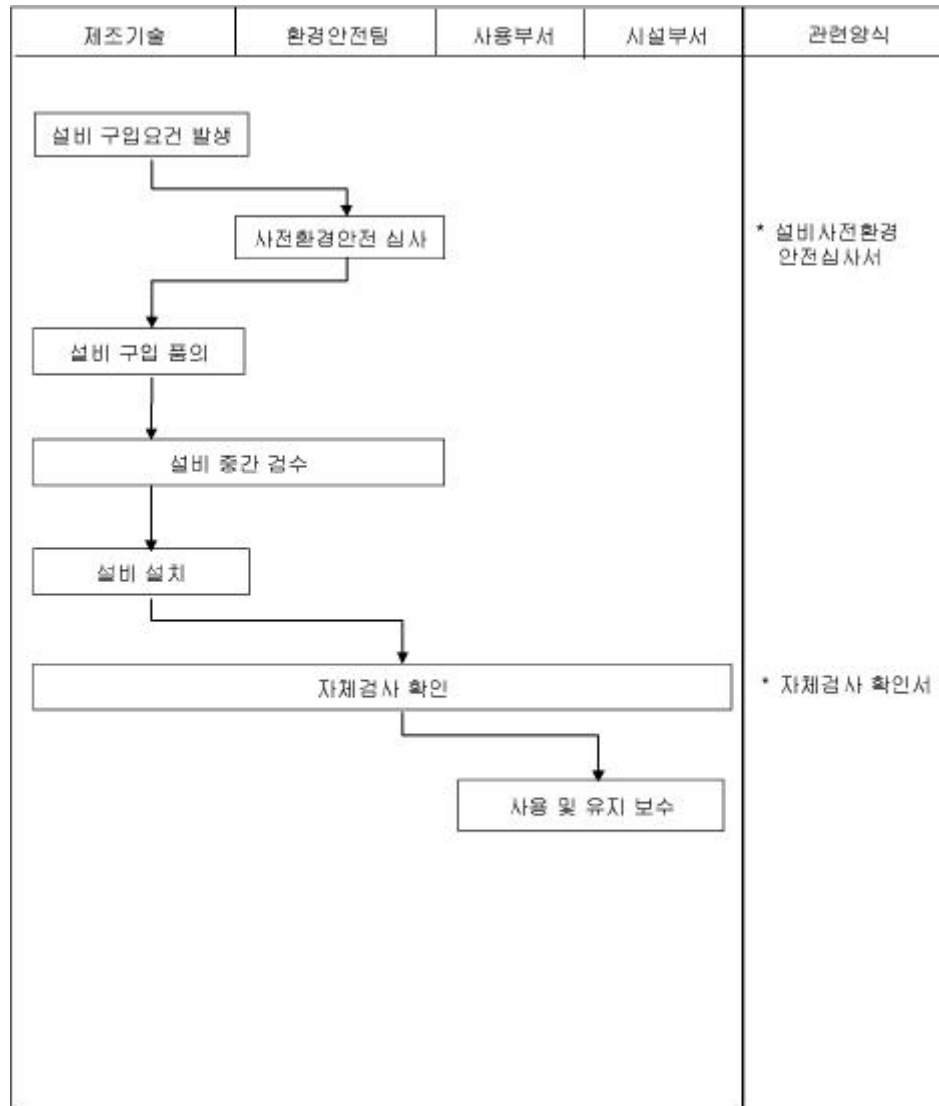


3.3.

· Spec 가  
· Spec  
Spec  
가  
Spec  
·  
· spec  
·  
·  
·  
(LG )  
· ( )  
: 50cm 75dB  
· ( 가 )  
: 50cm 80dB  
· ( , , )  
: 50cm 85dB 90dB  
· Spec  
·  
가  
가  
1m

(ISO Standard )

가 .



. 7

		dB (A)	
	75 75 140 140 280 280	73 76 82	,
	75 75 140 140	76 79 82	,
	10m³/ 10 30 30m³/	74 76 78	,
	75 75	74 76	, (60Hz)
		85	( )
	( ) 500kg 500kg	85 88	( )
	75 75 140 140 280 280	73 76 79 82	( )
		85	( )
<p>* 7.5m</p> <p>* : 210kg/cm ( , , , 3.1:2.6:1:0.55</p> <p>14 , ) , 가 , , 가</p> <p>50cm,50cm,50cm</p> <p>* : ( 2</p> <p>2 ) 210kg/cm (</p> <p>15mm ) 20cm , 가 , , 가</p> <p>50cm,50cm,20cm .</p>			