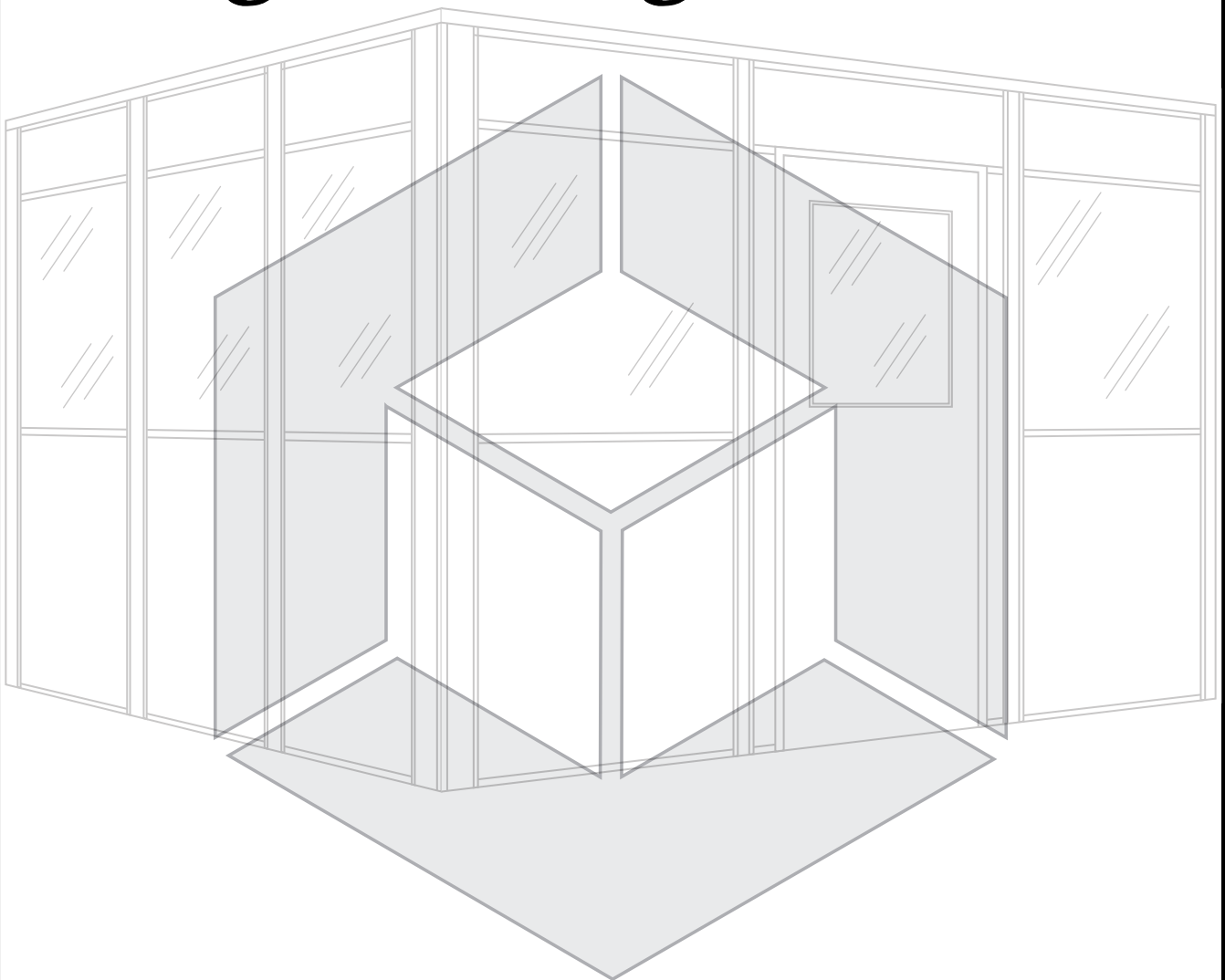




**NATIONAL
PARTITIONS**

Engineering Manual



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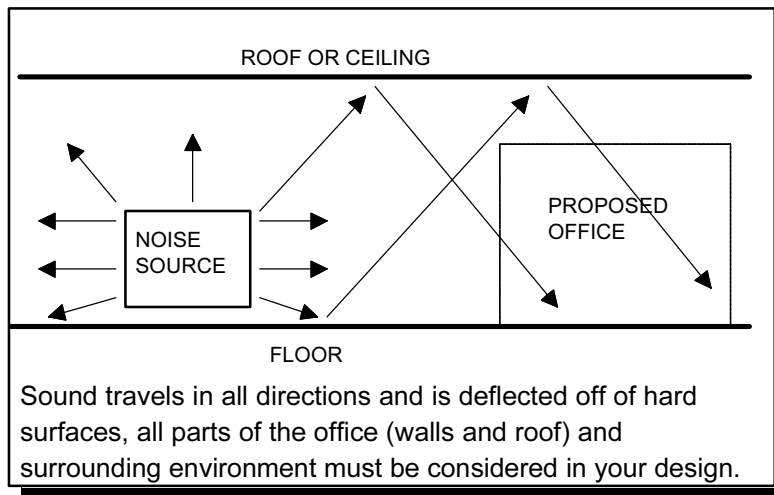
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DESIGNING FOR SOUND CONTROL

DESIGN CONSIDERATIONS

1. Group noisy equipment together in the same area.
2. Choose equipment that generates less noise.
3. Consider enclosing the noisy equipment with partitions.
4. Consider the travel of the sound and the acoustical properties of the area.
5. Locate your office away from the noisy areas.
6. Choose an area that is isolated and protected.
7. Design the office with doors or windows facing away from the noise source.
8. Design the office with matching sound deadening components.
9. Place closets or store rooms etc. on the walls closest to the noise source.
10. It is usually less expensive to avoid noise problems than to correct them.



RELATIONSHIP OF SOUND INTENSITY		
INTENSITY ENERGY UNITS	DECIBEL LEVEL	NOISE SOURCE
100,000,000,000,000	140	Jet Aircraft
10,000,000,000,000	130	Pain Threshold
1,000,000,000,000	120	
100,000,000,000	110	
10,000,000,000	100	Heavy Manufacturing
1,000,000,000	90	Medium Manufacturing
100,000,000	80	Light Manufacturing
10,000,000	70	Warehouse
1,000,000	60	Normal Speech - Shop Office
100,000	50	Quiet Office
10,000	40	Private Office
1,000	30	
100	20	Empty Theater
10	10	
1	0	Hearing Threshold

OSHA REGULATIONS

Manufacturing plants with noise levels above 90 decibels are required by OSHA to minimize the working time in those areas and to provide ear plug protection. Installing sound controlled rooms will maximize the productive time in an area.

OSHA STANDARDS	
ALLOWED WORK SHIFT	DECIBEL LEVEL
8 Hour Work Shift	90 dB
6 Hours	92 dB
4 Hours	95 dB
3 Hours	97 dB
2 Hours	100 dB
1.5 Hours	102 dB
1 Hour	105 dB
30 Minutes	110 dB
15 Minutes	115 dB

EFFECTS OF CHANGE IN DECIBELS	
DECIBEL CHANGE	EFFECT
3 dB	Just Perceptible
5 dB	Clearly Noticeable
10 dB	Twice As Loud (or 1/2)
15 dB	Big Change
20 dB	Much Louder (or Quieter)

SOUND DEFINITIONS:

ATTENUATION - Reduction or lessening.

TRANSMISSION LOSS (TL) - This refers to attenuation of sound passing through construction when tested according to ASTM E90. **The actual TL graph provides the best rating method.** Sound transmission through walls varies with the frequency, weight or mass and stiffness of the construction. Theoretically the transmission loss varies at the rate of 6 dB per doubling (or halving) of the weight and varies 5 dB for each doubling of the air space (minimum effective space is 2").

NOISE REDUCTION - The actual difference in the sound pressure level between two spaces being considered. It is what the ear hears and what we are interested in. It is dependent on the TL of the walls and the sound absorption present.

SOUND TRANSMISSION CLASS (STC) - Testing method is ASTM E90 - Airborne Sound Transmission Loss. This is a rating system which compares the transmission loss test curve for a construction with a "standard contour" which reflects known subjective response to the TL performance. The contour is fitted to the test curve of the construction, and the relative vertical position of the contour determines the sound transmission class. This is used for ranking materials. The standard curve fitted to the actual TL can not have a deficiency of more than 8 decibels. The inherent problem with this ranking standard is that building materials commonly have coincidence points at one particular frequency showing a deficiency of 8 or more points. The cause of the deficiency is usually unexplainable. The results are a

drop in the STC value which lowers the ranking. It is possible for a material to have a lower STC value than another and attenuate sound better in 17 of the 18 testing frequencies. For this reason we strongly suggest the use of the actual TL data when determining the appropriate material to use for any application and a field measurement for the applicable noise frequencies.

GENERAL SOUND ISOLATION CRITERIA		
LOCATION	USE	MINIMUM STC
Light Duty Warehouse (70 dB)	Executive Offices 50 dB	20
	Normal Offices 55 dB	15
	General Offices 60 dB	10
	Shop Offices 65 dB	5
Light Manufacturing (80 dB)	Executive Offices	30
	Normal Offices	25
	General Office Area	20
	Shop Office	15
Medium Manufacturing (90 dB)	Executive Offices	40
	Normal Offices	35
	General Office Area	30
	Shop Office	25
Heavy Manufacturing (100 dB)	Executive Offices	50
	Normal Offices	45
	General Office Area	40
	Shop Office	35

STC VALUE OF STANDARD COMPONENTS	
MATERIAL	STC
3/16" Tempered Glass	25
1/4" Laminated Glass	35
1/4" Laminated Glass - Spaced 2" - 3/16" Glass	45
1/2" Insulated Glass	32
Hollow Core Door	25
Steel Door	25
1/2" Gypsum Wall Panel	30
5/8" Gypsum Wall Panel	35
HushCore Wall Panel	45
Roof Deck with Mineral Tile Ceiling	35
Single Sheet 18 Gauge Steel	30
Single Sheet .025 Aluminum	19
Single Sheet Plywood 1/4"	22
Single Sheet Lead 1/16"	34

SOUND FREQUENCY - Octave band frequencies measured in cycles per second or Hertz (Hz).

OCTAVE - a frequency ratio of 2:1. For example from middle C (261hz) to one octave higher 522 or one octave lower 130.

COMMON SOUND FREQUENCIES

- Female voice range 600 - 800 Hz
- Flourescent light hum range 550 - 650 Hz
- Musical "A" 440 Hz
- High "C" 4186 Hz
- Span of human hearing 0 - 20000 Hz
- Speech interference range 550 - 5000 Hz
- Span of AM radio 200 - 5000 Hz
- Pedal of Pipe Organ 10 - 20 Hz
- Span of human hearing 0 - 20000 Hz

STANDARD PRODUCTS

DECIBEL REDUCTION - TRANSMISSION LOSS (TL) BY FREQUENCY

MATERIAL	FREQUENCY	100	125	160	200	250	315	400	500	630	800	1,000	1,250	1,600	2,000	2,500	3,150	4,000	5,000
GLASS																			
3/16" Temp Glass		23	25	25	24	28	26	29	31	33	34	34	35	34	30	27	32	37	41
1/2" Insulated Glass		26	21	23	23	26	21	19	24	27	30	33	36	40	44	46	39	34	45
1/4" Laminated Glass		25	26	28	27	29	29	30	32	34	35	35	36	36	35	35	38	43	46
1/4" Lam - 2"Space - 3/16" tem		24	25	34	33	34	40	41	44	44	46	47	47	48	48	46	50	55	56
PANELS																			
1/8"Hardboard-Foam-Hb Panel		12	15	12	16	17	19	20	22	22	23	18	12	32	41	49	55	53	47
3/16"Hardboard-HC-Hb Panel		9	11	14	13	17	19	21	22	23	23	24	25	26	27	30	39	46	47
5/8"Gypsum-HC-Gyp Panel		23	27	27	28	29	30	31	38	38	38	38	42	45	48	48	48	48	50
26 ga Steel-Foam-Steel Panel		12	14	18	17	20	21	21	23	25	24	18	15	30	43	51	54	56	53
26 ga Steel-Foam-5/8 Gyp		18	21	21	23	24	25	27	28	29	29	26	17	31	37	41	46	43	43
26 ga Steel-Gyp-Foam-Gyp-Steel		23	27	27	28	29	30	31	32	31	23	22	32	35	36	42	52	55	57
26 ga Steel-Gyp-Stud/FG-Gyp-Stl		16	24	31	33	38	41	46	50	51	53	54	53	51	48	48	48	43	43
.024 Aluminum-Foam-Gypsum		23	23	21	23	25	25	26	28	29	28	25	24	31	39	41	44	48	49

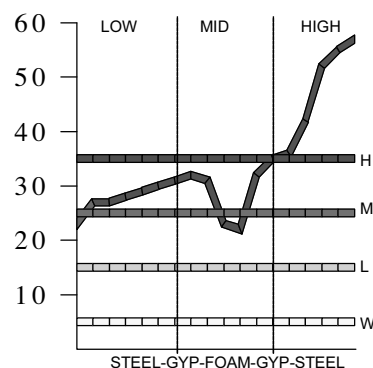
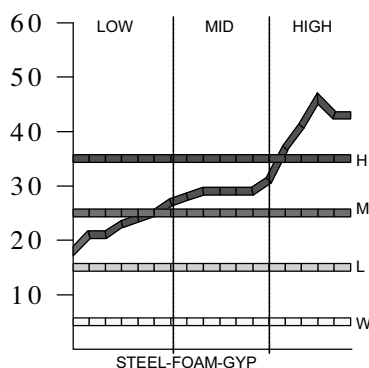
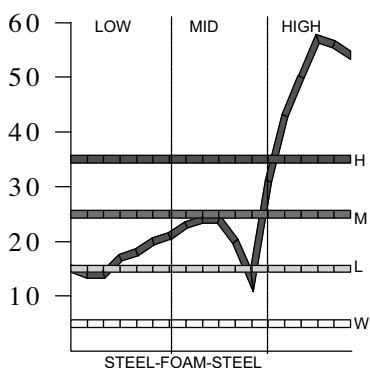
SHOP OFFICE PRODUCT RECOMMENDATIONS

The following illustrations represent the actual transmission loss for the listed products, and shows the recommended STC value for a typical shop office in various environments. The target value is 65 dB. The frequencies have been simplified into 3 major categories (low, mid range and high) rather than the tested 18 frequencies, this will make it easier to choose the proper product without knowing the exact frequencies of a particular area.

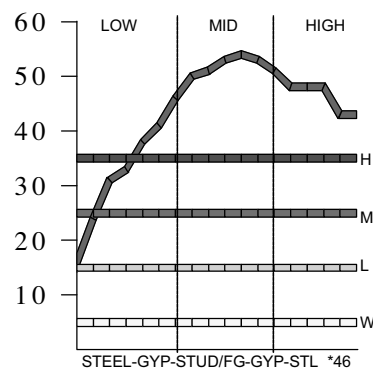
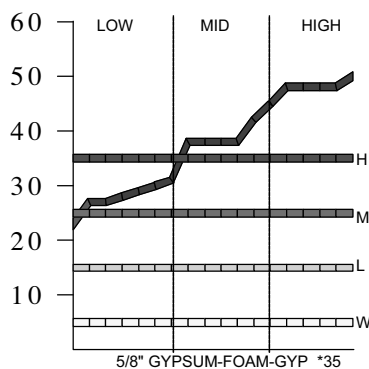
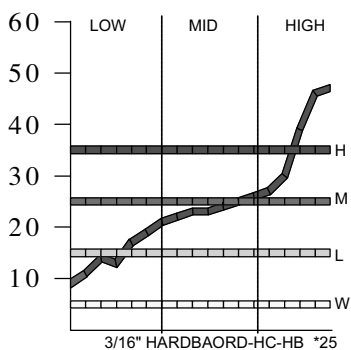
Illustration key

H	Heavy Manufacturing	100 dB
M	Medium Manufacturing	90 dB
L	Light Manufacturing	80 dB
W	Warehouse	70 dB

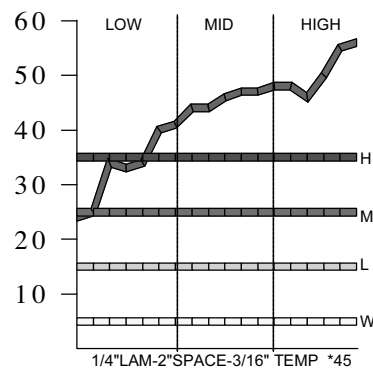
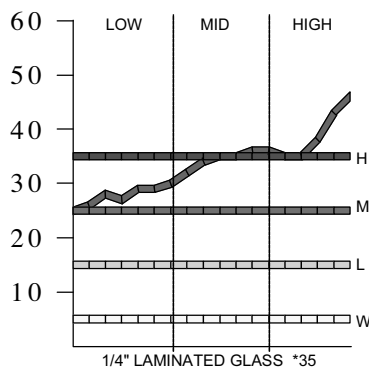
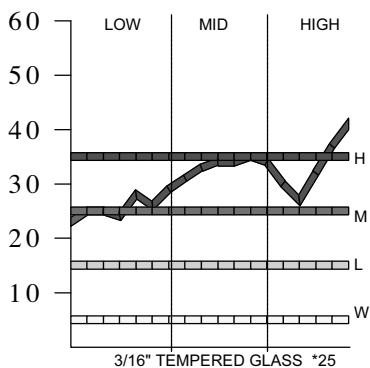
Super Structure™ Systems

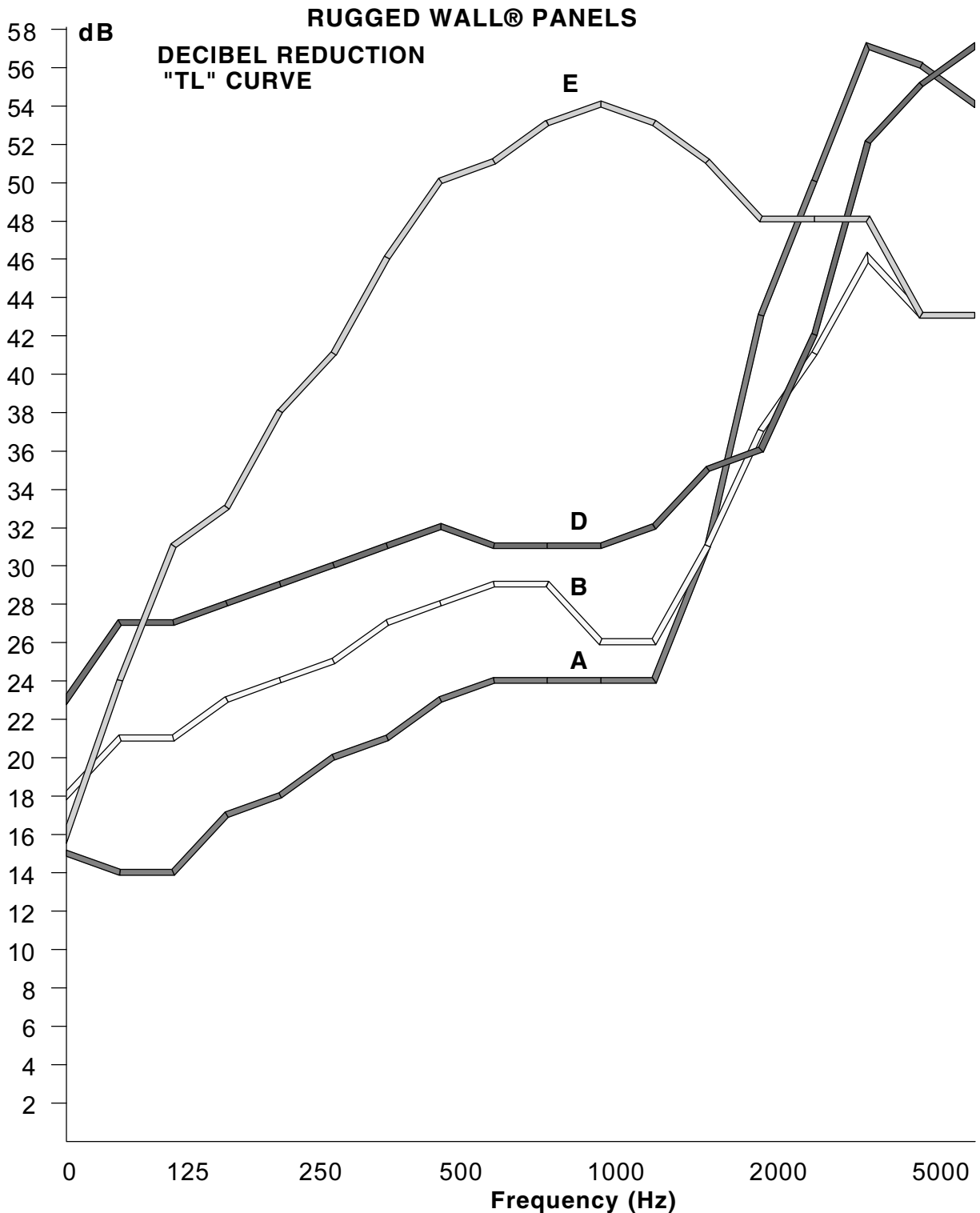


Standard Panels



Standard Glass Options

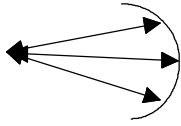




- A - Steel/Foam/Steel "SG"
- B - Steel/Foam/Gypsum "S2"
- D - Steel/Gypsum/Foam/Gypsum/Steel "SG2"
- E - Steel/Gypsum/Stud-Fiberglass/Gypsum/Steel "SSG"

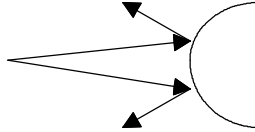
Note: Coincidence points have been smoothed for this illustration.

SOUND ABSORPTION AND THE EFFECTS OF SURFACE FORM



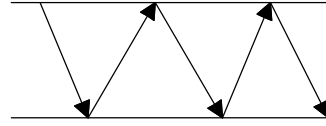
Focused by concave surfaces

Avoid these situations because the radial shape concentrates the noise into "Hot spots" which are objectionable.



Diffused by convex surfaces

Where possible, use convex surfaces and deep texture (6" or more) on large surfaces to diffuse sound pleasantly.



Reflected between parallel surfaces

If surfaces are 70' away or more distinct echoes may be heard. Avoid having direct sound and reflected sound following paths more than 50' different in length. Large parallel surfaces as little as 20' can produce rapid repeated reflections known as flutter.

DEFINITIONS

SOUND ABSORPTION COEFFICIENT - This is the ratio of sound absorbing effectiveness (at a specific frequency) of one square foot of material compared to one square foot of perfectly absorptive material. It is expressed in a decimal value and is usually measured at 125, 250, 500, 1000, 2000 and 4000 cycles.

NOISE REDUCTION COEFFICIENT (NRC) - This is the average sound absorption of the 4 center frequencies, 250, 500, 1000 and 2000 rounded to the nearest .05.

REVERBERATION - The persistence of sound after the source has stopped. High speed multiple reflections within a space.

Effective Sound Absorbing Materials

- Carpets
- Heavy gathered draperies or fabrics
- Upholstered furniture
- Thin materials with deep air space between them

CONSIDERATIONS FOR ACOUSTICAL DESIGN

- Use absorptive materials on surfaces that may cause objectionable reflection
- Seal all holes and openings in walls
- Make use of shapes to deflect noise

NOTE: The recommended NRC value for most rooms is .65 - .75, special consideration (over .75) should be given to the following rooms:

- Computer rooms
- Accounting rooms
- Class rooms
- Kitchens
- Any area where excessive noise is generated

DESIGNING FOR FIRE RESISTANCE

I. Flame Spread (FS) - Represents the surface burn characteristics of building materials.

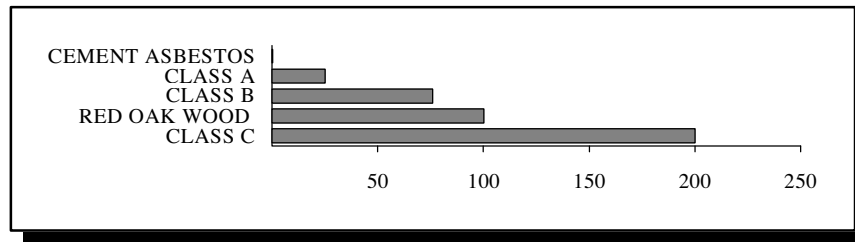
The testing method is the 25-foot **Steiner Tunnel test** ASTM-E-84.

The material to be tested is used as the roof of a furnace forming a tunnel. The size of the material used is 20 inches wide by 25 feet. A controlled flame source is placed 12" from one end of the tunnel and regulated to touch the sample 4'6" in. The time required for the flame to travel the distance remaining of 19'6" is compared to Red Oak which was arbitrarily given the value of 100 and cement asbestos board which is given the value of 0. The results listed are proportionate to those values.

FLAME-SPREAD DEFINITIONS

Flame Spread	0 - 25	26 - 75	76 - 200	201 - 500	over 500
Fire Class	Class A / UL-1	Class B / UL-2	Class C / UL-3	Class D	Class E

FLAME SPREAD UPPER LIMITS



COMPONENT MATERIAL FIRE RATINGS

COMPONENT	FIRE CLASS	FLAME SPREAD	Fuel Contribution	Smoke Developed
Cement Asbestos	Class A	0	0	0
Red Oak Wood	Class C	100	100	100
Hardboard	Class C	120	105	85
5/8" Gypsum	Class A	0	0	N/A
Steel	Class A	0	0	10
Aluminum	Class A	0	0	10
Diamond Coat™ Vinyl	Class A	13	10	3
Honeycomb Core	Class A	15	N/A	155-195
Polystyrene Core	Class A	15	20-80	25-80
Isocyanurate Core	Class A	20	N/A	140
Mineral Ceiling Tile	Class A	25	N/A	N/A

Fuel Contribution

This is a time temperature curve developed by plotting the temperature measured by a thermocouple located at the 24 foot point (vent end) in the furnace. The value for fuel contributed is derived by calculating the net area under the curve for the test material and comparing this area with the net area under the curve for unfinished select grade 3/4" red oak flooring.

Smoke Developed

The smoke developed during the test is determined by the output of a photoelectric circuit operating across the furnace outlet pipe. A curve is developed by plotting against time the values of the decrease in photoelectric cell output due to obscuration of the light source across the pipe caused by the smoke. The value for smoke developed is derived by calculating the net area under the curve for the test material and comparing this area with the net area under the curve for unfinished select grade 3/4" red oak flooring.

II. Fire Endurance and Resistance test ASTM E119-88.

Similar tests: UL 263 / UBC 43-1 / NFPA 251 / ANSI A2.1

The standard achieved is used to determine the time a material will contain a fire and retain its structural integrity. The test exposes a sample (10'x10') to specific fire temperatures according to a time temperature scale and for a predetermined time, then subjects the sample to a standard fire hose stream. If the sample stays intact then the material has passed the test for that predetermined time frame. If it fails then you must start again and use a shorter time frame. Unless several tests are run at a very high cost each, a company may never know the full capabilities of their product.

CERTIFIED FIRE RATED PRODUCTS MANUFACTURED BY NATIONAL

1 HOUR SYSTEMS

- A. 5/8 GYPSUM / HONEYCOMB / 5/8 GYPSUM PANEL (LABORATORY TESTED)
- B. 5/8 GYPSUM / STUD-FIBERGLASS / 5/8 GYPSUM PANEL (GAWP-1070)

NOTE: All rated systems must use the Super-Structure™ steel posts with gypsum insert and all steel channels etc. to achieve a rated system.

RECOMMENDED USE

- Hazardous "combustible" areas
- Paint booths
- Exit corridors
- Nuclear plants
- Chemical plants
- Load bearing walls
- Tenant separations
- High occupancy rooms

FIRE RATED DOORS and allowable wire glass (IBC CODE)

DOOR TYPE	RATING	MAXIMUM AREA	MAX. HEIGHT	MAX. WIDTH
Class A	3 Hours	0	0	0
Class B	1-1/2 Hours	100" ²	33"	10"
Class C	3/4 Hours	1296" ²	54"	54"
Class D	1-1/2 Hours	0	0	0
Class E	3/4 Hours	1296" ²	54"	54"

GLASS PANELS - 1/4" wire glass may be used in fire rated walls provided the wall rating does not exceed 1 Hour and the glass size does not exceed the glass size allowed on a class C door. (example 36" x 36" = 1296"²).

DESIGNING FOR INSULATION

DEFINITIONS

BTU - British Thermal Unit, The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

Thermal resistance - R - Value, a unit for the rate of heat flow through a given thickness of a homogeneous or composite material, or construction assembly with or without cavities or reflective surfaces. It is measured by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause one BTU to flow through one square foot per hour. Resistance's may be added.

R = temp difference F/BTU for 1 sf/hr.

R_T = The total thermal resistance of a construction assembly.

U = 1/R_T = Overall Heat Transmission Coefficient

Thermal Performance Reference R Values				
	Excellent	Good	Moderate	Minimal
Ceiling	24	19	13	9
Walls	13	11	8	7
Floor	19	13	9	7

COMMON "R" VALUES					
MATERIAL	R	MATERIAL	R	MATERIAL	R
1/2" gypsum	0.45	3.5" fiberglass	13.48	3" honeycomb	2.59
5/8" gypsum	0.56	6" fiberglass	19-23	single glass	0.94
1/2" plywood	0.02	1" polyurethane	5.88	insulated glass	1.65
1/8" hardboard	0.09	1" polystyrene	4	8" con. block	1.11
3/16" hardboard	0.14	1" isocyanurate	7.5	3" polystyrene	12
1/8" floor tile	0.05	1/2" mineral tile	1.19	3" polyurethane	17.64
1" mineral wool	3.7	wood core door	1.96	3" isocyanurate	22.5

Sum all the components used to determine a panels total R_T value

To calculate a buildings R-value, sum up all U-values of the various building components as a percentage of the overall structure, then convert to R=1/U.

Example: 10' x 10' x 8' room

Roof	100 sf	24%	x	U-.25	= .06
Walls	288 sf	68%	x	U-.083	= .0564
Glass	32 sf	8%	x	U-1.11	= .089
Total	420 sf			Total U .205	
				R 4.88	

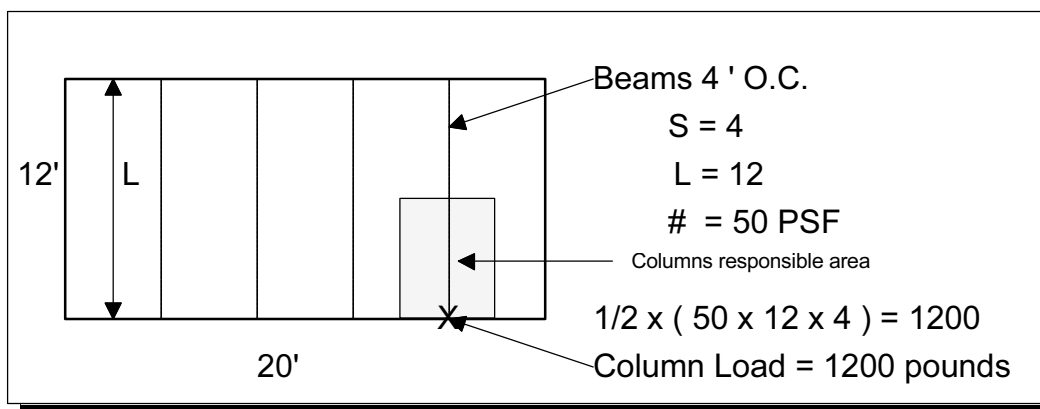
Note R values change as the ambient temperature changes. Some materials insulate better as it gets colder, etc.

STRUCTURAL DESIGN

FIVE BASIC CRITERIA FOR DESIGNING A LOAD BEARING ROOF

1. Calculate the Column load requirement.

Use this formula: **Column Load = $1/2 (\# \times L \times S)$** # = Required PSF , L = Beam Length, S = Beam spacing



2. Select the proper Steel Beam (use the charts found later in this section).
3. Make sure your load requirement does not exceed the capacity of the Steel Roof Deck (use the charts later in this section).
4. Check your Ceiling Height. Beams deeper than 6" will require a minimum 9' panel height. Add 2" to your beam depth and subtract the total from your panel height, this will give you the maximum ceiling height available. Standard ceiling heights are 90" for an 8' panel and 96" for a 9' and 10' panel. The greater plenum area on the 10' panel allows for duct work or HEPA filters etc.
5. All Existing walls to be used must handle the applied loads, or a separate steel support system is required. If a wall is load bearing then a "Beam Wall Clip" may be used to tie directly into the existing wall. The proper anchoring method of this clip is through bolts. Walls that run parallel to the beams will require a steel ledger angle for heavy loads or a 2"x4" wood adaptation for "no-load" situations, these are attached to the existing wall using installer provided anchors.

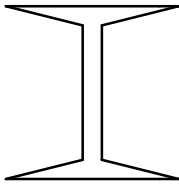
COLUMNS - CONCENTRIC LOADING

Column type	Capacity	Safe load
8' Structural inserts (3 sides) 11	12000 #	4000 #
8' tubular steel 3 x 3 - 3/16"	36000 #	12000 #
12' tubular steel 3 x 3 - 3/16"	21000 #	7000 #
8' tubular steel 5 x 5 - 3/16"	80000 #	26666 #
12' tubular steel 5 x 5 - 3/16"	67000 #	22333 #

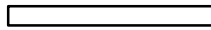
8' HIGH PANEL COLUMN LOADING USING A BEAM SADDLE

Panel type	Capacity	Safe load
5/8" gypsum - foam - gyp	14750 #	5900 #
5/8" gypsum - foam - 26 gauge steel	11800 #	4720 #
5/8" gypsum - 25 ga stud - gyp	21240 #	8496 #
5/8" gypsum - 20 ga stud - gyp	24780 #	9912 #
26 gauge steel - foam - steel	7080 #	2832 #
Window panel 3/16" glass	11800 #	4720 #

I-BEAM SOLID WEB JOISTS



DEFLECTIONS:



L/240 = STORAGE LOAD

ALLOWS 1" BEAM DEFLECTION IN 240" SPAN

L/360 = FLOOR OR LIVE LOAD

ALLOWS 1" BEAM DEFLECTION IN 360" SPAN

ALTERNATIVES TO USING THE SOLID WEB JOIST

1. Bar joist - Used for wide spans
2. Tubular steel joists
3. Panel beams
4. Heavier gauge roof decking
5. Panelized roof - 4" thick Steel/Foam/Steel panel spans 24' without beams

COMMON ROOF LOADING REQUIREMENTS

1. No load 7 psf L/240, space beams 12' oc (California 10 psf L/240, space beams 10' oc max.)
2. Maintenance or walking loads 20 to 24 psf L/240, space beams 8' oc
3. Two story floor 70 to 100 psf L/360, space beams 4' oc
4. Mezzanine loading 125 psf L/240

Steel Floor and Storage Loading Table - Utilizing Solid Web Steel Joists

Uniform Load in lbs. Per Square Foot (PSF) beams 4' on Center																	
Joist	Depth	Beam Length	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'
M6X4.4	6	FLOOR L/360	77	58	44	35	28										
		STORAGE L/240	96	79	66	53	42										
W6X9	5.9	FLOOR L/360	179	134	103	81	65	53	44	36	31	26	22				
		STORAGE L/240	222	183	154	122	98	79	66	54	46	39	33				
W6X15	5.99	FLOOR L/360	318	239	184	144	116	94	78	65	54	46	40	34	30	26	23
		STORAGE L/240		321	270	217	174	141	116	97	82	70	60	51	45	39	34
W8X10	7.89	FLOOR L/360		252	195	153	122	100	82	68	58	49	42	36	31	27	24
		STORAGE L/240		258	217	184	159	138	122	102	87	74	63	54	47	41	36
W10X12	9.87	FLOOR L/360			302	258	214	174	143	119	100	86	73				
		STORAGE L/240			302	258	222	193	170	150	134	120	110				
W10X15	9.99	FLOOR L/360					269	219	180	150	127	107	92	80	69	60	53
		STORAGE L/240					281	245	215	191	170	153	138	119	104	91	80
W10X17	10.1	FLOOR L/360										128	110	94	82	72	63
		STORAGE L/240							253	224	200	179	162	142	124	108	95
W12X19	11.9	FLOOR L/360							333	289	243	207	177	153	133	116	102
		STORAGE L/240							333	294	263	236	213	193	176	161	148

USE THIS TABLE FOR WALKING AND MAINTENANCE ROOF LOADS

Steel Floor and Storage Loading Table - Utilizing Solid Web Steel Joists																	
Uniform Load in lbs. Per Square Foot (PSF) beams 8' on Center																	
Joist	Depth	Beam Length	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'
M6X4.4	6	FLOOR L/360	38	29	22	17	14										
		STORAGE L/240	48	39	33	26	21										
W6X9	5.9	FLOOR L/360	89	67	51	40	32	26	22	18	15	13	11				
		STORAGE L/240	111	91	77	61	49	39	33	27	23	19	16				
W6X15	5.99	FLOOR L/360	159	119	92	72	58	47	39	32	27	23	20	17	15	13	11
		STORAGE L/240		160	135	108	87	70	58	48	41	35	30	25	22	19	17
W8X10	7.89	FLOOR L/360		126	97	76	61	50	41	34	29	24	21	18	15	13	12
		STORAGE L/240		129	108	92	79	69	61	51	43	37	31	27	23	20	18
W10X12	9.87	FLOOR L/360			151	129	107	87	71	59	50	43	36				
		STORAGE L/240			151	129	111	96	85	75	67	60	55				
W10X15	9.99	FLOOR L/360					134	109	90	75	63	53	46	40	34	30	26
		STORAGE L/240					140	122	103	95	85	76	69	59	52	45	40
W10X17	10.1	FLOOR L/360										64	55	47	41	36	31
		STORAGE L/240							126	112	100	89	81	71	62	54	47
W12X19	11.9	FLOOR L/360							166	144	121	103	88	76	66	58	51
		STORAGE L/240							166	147	131	118	106	96	88	80	74

USE THIS TABLE FOR SPECIAL BEAM SPACING REQUIREMENTS

Steel Floor and Storage Loading Table - Utilizing Solid Web Steel Joists																														
Total Allowable Load in Pounds per linear foot of beam																														
Joist	Def.	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30						
M6X4.4	L/360	600	474	330	317	267	227	193	171	150	133	119	106	96																
	L/240	600	474	380	317	267	213	168	139	114	95	81	68	59																
W6X9	L/360	1,388	969	699	536	409	319	259	222	172	145	121	109	88																
	L/240	1,388	1,099	890	736	618	483	386	314	259	216	182	154	132																
W6X15	L/360	2,375	1,696	1,223	937	715	558	454	366	300	253	212	179	155																
	L/240	2,375	1,877	1,520	1,256	1,056	843	676	550	453	397	318	270	232																
W8X10	L/360	1,953	1,543	1,250	1,010	778	612	490	399	328	273	231	196	168																
	L/240	1,953	1,543	1,250	1,033	868	740	638	556	488	410	346	293	252																
W10X12	L/360	2,725	2,153	1,744	1,441	1,211	1,032	854	689	567	473	399	376	291	251	218	191	168												
	L/240	2,725	2,153	1,744	1,441	1,211	1,032	890	775	681	603	538	483	436	376	327	287	252												
W10X15	L/360							1,081	872	714	603	504	427	368	318	276	242	213	188	168										
	L/240							1,127	981	862	764	681	612	552	501	456	417	383	353	327										
W10X17	L/360									844	704	565	504	432	373	325	284	250	221	196	176	158	142	128						
	L/240									1,013	897	800	718	616	560	487	426	375	332	295	264	236	212	192						
W12X19	L/360											974	789	714	613	531	463	411	362	324	288	259	233	210						
	L/240											1,052	944	852	773	704	644	592	545	485	432	388	349	316						

BEAM RECOMMENDATIONS FOR STANDARD ROOF LOADS

ROOF LOAD	7 PSF	20 PSF L/240	50 PSF L/240	100 PSF L/360
BEAM SPAN	NO LOAD	WALKING	STORAGE	TWO STORY
0 - 20'	M6 X 4.4	SEE CHART	SEE CHART	SEE CHART
24'	W6 X 9	W10 X 12	W10 X 15	W12 X 19
26'	W8 X 10	W10 X 12	W10 X 15	W14 X 22
28'	W8 X 10	W10 X 15	W10 X 17	W14 X 26
30'	W10 X 12	W10 X 15	W10 X 17	W16 X 26
32'	W10 X 12	W12 X 19	W12 X 19	W16 X 31
34'	W10 X 12	W12 X 22	W12 X 22	N/A
36'	W12 X 19	W14 X 22	W14 X 22	N/A
38'	W12 X 19	W14 X 22	W14 X 22	N/A
40'	W12 X 19	W14 X 26	W14 X 26	N/A

USE C-CHANNELS TO PLACE AGAINST EXISTING WALLS THAT ARE NOT LOAD BEARING

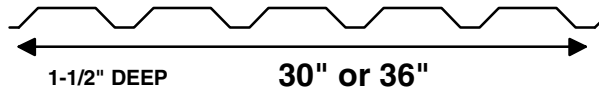
Formula: $1/2 \text{ (Beam Length x PSF)} = \text{Total Load per linear foot Required}$

Steel C - Channel Loading Table														
Total Allowable Load in lbs. Per Linear Foot														
Channel	Beam Length	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'
C10 X 15.3	FLOOR L/360	1,540	1,192	992	864	704	576	488	427	371	318	270	234	
	STORAGE L/240	1,540	1,192	992	864	768	680	608	560	511	456	405	355	300
C12 X 20.7	FLOOR L/360	2,460	1,856	1,544	1,352	1,224	1,056	952	808	712	584	496	440	390
	STORAGE L/240	2,460	1,856	1,544	1,352	1,224	1,056	952	872	816	704	632	584	540
C12 X 25	FLOOR L/360	2,760	2,096	1,744	1,528	1,376	1,192	1,072	912	800	664	616	496	440
	STORAGE L/240	2,760	2,096	1,744	1,528	1,376	1,192	1,072	984	920	800	720	656	608
C12 X 30	FLOOR L/360		2,380	1,900	1,730	1,550	1,360	1,220	1,040	900	750	640	560	500
	STORAGE L/240		2,380	1,900	1,730	1,550	1,360	1,220	1,120	1,080	910	810	740	630

CORRUGATED STEEL ROOF DECK

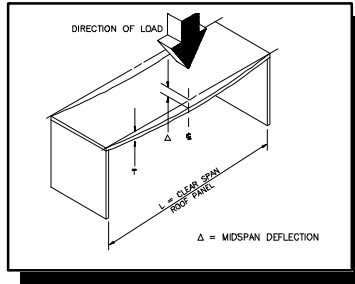
STANDARD SIZES 8', 10', 12'

TABLE SHOWS TOTAL UNIFORM LOAD PSF



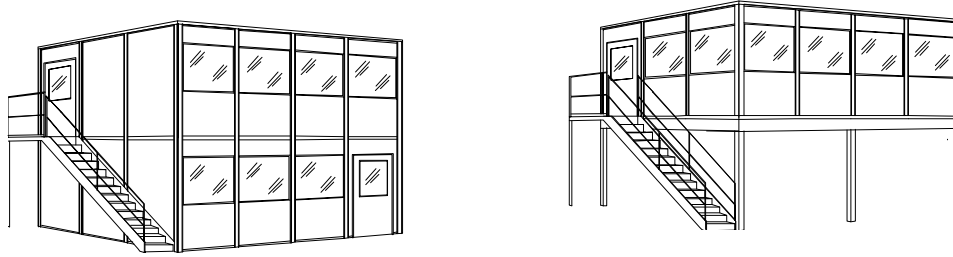
ROOF DECK LOADING PSF		22 GAUGE					20 GAUGE							18 GAUGE								
SPAN	Deck Length	4	6	8	10	12	4	6	8	10	12	14	16	4	6	8	10	12	14	16	18	20
	FLOOR L/360	114	38	16	8	5																
	STORAGE L/240	172	58	24	12	7	210	73	36	18	10	6	4	277	101	48	24	14	9	6	4	3
	FLOOR L/360	114	51	28	17																	
	STORAGE L/240	172	77	43	25		210	93	53	30				277	123	69	40					
	FLOOR L/360	140	64	30	17																	
	STORAGE L/240	212	96	46	26		260	117	55	31					154	73	42					

ROOF PANEL LOADING



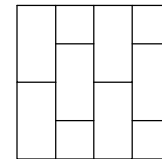
SANDWICH PANELS IN FLATWISE BENDING																									
PANEL CONSTRUCTION	△ MID SPAN DEFLECTION	ALLOWABLE UNIFORM LOAD LBS. PER SQ. FT. L = CLEARSPAN IN FEET																							
		8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	15	16	17	18	19	20	21	22	23	24	
3" STEEL	L/180					44	40	36	33	30	28	25	23	21	18	15	14	12	11	10					
	L/240		44	40	36	33	30	27	25	22	21	19	17	15											
4" STEEL	L/180									47	44	40	37	34	29	26	23	20	17	16	14	13	12	10	
	L/240						45	41	38	35	33	30	28	26	22										
3" ALUMINUM	L/180	45	40	35	30	27	24	21	19	17	14														
	L/240	34	30	27	24	21	19	16	14																
4" ALUMINUM	L/180					44	40	35	32	28	26	23	21	19	16										
	L/240			41	37	33	30	27	24	21	19	17	16	15	14										

TWO STORY AND VISION TOWER™ DESIGN



The design of a two story office includes three items in addition to the standard design of any two single floor offices. This includes:

1. The structural design, which is the proper beams every 4' on center (in accordance with the beam loading tables) and structural Inserts or columns to support the beams.
2. The flooring for the second level. The standard is 3/4" T & G plywood underlayment which is acceptable for carpeting. A second wood floor will need to be applied perpendicular to the first wood deck if tile is going to be used, fastening the floor down securely is essential to prevent cracking. Bonding the floor and steel deck with liquid nails is excellent, but permanent. All decking should be staggered for strength.
3. The stairs and landing. Check for clearance, see notes below.



Typical
T & G
Plywood
Installation
for 2nd floor

The design of a Vision Tower™ includes the mezzanine (see the Mezzanine section for details) and the standard office design.

Both systems offer excellent use of floor space and better visibility for supervision of personnel and manufacturing.

DESIGN CONSIDERATIONS

BEAMS

If possible use the same depth beams so your columns are universal. If two beams share the same column they must be the same size since they will both sit on top of the column. Make sure the column can handle the load. As a heavy standard 100 PSF floor loading or L/360 is used. However lighter loads such as 70 PSF are acceptable. Check your local codes to see what is required.

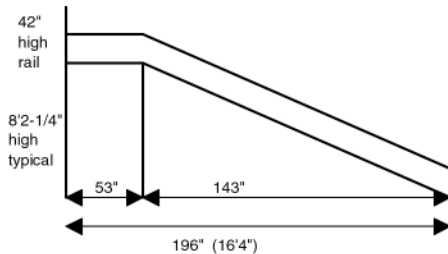
PANELS

Consider the panel layout, Posts should line up on the first and second floor for appearance, structurally it will not make a difference. With the Plant Master™ system this is a requirement because the outside posts are full height. Interior walls can support loads and take the place of any beam. Beam flanges are usually wider than the 3" space between the panels, so if a beams design is such that it would pass through this area the panels will require field notching.

STAIRS

Consider the clearance for the stairs and landing. Stairs incline at about 33 degrees which means 8' stairs will stick out a nominal 12' plus 4' for the landing. Stairs are half modesty type, 36" wide, IBC code design, check your local code if this is acceptable. The stairs are primer coated only, field painting may need to be arranged.

Note: Stairs over 12' high are required by OSHA to have a double landing that splits the incline allowing for a rest.



8' high - 143" out (Add your Landing - 53")
 9' high - 165" out
 10' high - 187" out
 12' high - 220" out

DOORS

Do not place doors under stairs, there is adequate space to do so, however if it is a heavy traffic area the restricted space could be a hazard. Doors on top of stairs should swing into the room and have a window to prevent a person from being knocked down the stairs. Check local codes for door swings, some require doors to swing out for fire escape reasons.

WINDOWS

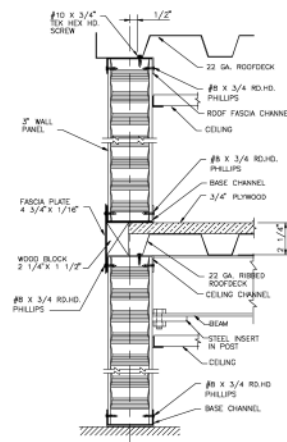
Do not put windows in the path of the stairs. The view is obstructed and there may be some liability or threat of harassment for women that work on the second floor and wear dresses.

OVERALL HEIGHT

Consider the height of the warehouse, The standard office height is figured by adding the two floors panel height plus 4-1/4" for the panel height growth, roof decking and flooring. 12' wide two stories require a minimum of 16' 4-1/4" clearance because the beams used can be 6" deep and the panels can be 8' high, up to 20' wide requires 17' 4-1/4" clearance because the support beams are deeper than 6" and would require a 9' first floor panel. Any beams deeper than 6" require a minimum 9' panel on the first floor. Options such as using an existing roof or using a roof panel on the second floor could help lower the height necessary for a two story.

CEILING HEIGHT and PLENUM SPACE

Check local codes for the required ceiling height before adjusting this to meet overall height restrictions. Make sure there is enough plenum space to allow room for your beams and central air ducts if used.



HVAC DESIGN

Note: All general formulas listed are based on normal conditions and are to be used for estimating requirements. In cases of extreme or unusual conditions a more accurate figure can be determined by a qualified engineer or architect.

Important criteria to be considered:

- Geographical Location
- Amount of Direct sun light
- Number of People
- Equipment - that generates heat
- Target Temperatures
- Ambient Temperature ranges
- Percentage of Glass and tint
- Amount of Lighting
- Insulating values of the building
- Traffic through the exits

HEATING

General Formula = 7 watts per square foot

example 10' x 10' room = 100 square feet
 100 sf x 7 watts = 700 watts required for heating.

VENTING

In general, venting occurs in most rooms through the air conditioning system, however there are occasions when additional venting will be necessary. For example lunch rooms or conference rooms where smoking is permitted or kitchens or other areas that may generate smoke or rest rooms. The design requirements will either be listed as the total CFM's (cubic feet per minute) required like 200 CFM's, which is how venting/exhaust fans are rated or a fractional formula like .15 CFM's per cubic foot where you would multiply the cubic feet (L x W x H) by the fraction (.15) to determine the total requirement or it may be listed as the air changes required per hour.

Air changes per hour is simply the number of times "old air" will be replaced by "new air" in 60 minutes.

example 10' x 10' x 10' high room = 1000 cubic feet
 3 air changes per hour is required (1 time every 20 minutes)
 1000 cubic feet X 3 air changes = 3000 cubic feet
 3000 cubic feet / 60 minutes = 50 Cubic feet per minute

AIR CONDITIONING

One ton of air conditioning is equal to 12,000 BTU's.

General Formula for an interior office is 1 ton per 400 - 500 square feet.

Add 800 BTU's per person when high room occupancy is a factor.

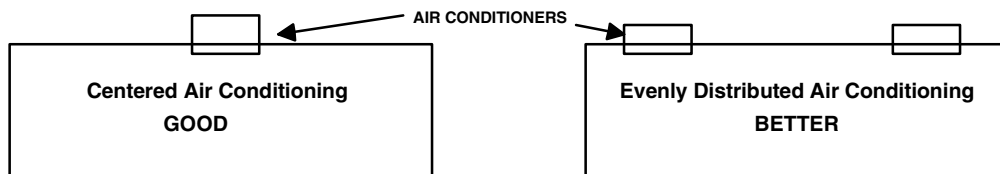
When using this formula place careful consideration on the criteria listed at the top of this section to adjust the formula as necessary. Air conditioners generally have thermostats so as a rule *a little more BTU's than not enough is better.*

Exterior buildings such as guard buildings, that have direct sun light, maximum glass for visibility should have 1 ton per 150 square feet. Add to that active traffic through the door or constantly opening a sliding glass window and that formula could change to 1 ton per 75 - 100 square feet.

Two Types of Air conditioners:

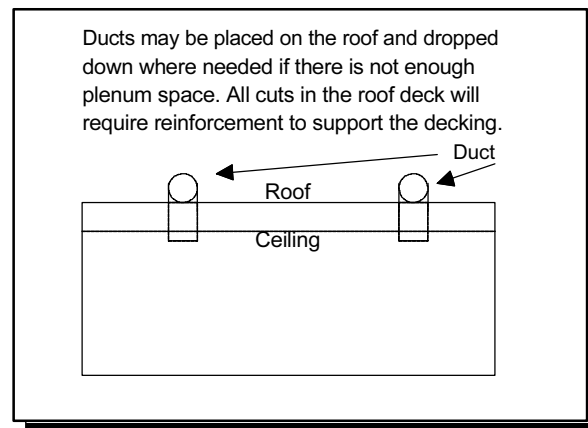
1. Wall or Window units:

- A. Locate them high on the panel when possible.
- B. Electrical Outlets are usually on the right.
- C. Center the unit in the room or use 2 small units rather than 1 large unit to cool a large room.
- D. All units form condensation, however the typical design is to have an evaporator pan to handle this. If this is not adequate an alternate drainage hose may be needed.



2. Central Air Conditioning:

- A. For large offices this is the preferred choice.
- B. Central Air is more cost effective and quieter.
- C. The Duct work can be placed in the "plenum area" if a minimum of 6" - 12" of space is available between the ceiling grid and the lowest beam, greater height may be needed for larger areas or where more air flow capacity is needed. If this area is not adequate then placing the duct on top of the roof is an option.
- D. In general 1 Air supply register is required per 200 square feet.
- E. Offices that do not have return air grills should have louvers in the doors or the doors should be cut short to allow for air flow.



ELECTRICAL DESIGN

OUTLETS

- A. The best formula for outlets in an office is to place them where they are needed. By desks, equipment or where convenient for maintenance.
- B. A less desired formula is 1 outlet per wall on small offices or 1 per 12' on large offices.
- C. Computers or large equipment should be on isolated circuits.
- D. Air conditioner outlets are always on separate circuits. Required information on 220 volt wall mount air conditioners includes the amperage and the plug type since many different types are available.
- E. Standard outlet height is 24" above the floor, switch height is 48" and air conditioner outlets are typically 24" from the ceiling.

Symbols



**DUPLEX
OUTLET**



**SINGLE
OUTLET**

MAY SHOW A "AC" FOR
AIR CONDITIONER OR "F"
FOR A FAN.



SWITCH

MAY SHOW TWO FOR A
DOUBLE SWITCH OR A "3"
FOR 3-WAY OR "F" FOR FAN



**PHONE
OUTLET**

LIGHTS

Standard lighting used is a 2' x 4' recessed troffer with 4 - 32 watt bulbs = 128 watts
Lumens per bulb (T8 type) = 3100

The calculation of lights fixtures can be a very involved process when all aspects of lighting are considered. The easiest way to determine the number of lights for the average office is use a simple 50 foot candle formula which is 1.5 watts per square foot (using an 8' ceiling and average light reflection).

$$\text{Number of lights} = \frac{\text{Square footage} \times 1.5 \text{ watts}}{128 \text{ watts}}$$

50 fc

$$\text{Number of lights} = \frac{\text{Square footage} \times 3.0 \text{ watts}}{128 \text{ watts}}$$

100 fc

Note: The trend in lighting is to reduce the watts used per square foot in the common areas and to increase the availability of task lighting to fit the work being performed, this saves lighting, cooling and maintenance expenses. Current designs use 1.5 watts/sf, however a push for acceptability of lower levels such as 1.0 watts is now being debated.

Simplified lighting calculations as defined by the Illuminating Engineer Society.

Definitions

Luminaire - Complete lighting unit including lamps and all of its components.

Luminous Flux - The time rate flow of light.

LLF = Light Loss Factor, A factor used in calculating illuminance after a given period of time and under certain circumstances. It considers temperature and voltage variations, dirt accumulation, lamp depreciation, maintenance procedures etc. Use LLF = .8 as a general figure.

CU = Coefficient of utilization, The ratio of luminous flux (lumens) from a luminaire calculated as received on a work plane to the luminous flux emitted by the luminaires lamps alone. Considered in this calculation is the light reflection (LR) from the ceiling, walls and floor as well as the cavity ratio (W x L x D).

RCR - Room cavity ratio (assumes 8' ceilings 30" desk height)

Sizes	8'	12'	16'	20'	24'	30'	40'
8'	6.2	5.3	4.7	4.4	4.2	4	3.7
12'	5.3	4.2	3.6	3.4	3.1	3	2.7
16'	4.7	3.6	2.9	2.7	2.5	2.3	2.1
20'	4.4	3.4	2.7	2.5	2.1	1.8	1.7

Coefficient of Utilization Chart for the above fixture (assumes LR 80% ceiling, LR 20% floor)

RCR	0	1	2	3	4	5	6	7	8	9	10
LR 80% White walls	0.75	0.7	0.62	0.58	0.52	0.48	0.45	0.4	0.37	0.42	0.32
LR 60% Sand walls	0.75	0.68	0.61	0.55	0.49	0.45	0.41	0.37	0.34	0.32	0.29
LR 50% Gray walls	0.75	0.67	0.59	0.53	0.47	0.43	0.39	0.35	0.32	0.3	0.27
LR 30% Hickory walls	0.75	0.64	0.56	0.48	0.42	0.37	0.33	0.3	0.27	0.25	0.22

$$\text{Number of Light fixtures} = \frac{\text{FOOT CANDLES} \times \text{SQUARE FOOTAGE}}{\text{CU} \times \text{LLF} \times \text{BULBS/LIGHT} \times \text{LUMENS/BULB}}$$

FOOT CANDLE LEVELS BASED ON ILLUMINATING ENGINEERING SOCIETY RECOMMENDATIONS

5 FC	10 FC	20 FC	30 FC	50 FC	70 FC	100 FC	150 FC	200 FC	500 FC
Parking	Storage	lobbies	lavatory	classroom	proof reading	drafting	fine drafting	fine drafting	color identification
Tv Viewing	Rough stock	auditorium	conference room	store	office area	general assembly	fine assembly	extra fine assembly	minor surgery
Construction	receiving	corridor	casual desk work	reading room	general assembly	testing	testing	testing	special inspection
		stairway	cafeteria	testing	testing	inspection	inspection	severe office tasks	testing
				Inspection	inspection	counter displays	display lighting		very severe and prolonged visual tasks
				rough assembly			severe prolonged seeing tasks		
							medium severe office tasks		

BREAKER PANEL

- 16 lights per switch or 20 amp circuit breaker
- Average 6 duplex outlets per circuit breaker. A more accurate calculation would be to add up the total amperage of the electrical items being used and use 80% of the breakers capacity (20 amp breaker design usage 16 amps).
- Isolate Air Conditioners on a separate circuit. 220 volt requires 2 breakers.
- Do not exceed the total amperage rating on a breaker panel. The standard small models are rated for 70 amps the larger ones are rated for 100 amps.
- National Electric Code 230-2 requires that only one breaker panel be used for a building. Should a requirement for a panel larger than our standard 12 circuit breaker panel be necessary that panel should be provided locally.

GROUNDING

In some circumstances the grounding of the building may be necessary, especially when using all metal components in the construction. This can be accomplished by sinking a standard grounding rod and connecting it to the building. An electrician would be familiar with the procedure.

MISCELLANEOUS INFORMATION

Wire recommendations

#12 AWG	20 amps
#10 AWG	30 amps
#8 AWG	40 amps
#6 AWG	50 amps

Formulas

Watts = Amperage x Voltage

Amperage = Watts/Voltage

WIRE-PAK™ MODULAR WIRING SYSTEM

Wire-Pak™ electrical wiring system was introduced in 1984. It is a custom designed snap together wiring system that snaps together as the building is being assembled. The male and female connectors used are directional thus insuring the system cannot be assembled incorrectly. All pieces are interchangeable allowing for last minute field alterations except for 3-way switches which must be assembled in accordance to the layout provided. Note: 3-way switches use circuits C/2 and C/3, no other item can be on C/3 with a 3-way switch.

Specifications

- 7 wire system utilizing three separate circuits for 110 volts 20 amps only
- Circuit 1 (C/1) typically for outlets uses Red - Hot, White - Neutral, Green - Ground
- Circuit 2 (C/2) typically for Lights uses Black - Hot, White - Neutral, Green - Ground
- Circuit 3 (C/3) typically for 110v air conditioners or isolated lines uses Blue - Hot, Gray - Neutral, Green - ground
- All wiring is 12 gauge, THHN type, Stranded copper
- All conduit to be 1/2" flexible type, .638 inside diameter, .91 outside diameter
- The system conforms to the National Electric Code
- All Components are UL Listed and Recognized (UL File no. E86583)
- 220 volt outlets may be provided as separate runs to the breaker box
- Conduit clips are provided for fastening the cabling and junction boxes to the roof. Flex conduit should be fastened every 4-1/2' and within 12" of every junction box or fitting
- All cable runs shall not exceed 12' without having a junction box connector
- An electrician will only be required to bring power to the building and complete the hook-up at the breaker panel. No other field wiring will be necessary
- A complete bill of materials and electrical schematic are provided

FEATURES

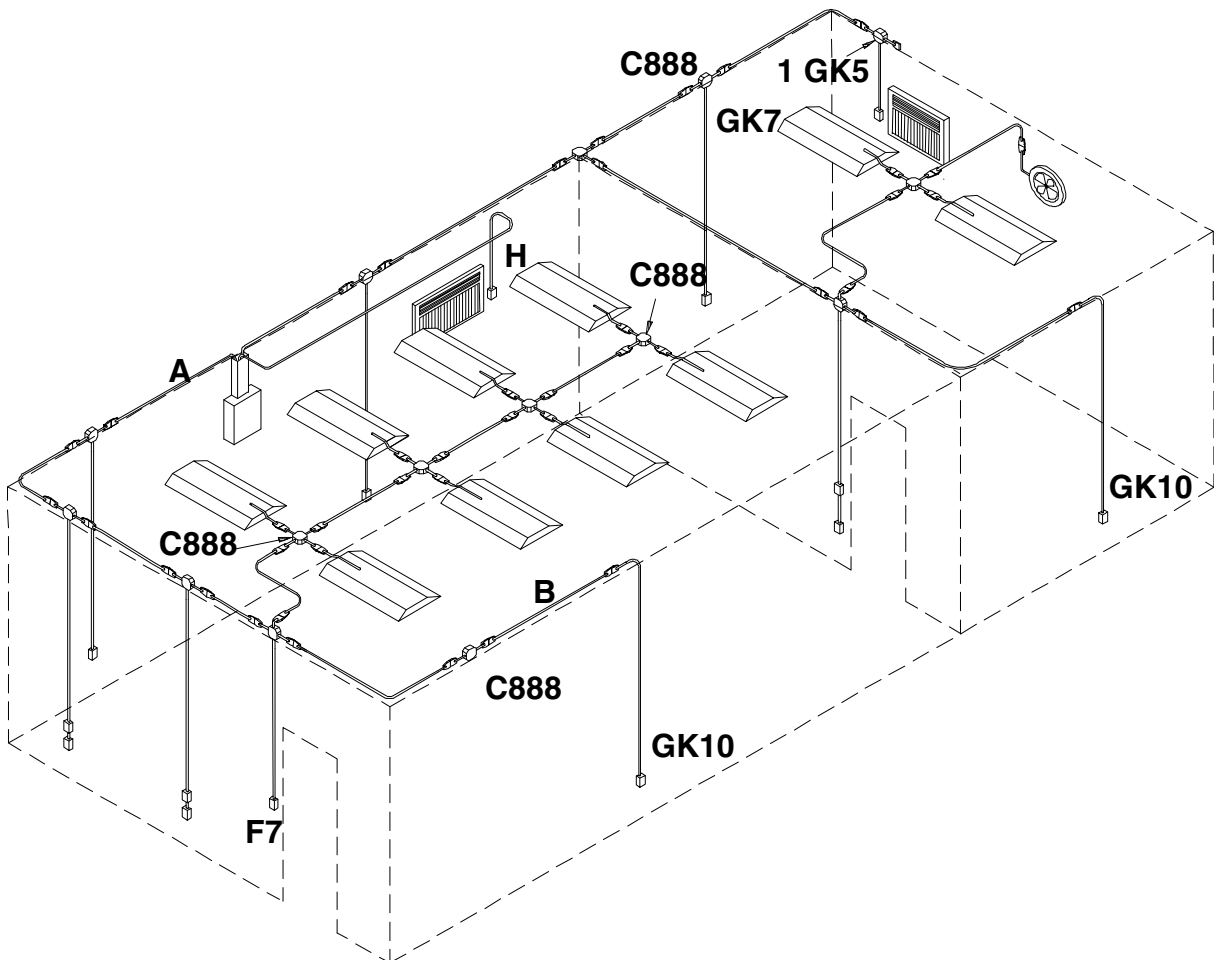
- Competitive with conventional wiring.
- 100% reusable
- Easy to install with a "fool proof" design
- Future outlets can be added
- All UL listed components
- Meets NEC 2008 requirements
- Accepted in most areas across the country
- UL inspected assemblies **UL# 2S26 & 3S41**

COMPONENT	DESCRIPTION
A-n	Power entry, pig tail to the breaker panel (always female one side)
B-n	Flex jumper between outlets, lights etc. (always female)
C888	Universal connector junction box (male)
G-n	Outlet assembly (always female)
F-n	Switch assembly (always female)
H-n	220 volt direct wire outlet assembly (always pig tail)

n - represents the length of the component

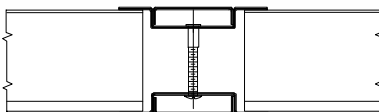
Warnings: Risk of fire or electrical shock. Do not electrically connect any panel or assembly to more than one supply source. Always determine that each panel or assembly is connected to one and only one electrical power source. Note: The only known areas where this product is not acceptable by code is Cook County, Illinois. Los Angeles County, California requires county approval for all electrical systems, the expense does not justify having this. It is the responsibility of the purchaser to check for any local code restrictions.

Typical Wire-Pak® Layout



SPECIFICATIONS

Rapid Wall™ Post



- Industry's Best System
- Rigid Steel Design
- 1 Hour Fire Rating Option
- Best Sound Deadening
- Full Featured
- Non-Progressive
- Smooth, Flush Design
- Attractive - Blends with Walls
- Easy to Assemble
- Conceals Electrics & Wires
- TrueMatch® Vinyl on Steel Posts and Channels Available

WALL TYPES

System / Post	Exterior Face	Substrate	Standard Core	Substrate	Interior Face
ValueWall™	4 mil Tan vinyl	5/8" Gypsum	Polystyrene	5/8" Gypsum	4 mil vinyl*
PremierWall™	7 mil Tan vinyl	5/8" Gypsum	Polystyrene	5/8" Gypsum	7 mil vinyl*
ToughWall™	26 Ga. Steel	5/8" Gypsum	Polystyrene	5/8" Gypsum	7 mil vinyl*
RuggedWall™	26 Ga. Steel	5/8" Gypsum	Polystyrene	5/8" Gypsum	26 Ga. Steel

*Standard Vinyl or Steel Color: Tan Optional: Gray and White

System / Post	Exterior Face	Substrate	Standard Core	Substrate	Interior Face
GG	7 mil vinyl	5/8" Gypsum	Polystyrene	5/8" Gypsum	7 mil vinyl
S2	Enamel Paint	26 Ga. Steel	Polystyrene	26 Ga. Steel	Enamel Paint
SG	Enamel Paint	26 Ga. Steel	Polystyrene	5/8" Gypsum	7 mil vinyl
SGS	Enamel Paint	Steel/Gypsum	Polystyrene	26 Ga. Steel	Enamel Paint
SG2	Enamel Paint	Steel/Gypsum	Polystyrene	Steel/Gypsum	Enamel Paint
SSG	7 mil vinyl	5/8" Gypsum	Stud/Fiberglass	5/8" Gypsum	7 mil vinyl
HushCore™	4 mil white vinyl	5/8" Gypsum	Polystyrene	5/8" Gypsum	4 mil white vinyl
CleanWall™	Enamel Paint	26 Ga. Steel	Polystyrene	26 Ga. Steel	Enamel Paint

SPECIFICATIONS

Panel General Substrate - Panels are to be 3" thick and fully fabricated. Heights over 8' may use horizontal H-mull. 5/8" Type "X" Gypsum, up to 1 Hour fire rated.

ThermalCore - Expanded Polystyrene ,1 pound density, fire retardant class "A", flame spread 15, Smoke development 25-85, insulation R-12, U-.09, effective temperature range 180° Fahrenheit, water absorption less than 2%, approved material Southern Building Code Congress.

Kraft Honeycomb Core - Resin impregnated, fire retardant class "A", flame spread 15, Smoke development 155-195, insulation R-4, U-.25 (Required for 1 Hour ratings, available on 5/8" Gypsum only)

One Hour Core - Steel stud frame R-12 Thermalfiber fill.

HushCore - For the noisiest of environments- STC 45 or better.

ValueWall Surface - 4 mil Vinyl surface, flame resistant class "A", no maintenance. Almond Color.

PremierWall Surface - TrueMatch™ Vinyl, thickness 7 mil, flame resistant class "A", flame spread 14, smoke development 1, self extinguishing, no maintenance, stain resistant, no permanent stain after 18 hours contact with Clorox, alcohol, ammonia, ink, hydrochloric or sulfuric acid etc. Color: Bisque, Optional: Cloud, White.

Steel Panel Surface - 26 gauge steel. G90 hot-dip galvanized, stucco embossed pattern.

ToughWall (SGG) - Steel laminated to one side of gypsum panel. Other side uses vinyl wall finish.

RuggedWall (SG2) - Steel and gypsum applied to both sides of wall panel.

CleanWall (SS) - 26 gauge, hot-dip galvanized facings with bake-on acrylic enamel, utilizing ThermalCore™ insulation.

Gripper Post System - Painted 20 gauge galvanized high strength DQ steel, 2-piece design connected with bolts on 20" centers. Trimmed with painted 26 gauge steel feature fillers that snap into posts on each side. They also function as a housing for structural inserts capable of supporting 12,000 pounds where design dictates. Posts are used to conceal all electrical wiring, telephone wiring and computer cabling. The two-piece design allows for a non-progressive panel system, which means panels can be removed and replaced without disturbing adjacent panels. All panels of like size are interchangeable.

Base Channel - Base Channels shall be a continuous, substantial aluminum or steel "U" channel finished to match the post system. When fastened to floor shall securely support the wall panels and not require additional pieces such as cove molding for a finished appearance.

Doors and Frames - Doors shall be 1-3/4" thick, 3' x 7', Heavy duty steel painted to match the wall. All doors shall include thresholds and locksets. Doors shall be pre-hung at factory to insure proper fit. Doors are expected to be field adjusted and leveled to insure proper operation.

Hardware - Hardware shall be commercial grade the standard of National Partitions®, unless otherwise specified. Doors will be outfitted with key, lock and one and one half pair 4-1/2" butt hinges.

Acoustical Ceiling - Mineral fiber suspended ceiling with heavy duty grid, random fissured design, fire rating class "A", flame spread 25.

Steel Roof Decking - Corrugated 22 gauge steel, fire rating noncombustible. Sound deadening with closure gaskets and ceiling STC 35.

Electrical option #1 - Wire-Pak™ modular wiring quick connect system, UL listed components, conforms to 2008 National Electric Code, connects all outlets, lights and switches and terminates with a 7 wire "pig-tail" at designated location, final hook up to distribution panel and power to the building is not included and should be provided by a licensed electrician. Lights are 4 tube Fluorescent troffer T8 type with energy saving ballast, 128 watts, 110 volt. Outlets are convenience type duplex, three wire, grounded. switches are quiet type.

Electrical option #2- Standard package includes: UL listed components and conforms to National Electric Code. Outlets and switches have junction boxes, 1/2" rigid conduit, couplings and 90 degree elbows that extend into the plenum area. All wiring and light conduit is not included. A licensed electrician is required to complete the wiring. Lights are 4 tube Fluorescent troffer T8 type with energy saving ballast, 128 watts, 110 volt. Outlets are convenience type duplex, three wire, grounded. Switches are quiet type.

Glass - Glazed panels will be picture window type and unless otherwise specified, be sized to full 40" in height, by full panel width. Sill height shall be 41" from the floor. All glass shall be 3/16" tempered safety type and assembled in aluminum frame. Glazed panels are to be shipped in three sections. Optional glass: 1/4" laminated, insulated, wire, tinted, polycarbonate etc.

HVAC (Heating, Venting and Air Conditioning) - Shall be designed in accordance to the use of the building.

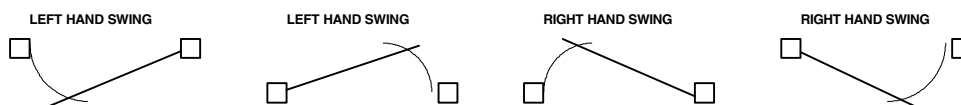
DRAWINGS

Drawings can be used for proposals or for ordering. In either case it is important for the drawings to accurately show the building and all options. Using consistent terminology and symbols will minimize errors.

ITEMS TO SHOW

- A. All dimensions. Point out restrictions in size if any. All National Partitions® systems use a **center line** of wall as a standard dimension. Unless otherwise stated any drawings received showing nominal simple dimensions are interpreted as National's standard. Centerline from corner to corner is the nominal size plus 1/2". The reason for this is in the design, corners grow 1/4". The dimension from center of post to center of post is the nominal size exactly, typically 4'.
- B. Location of doors **and the swing**. If there are different types of doors, note the various types. To explain a door swing, stand in the middle of the jamb with your back to the hinges, if the door is on your right it is a right hand door and vice versa.

DOOR SWINGS ILLUSTRATED



- C. Air Conditioner or Prep. If prep only is being supplied note the size and any special instructions. Remember to list the voltage/ampere and any special plug requirements.
- D. If modular wiring is used you must show the location of the outlets, switches and the **breaker panel**.
- E. Do not layout the ceiling. The ceiling will be designed the most advantageous way by our engineering.
- F. The colors of the walls, especially dividing walls.
- G. The location of windows etc.
- H. The System, Panel type and Core type.

COMMON ABBREVIATIONS AND SYMBOLS

S	Solid 4' panel actual size 45"	SG	Sliding Glass panel (side sliding only)
S3	Solid 3' panel 33"	D	Door Panel 3'x7' Steel
S2	Solid 2' panel 21"	DL	Door panel w/glass 20"x30"
S1	Solid 1' panel 9"	DD	Double door (6' x 7')
Sx	Solid special size panel	SC	Starting Channel or Solid Core door
HL	Half Light Window 4' panel 45"	SP	Starting Post or Wall Start
HL2	Half Light Window 2' panel 21"	FP	Full post - used instead of starting post

BILL OF MATERIALS

The bill of materials is the communications from the engineering department to the shop floor on what to fabricate. For the most part the drawing doesn't even come into play. All the information to fabricate should be on the bill of materials with exception to special items that require a separate detail to fabricate or the door swings.

The bill of materials is a complete list of what will be provided. If it is not on the bill of materials it will not be provided.

Panels - Standard panels are listed as 96" high. Some higher panels will require a header panel because stock is not available in that size. If this is the case the panel extension is called a header panel and is listed separately with aluminum H-mulls that act as a panel splice. The panel section lists cutouts, sizes, types etc. HL window panels are listed as bottom ($\pm 40"$ high) and top pieces ($\pm 15"$ high) because of a separate glass assembly.

Posts - Posts are listed as inside and outside. Inside posts are cut to the height of the ceiling. Outside posts are cut to the panel height. There are 2 basic types of posts - Post halves (intermediate), and Corner posts.

Channels - The channels include Starting Channels that attach to existing walls, Base Channels that are anchored where the walls will be installed, Top Channel that is used for the top of the walls when there is a dividing wall, and Roof Fascia Channel that is used around the perimeter, this fits on top of the wall and has a decorative angle to conceal the roof deck from the outside.

Glass - sliding glass is installed in the panel, but fixed glass is packed separately in pre-glazed assemblies. Special size glass must always be the 1/4" 2-ply laminated glass because the factory can cut it. Tempered glass is only available for 4' and 2' standard windows.

Roof and Ceiling - Roof deck comes in 3 sizes 8', 10' and 12' lengths and all are 3' wide. The roof deck is interlocking in 6" increments and can be overlapped. Special length decking can be sized in the field or by the factory for a fee. With each roof deck comes 10 closure gaskets that fit in the corrugated sections to give a complete dust seal. Acoustical ceilings have these common pieces: wall angles (12' long) to fit around the perimeter of each room, Main tees (12' long) that are every 4' and carry the ceiling load, tie wire that is used to suspend the ceiling from the decking attaching to the main tees, cross tees (4' long) that snap into the main tees to set the grid for the lights and tiles. Tiles are 2' x 4'. These ceiling pieces are expected to be cut to fit in the field. Steel angle is used to support the roof deck on a 2 or 3 wall application.

Electrical - Electrical items are listed as pieces that were ordered. When modular wiring is used a separate schedule is added, see the Wire-Pak™ section for details.

Steel - Steel components are listed on a separate schedule and include Beams, Columns, Structural Inserts, Stairs, etc. Each component listed typically has a corresponding detail for fabrication.

PRICING PRINCIPLES

Pricing a job can be handled in 3 easy steps.

Walls (lf) + Roof (sf) + Options (ea) = Price

A. Walls (linear feet)

Standard Wall Substrates

1. 5/8" Type "X" Gypsum
2. 26 gauge Steel

Step 1. Determine the system type required (refer to the specification section)

Step 2. Add up your linear footage. Use even footage on each wall. i.e. 2-4-6-8-10...

Step 3. Multiply the price by linear footage.

Note: Many options such as colors, heights or special surfaces etc. are available on walls, contact the factory for more information.

B. ROOF AND CEILING (square feet)

Step 1. Determine your square footage (L x W). Use even footage on each wall.

Step 2. Pick the appropriate ceiling charge based on the width or the smallest dimension. Roof decking over 12' requires beams, the price that includes these non-load support beams can be used or the beams can be priced separately and the lower roof and ceiling price used.

Step 3. Multiply the square footage by the appropriate price.

Step 4. If a roof is going to be used for storage or a second floor, design the steel required (as listed in Structural Design Chapter) and price the components individually. Use the less expensive roof and ceiling price if you price your beams separately.

Note 1. Rooms that don't have four walls may need additional columns to support beams.

Note 2. All existing walls that require a beam to be attached to hold the roof deck must be load bearing.

C. OPTIONS (each) (see the appropriate chapters for HVAC and Electrical formulas)

Step 1. Count each item, doors, windows, electrical etc.

Step 2. Multiply quantity by price.

Important design tip: Match the features of the options to the features of the walls, for instance sound design.

STC 25

3/16" TEMP GLASS

STC 35

5/8" GYPSUM PANELS
1/4" LAMINATED GLASS

STC 45

HUSH CORE
SOUND GLASS (DBL PANE)

PLACING AND PROCESSING AN ORDER

When placing an order it is important to have complete information so your order won't be delayed. The following items should be included with your order.

1. Purchase order with complete itemized pricing and descriptions
2. Drawing or sketch locating all options (including breaker panel)

Other important information that should be clearly noted:

- Building colors
- Size restrictions - be conservative
- Special requests
- Air conditioner cut out size plus voltage, amperage and plug type if unusual
- Shipping instructions and markings
- Request for approval drawings

Note: If special colors for painting etc. are required a color sample is required.

PROCESSING

1. The Sales Department enters orders and sends acknowledgments. Complete orders are then released to Engineering. Orders requiring additional information are not released.
2. The Engineering Department completes a Floor plan and if approval drawings are needed sends them. As company policy approval drawings are sent on all special orders, large orders or when requested. No other processing will take place until the approval drawings are signed and returned. Once these drawings are received the Bill of Materials is completed and the order is released to Manufacturing.
3. Manufacturing will produce the order on a "FIFO" basis (first in first out).

PRODUCT LEAD TIMES AFTER AN ORDER IS RELEASED TO MANUFACTURING	
Product	Fabrication time
Small In-Plant Office	± 1 weeks
Large In-Plant Office	± 2 weeks
Orders with heavy steel	± 3 weeks
Assembled Building	± 4 weeks
Exterior Buildings	± 4 weeks
Clean rooms w/ High Pressure Laminate	± 4 weeks
Sound Silencer™ (stud walls)	± 4 weeks
Powder Paint rooms	± 4 weeks
Painted Products	± 5 weeks
Hi-Wall™	± 5 weeks
Two Hour Systems	± 6 weeks
Custom Orders with special materials	Depends on material arrival

RECEIVING MATERIALS

Most businesses are well versed in how to receive freight, however since the typical office will include many packages of different sizes and weights the receiving is far from typical, the following steps will eliminate problems.

1. Use only 48" forks when removing panel crates from the truck. Do not allow the forks to touch the crate bottom, they must stay within the 2x4 supports.
2. Only lift a panel crate from the front end, never from the sides or back.
3. Do not stack items on the crates.
4. Count the number of pieces and compare the crate and box sizes as listed on the packing list. Just counting is not adequate, you must check sizes. Make sure all boxes are addressed to the destination.
5. List any visible damage to a package or any marks that look suspicious on the bill of lading. If a clear bill of lading is signed then any problems that are discovered afterwards will be the receivers responsibility (excluding concealed damage).
6. If there is concealed damage, this needs to be reported (without exception) immediately to the carrier so your rights to reimbursement are not lost. Never assume that the packaging was not adequate and not make a claim, National will not provide materials free of charge, a purchase order must be issued. If the claim is denied based on packaging a credit will be issued for the materials.

IF MATERIALS ARE DAMAGED:

1. All freight is sent FOB origin, the distributor or receiver is to call the freight company for an inspection. FOB origin means ownership is the receivers when material leaves National's docks and is in transit.
2. Identify all damaged pieces and fax the list to National for pricing.
3. National will return a quotation for the items.
4. The distributor or receiver is to use this quotation for the claim. The claim can also include freight charges provided the responsible carrier is the shipper again. Do not inflate claims.
5. If goods must be returned to National, ship them via the same carrier "free astray", get a return authorization from National.
6. The distributor or receiver is to send a purchase order for the damaged items along with a copy of the freight claim.
7. National will ship the goods ASAP.
8. National will assist whenever needed to get carriers to honor claims.

The success rate when following these steps is excellent.

WEIGHTS AND MEASURES

Aluminum 1"	13.75 lbs/sf
Lead 1"	59.166 lbs/sf
28 gauge steel (.017)	.694 lbs/sf
26 gauge steel (.019) G90	.906 lbs/sf
26 gauge steel (.019)	.75 lbs/sf
24 gauge steel (.024) G90	1.156 lbs/sf
24 gauge steel (.024)	1.0 lbs/sf
22 gauge steel (.030)	1.25 lbs/sf
20 gauge steel (.036)	1.5 lbs/sf
18 gauge steel (.047)	2.0 lbs/sf
16 gauge steel (.058)	2.50 lbs/sf
14 gauge steel (.071)	3.125 lbs/sf
12 gauge steel (.10)	4.375 lbs/sf
11 gauge steel (.115)	5.0 lbs/sf
10 gauge steel (.130)	5.625 lbs/sf
3/16" steel plate	7.656 lbs/sf
1/4" steel plate	10.208 lbs/sf
1/2" steel plate	20.417 lbs/sf
3/4" steel plate	30.625 lbs/sf
1" steel plate	40.833 lbs/sf
Concrete 1"	12 lbs/sf
Gypsum 5/8"	2.59 lbs/sf
Gypsum 1/2"	2.07 lbs/sf
Hardboard 3/16"	1.05 lbs/sf
Harboard 1/8"	.715 lbs/sf
Plywood 3/8"	1.125 lbs/sf
Plywood 1/2"	1.5 lbs/sf
Plywood 3/4"	2.25 lbs/sf
Glass 1/4"	3.28 lbs/sf
Glass 3/16"	2.46 lbs/sf
Glass 1/4" wire	3.5 lbs/sf
Water	62.4 lbs/cf
Water 1 gallon	8.33 lbs

1000 millimeters = 1 meter.
 100 centimeters = 1 meter
 1 centimeter = .3937 inches
 1 meter = 39.37 inches
 1 meter = 3.281 feet
 1 inch = 2.540 centimeters
 1 foot = 30.48 centimeters
 1 yard = 91.44 centimeters
 1 Ton = 2000 lbs
 16 ounces = 1 pound
 Centigrade (C) = (degrees F - 32) x .555
 Fahrenheit (F) = (degrees C x 1.8) = 32
 Water boils 100° C or 212° F
 Water freezes 0° C or 32° F
 Board Foot = 144 square inches by 1" thick

PRODUCT ESTIMATED SHIPPING WEIGHTS ADD ±10% FOR PACKAGING

3/16 Hardboard or Steel panels = 3.5 lbs/sf
 Gypsum panels = 7 lbs/sf
 Roof and Ceiling = 3 lbs/sf
 Glass assembly = 45 lbs each
 Light fixtures = 40 lbs each
 Modular wiring outlets = 15 lbs each
 Air conditioners = 75-120 lbs each
 Structural inserts = 3 lbs/ft
 Columns 3 x 3 = 6 lbs/ft
 Beams = Last number is the lbs/ft
 example W10 x 12 = 12 lbs/ft
 8' Stairs and Landing = 800 lbs

NATIONAL PARTITIONS® IS SUPERIOR TO CONVENTIONAL

- **Relocate and reuse the office.** The number one reason for buying National Partitions® is the ability to take the building down and relocate it. This feature benefits the small firm that leases because the offices always remain their asset, when it is time to move, the offices can go with them. This feature also benefits the larger company. Should their needs change and the office would be better suited elsewhere then it can be moved and they never lose their original investment.
- **Redesign to adapt to new requirements.** Companies grow, needs change and so can the office. Whether you need more space or need to change your current office configuration your not locked into your original design. All panels are interchangeable and can be assembled to fit any current need. The non-progressive post design provides the ability to swap or replace individual panels without disturbing adjacent panels. For example, if a solid wall panel now requires a door it can be switched out for a door panel in a matter of minutes.
- **Stronger construction** that's suited for an industrial environment. Many offices today are built using drywall and studs, leaving unsupported cavities that can be punctured easily. National's offices use much stronger materials and utilize an important design feature, fully supported wall substrates using either insulated polystyrene or honeycomb cores, this gives the walls true impact resistance for long useful life. In addition the availability of steel facings adds even more strength.
- **Better sound deadening** than conventional offices, to create a comfortable work area even in the loudest manufacturing plants. installing an industrial office is more than just putting up walls, it involves utilizing a system that will meet the specific requirements of the plant. One of the most important requirements is sound control, without the proper sound control an office could virtually be rendered useless. National Partitions® has sound controlled offices that are acoustically designed to out perform any typical conventional construction. The more extreme the noise the more Nationals products are better qualified. National Partitions® can design a structure for any sound problem.
- **Faster Occupancy** so you can get back to business. The standard small office is assembled and ready to move in, in one day, with conventional construction that time can be weeks. Weeks of sub contractors and inspections can put any company behind schedule and this can translate directly into money lost. The faster you are back to normal the faster you get back to business.
- **Fewer plant disruptions** that can cause expensive loss of productivity. All construction even modular causes plant disruption, however the longer it takes to complete a project the more disruption you get. A serious evaluation of costs would include this often over looked expense, most people are amazed how fast these costs add up. For an estimate, multiply the number of people in the area of construction by just 10 minutes of distractions, then multiply that by the number of days it takes to complete the project, from this you can determine the number of hours lost, now multiply this by the average cost per labor hour. The loss of productivity is real and expensive.
- **Less mess** to contend with means less cost. Sealing off areas, and detailed cleaning of equipment all can be expensive for the average industry, but if a company is involved in food processing or clean environments the costs to shut down and handle this are enormous.
- **No engineering or architectural fees** to design your buildings, another cost savings. Our design service is included with our package. Each job gets detailed drawings and a complete bill of materials. The product is pre-engineered and can meet any building code. At most you may be required to have an engineer review and seal our drawings this is much less expensive than if he started from scratch.

- **Permits are not always needed.** Small offices within a plant can usually be assembled without permit (consult your local building department). This is never the case with conventional construction, it always requires a permit and can tie up a project for weeks.
- **Quality.** National Partitions® product is quality inspected before it ships and is manufactured to exact standards. The finished product is never questionable, a clear point that conventional construction can not make. How good is conventional construction? It depends on the work crew. The truth is that most construction, if not closely watched can turn into a disaster. A buyer must always be on the watch for shortcuts and sub standard work, this is never the case with National Partitions® and the proof of the quality is in the warranty. **National Partitions® warrants their offices for 10 years.**
- **National Partitions® always costs less than conventional.** Compare any project fairly, each office is to have identical specifications and each is to perform to the same requirements and National Partitions® will always cost less. Add to this the other benefits previously listed and the much faster depreciation allowed for modular construction (as illustrated below) and you will see why the popularity of National Partitions® buildings has grown tremendously and why many companies are so convinced that they no longer consider conventional construction for their in-plant needs.

CONSTRUCTION DEPRECIATION

On our request National Partitions® accounting firm Grant Thornton® rendered an opinion of the wall systems with regards to depreciation and its classification. In general by definition (which has remained consistent over the years), the product is considered equipment and depreciates accordingly. Thus allowing a company to completely write off the expenditure over 4 times faster than typical construction.

How does this advantage effect the cost?

With current tax laws, the bottom line is that conventional construction's initial cost would need to be over 28% less to match the tax advantages of National Partitions® product. The following breakdown illustrates this and lists the assumptions.

Assumptions

- Maximum corporate tax is 39.6%
- National Partitions® product qualifies for 7 year depreciation, yearly write off is 14.3% (1/7 project cost)
- Construction depreciation is 39 years, yearly write off is 2.6% (1/39)
- After seven years National Partition® building is completely written off, and only 18.2% of conventional is written off.
- Using the above tax (39.6%) to determine a projects true cost, National Partitions® returns 39.6% in tax savings to the company where conventional returns only 7.2% (18.2% x .396%) in the first seven years. (100% - 39.6%) = 60.4% modular cost = 92.8% conventional cost x Y (Y being the cost difference)
- Y = .604 - **Conclusion, National Partitions® has a 32.4% price advantage** (1 - .604 = .396).

$$Y = \frac{(1 - \text{Tax rate})}{1 - \left(\frac{\text{modular depr years}}{\text{conventional yearly depr}} \times \text{tax rate} \right)} = \frac{1 - .396}{1 - (7 \times .032 \times .396)}$$

*As a foot note, many situations can cause other rulings to apply, Grant Thornton ® does recommend companies discuss the matter with their CPA's to determine if their particular situation would qualify for this depreciation.

DESIGNING CLEAN ROOMS

National Partitions® markets clean rooms Under the National Cleanrooms® name and is a turnkey provider. The following is for information guideline purposes only, actual requirements will vary and should be designed by qualified professionals.

National's Cleanrooms provide the following features:

- Beveled sill design or flush window design eliminating dust collecting sills. Flush two sides is also available.
- White Cleanroom posts with snap in "post sealing" white steel feature. Allowing for flush and sealed design. Cleanroom posts clamp down on the wall panels for the best seal; other manufacturers systems can "bottom out" allowing for leaks and contamination.
- Optional "Air duct" double wall panel design
- Many surface options available to meet any application.
- Wall designs for up to class 10 (M2.5) cleanrooms.
- All exposed metal is white.

SPECIFICATIONS

Panel General - Panels are to be 3" thick and fully fabricated. Heights over 8' may use horizontal H-mull.

Panel Substrate #1 - 5/8" Type "X" Gypsum, 1 Hour fire rated.

Panel Surfaces- White vinyl, thickness 4 mil, flame resistant class "A", no maintenance. Optional choices include: steel, FRP, high pressure laminate, aluminum, PVC etc.

Panel Core #1 - Expanded Polystyrene, 1 pound density, fire retardant class "A", flame spread 15, Smoke development 25-85, insulation R-12, U-.09, effective temperature range 180° Fahrenheit, water absorption less than 2%, approved material Southern Building Code Congress.

Panel Post System #1 (RuggedWall™) - Painted 20 gauge galvanealed high strength DQ steel, 2-piece design connected with bolts on 20" centers. Trimmed with painted 26 gauge steel feature fillers that snap into posts on each side. They also function as a housing for structural inserts capable of supporting 12,000 pounds where design dictates. Posts are used to conceal all electrical wiring, telephone wiring and computer cabling. The two-piece design allows for a non-progressive panel system, which means panels can be removed and replaced without disturbing adjacent panels. All panels of like size are interchangeable.

Panel Post System #2 - Cleanroom Class 10 Post System, 6063-T5 aluminum extrusion painted white. Posts are a major structural element capable of supporting 2000 pounds, they are also used to house structural inserts capable of supporting 12,000 pounds. Posts are used to conceal all electrical wiring, telephone wiring and computer cabling. The two-piece design allows for a non-progressive panel system, which means panels can be removed and replaced without disturbing adjacent panels. All panels of like size are interchangeable.

Base Channel- Base Channels shall be a continuous, substantial steel "U" channel finished to match the post system. When fastened to floor shall securely support the wall panels and not require additional pieces such as cove molding for a finished appearance.

Doors and Frames - Doors shall be 1-3/4" thick, 3' x 7', Heavy duty metal painted to match the wall. All doors shall include thresholds and locksets. Doors shall be pre-hung at factory to insure proper fit. Doors are expected to be field adjusted and leveled to insure proper operation.

Hardware - Hardware shall be commercial grade the standard of National Partitions®, unless otherwise specified. Doors will be outfitted with key, lock and one and one half pair 3-1/2" butt hinges. Finish to harmonize with aluminum trim.

Steel Roof Decking - Corrugated 22 gauge steel, fire rating noncombustible. Sound deadening with closure gaskets and acoustical ceiling STC 35.

Ceiling Grid and tile - Heavy duty grid with vinyl faced metal ceiling tile is available.

Electrical option #1 - Wire-Pak™ modular wiring quick connect system, UL listed components, conforms to National Electric Code, connects all outlets, lights and switches and terminates with a 6 wire "pig-tail" at designated location, final hook up to distribution panel and power to the building is not included and should be provided by a licensed electrician. Special sealed lights should be provided by a local contractor (modular wiring pigtails are available for this). Outlets are convenience type duplex, three wire, grounded. Switches are quiet type.

Electrical option #2- Standard package includes: UL listed components and conforms to National Electric Code. Outlets and switches have junction boxes, 1/2" rigid conduit, couplings and 90 degree elbows that extend into the plenum area. All wiring and light conduit is not included. A licensed electrician is required to complete the wiring. Sealed lights should be provided locally. Outlets are convenience type duplex, three wire, grounded. Switches are quiet type.

Glass - Glazed panels will be picture window type and unless otherwise specified, be sized to full 40" in height, by full panel width. Design shall be flush 1 or 2 sides, height shall be 41" from the floor. All glass shall be 3/16" tempered safety type and assembled in white aluminum frame. Glazed panels are to be shipped in three sections. Optional glass: 1/4" laminated, insulated, wire, tinted, polycarbonate etc.

DEFINITIONS

Air Showers - Chambers located between the cleanroom and an outside environment that remove particulate contamination from cleanroom garments as personnel pass through. The chambers may include HEPA filters, interlocking doors, a recirculating air system, and air nozzles in various patterns through which filtered air is blown onto the personnel in the shower. The air is moved over the worker, removing particulate contamination from the worker's garments.

Airborne Particulate Cleanliness Classes - The Statistically allowable number of particles per cubic foot of air according to federal standard 209E.

Measured particle size in micrometers (M)					
Class Name	0.1 M	0.2 M	0.3 M	0.5 M	5 M
1 (M 1.5)	35	7.5	3	1	N/A
10 (M 2.5)	350	75	30	10	N/A
100 (M 3.5)	N/A	750	300	100	N/A
1000 (M 4.5)	N/A	N/A	N/A	1,000	7
10000 (M 5.5)	N/A	N/A	N/A	10,000	70
100000 (M 6.5)	N/A	N/A	N/A	100,000	700

Ceiling Grid Systems - Frameworks of parallel and perpendicular bars used to house filters and light fixtures in cleanroom ceilings. The grids may include a gel or other type of sealant for providing an air tight seal around the filters.

Cleanroom - A room in which the concentration of airborne particles is controlled to specified limits. (Federal Standard 209E)

Federal Standard 209E - The document that establishes standard classes of air cleanliness for airborne particulate levels in cleanrooms and clean zones. It prescribes methods for class verification and monitoring of air verification and monitoring air cleanliness. It also addresses certain other factors, but only as the affect control of airborne particulate contamination.

Filter Modules - Units that house a HEPA or ULPA filter. The units are mounted into cleanroom ceilings, walls or benches and provide filtered air flow.

Flooring - Various types of flooring are used in cleanrooms, depending upon cleanliness levels. Contamination control flooring may have a tacky finish to trap dust and other debris from wheels and shoes. Access flooring consists of solid or perforated panels or raised pedestals. Air can flow through perforated panels and can be exhausted in a subfloor area. Vinyl flooring features sealed seams to prevent accumulation of contamination. Static Dissipative flooring prevents static buildup and electrostatic discharge.

HEPA Filters - High efficiency particulate air filters are replaceable extended-media dry-type filters in a rigid frame having a minimum particle collective efficiency of 99.97 percent for a 0.3 micron particle, and a maximum clean filter pressure drop of 2.54 cm (1") water gauge when tested at rated airflow capacity.

Laminar Flow - Airflow in which essentially the entire body of air within a confined area moves with uniform velocity and direction as the ambient atmosphere being sampled.

Lighting - Room lighting is supplied by ceiling mounted modules, often incorporated into ceiling HEPA filter modules. Work area lighting may be supplied by illuminators (concentrated light sources that are placed next to the work area which can be adjusted to focus light on a desired area. Fixtures are sealed to prevent contamination.

Particle - A solid or liquid object, generally between .001 micron and 1000 microns in size.

Particulate - A substance that consists of particles (minute quantities of solid or liquid matter).

Pass-Throughs or Pass-Thrus - Openings in walls with two doors through which materials and objects are passed. Pass-Through doors interlock so that one door always is closed while the other is open.

Prefilters - Replaceable filters installed before a final filter to remove gross contaminants and protect the final filter from environmental conditions. The prefilters have a lower efficiency than the one they protect.

Sealants - Used to seal HEPA filters into ceiling grid systems. Plastic, silicone and gel sealants are commonly used.

Testing/Certification Services - Independent, contract services for the testing and certification of HEPA filters, laminar flow equipment, safety cabinets and HVAC systems. Certification and testing of HEPA filters includes leak testing, scanning, electrical testing, particle count surveys, sound level measurement, vibration measurement, temperature and humidity measurement, airflow balancing, gas system testing, light level measurement and room pressurization. Product qualification testing and environmental analysis/testing also are available.

Turnkey - A method of construction, design, installation, etc. Assumes total responsibility from design through completion of the project.

ULPA Filter - Ultra low penetration air filters are extended media dry filters in a rigid frame that have a minimum particle collection efficiency of 99.999 percent for particles greater than or equal to .12 micron.

CLEANROOM DESIGN CRITERIA

Criteria	Class 10	Class 100	Class 1000	Class 10000	Class 100000
Minimum NP Wall System	Cleanroom white alum.	Cleanroom white alum.	All National systems	All National systems	All National systems
Minimum wall surface	Steel - porcelain or epoxy paint	High pressured laminate	Vinyl	Vinyl	Vinyl
Optional surface		Steel - porcelain or epoxy paint	Smooth steel, HPL	Embossed Steel	Embossed Steel
Paints	Epoxy	Epoxy, Powder, Enamel	Epoxy, Powder, Enamel	Latex, Enamel	Latex, Enamel
NPI window type	N/A	Flush Window	Standard or flush window	Standard or flush window	Standard or flush window
Lights	Incorporated in HEPA filter	Incorporated in HEPA filter	Special sealed fixture	Special sealed fixture	Special sealed fixture
Air change/hour	600	250-600	150-250	50-120	20-50
Filter cover	100%	70-100%	30-60%	10-30%	5-10%
Filter velocity	70-110 FPM	70-110 FPM	70-110 FPM	70-110 FPM	70-110 FPM
Filter type	99.999 (5-9's)	99.99 (4-9's)	99.99 (4-9's)	99.97 minimum	99.97 minimum
Ceiling design	Mod/T bar	Mod/T bar	T-bar	T-bar	T-bar
Grid	gasketed	gasketed	gasketed	gasketed	gasketed
Grid support special item	All-thread w/ unistrut all-thread rod turnbuckles	All-thread w/ unistrut all-thread rod turnbuckles	12 ga wire to grid. 10 ga wire to filter turnbuckles at filter	12 ga wire to grid. 10 ga wire to filter turnbuckles at filter	12 ga wire to grid. 10 ga wire to filter turnbuckles at filter
Ceiling panel	Capaul Enviroguard 1180 or Mylar E or Conwed Cleanroom				
Special items	Hold down clips	Hold down clips	Hold down clips	Hold down clips	optional hold down clips
Flooring (depends on room use)	Mipolam or Equal	Mipolam or equal	Mipolam or equal	Sheet vinyl	Sheet vinyl
Base Molding	6" Cove	6" Cove	6" Cove	6" Cove	4" Rubber
Optional Floor Conductive or non conductive HPL	Perforated access	Perforated access	Perforated access	Optional	Optional
Air return	Low wall	Low wall	Low wall	Low wall	Low wall/ceiling
Air return registers	Eggcrate optional damper	Eggcrate optional damper	Eggcrate	Eggcrate	Eggcrate
Certification	Filter and room scan/report	Filter and room scan/report	Filter and room scan/report	Filter and room scan/report	Filter and room scan/report
Option	Balance filter Registers	Balance filter Floors	Balance filter	Balance filter	Balance filter

DESIGNING PAINT ENVIRONMENTAL ENCLOSURES

PURPOSE: To control temperature and humidity of the powder room and to isolate the powder process from outside dirt contamination, thus insuring the best possible finishing results. These rooms are also known as Powder rooms or Clean rooms.

PRODUCT RECOMMENDATION

Walls - National Partitions™ one piece full height Hi-Wall™ panels (R-13 insulation). Optional 2-hour fire rated design is also used when needed.

Roof - Option 1 Roof panel similar to the walls (R-19)

Option 2 Standard corrugated steel deck with drop ceiling and fiberglass R19 batten

Option 3 Drop ceiling and fiberglass R19 batten only (when close to roof joists)

Note: Vinyl faced fiberglass tiles are optional.

TYPICAL DESIGN CRITERIA

National Partitions™ is only a building provider. The following is for information guideline purposes only, actual requirements will vary and should be designed by qualified professionals. Special equipment such as air handling etc. should be provided by a qualified contractor.

1. Buildings should be large enough to operate, clean and maintain the equipment, they should also allow for a forklift to bring the powder into the room.
2. Storage space for powder to bring it to the proper temperature and humidity is important.
3. Buildings are high cube design as needed to allow for easy movement of product on conveyors.
4. Custom wall penetrations can be made to move product via conveyors through the building.
5. Product openings in the wall are designed for the specific product. Large openings will require a tubular steel frame design.
6. Buildings are to have maximum clear span roof design and have a minimum number of column supports as practical.
7. Large door openings (typically a steel framed opening for garage doors) to allow for equipment removal or maintenance can be provided.
8. Man doors are provided.
9. Windows are provided to allow monitoring of the product.
10. Walls and ceilings should be made of smooth easy to clean surfaces. National's stucco embossed steel is considered smooth and perfect for this application. The skins embossing is light enough not to allow buildup and smooth enough for easy cleaning. The embossed steel will hide normal dents and scratches that occur allowing the building to look good for many years. The negative aspect of flat, smooth steel is that it telegraphs every imperfection. This is why National pays extra to have the steel embossed. Vinyl coated ceiling tiles can also be provided.
11. Standard electrical and lighting can be provided however explosion proof or any other specialty items are to be provided by a local contractor.
12. Removable panel sections are available.
13. Floors should be sealed. Tiling should be considered. Vacuum systems for powder spills should also be considered.
14. The room should have positive air pressure to prevent contamination from entering the room. Air velocity should be approximately 120 fpm through any part openings. Air vents should be distributed uniformly through the building and should not exceed 50 fpm, these vents should not be positioned over the booth or next to booth openings.
15. Air conditioning should allow for 60° to 80° Fahrenheit, and 40 - 70 % relative humidity.
16. Return air velocity should be less than 50 fpm and filtered to prevent powder as small as 2 microns from entering the exchanger coil.

FEATURE AND BENEFITS

- CLASS "A" FIRE RATED FOR SAFETY
- INSULATED FOR ENERGY SAVINGS (R-13 WALLS, R-19 ROOF OR BETTER)
- MOVABLE AND EXPANDABLE FOR FUTURE GROWTH
- CUSTOM DESIGNED TO YOUR SPECIFICATIONS
- DEPRECIATED LIKE EQUIPMENT FOR FAST PAYBACK
- DESIGNED BY A COMPANY MAKING THESE UNITS FOR OVER 25 YEARS
- BACKED BY A 10 YEAR GUARANTEE

SPECIFICATIONS

WALLS UP TO 30 FEET IN SEAMLESS HEIGHT...Allows for the fastest and cleanest looking installations for quick start up time. 3" to 4" thick 3-ply sandwich construction. Facings of durable 26 gauge G90 hot-dip galvanized steel with "maintenance free" stucco embossed pattern. Pre-painted with baked acrylic enamel for a long lasting finish. Thermal insulated core of polystyrene or optional isocyanurate for energy efficiency up to R-30.

CONNECTING POSTS - Made from rugged, pre-finished 20 gauge steel. Two-piece design connected with bolts on 24" centers gives a non-progressive design which allows the removal of individual panels when needed. Trimmed with painted 26 gauge steel feature fillers that snap into posts on each side to conceal the fasteners. These posts also function as a housing for structural inserts for roof load requirements or to conceal any type of wiring needed for the structure. Progressive anodized aluminum H-mull posts are optional.

BASE CHANNELS - Continuous painted 20 gauge steel with optional anodized aluminum.

ROOFING

Panel system - 4" thick 3-ply sandwich construction with facings of 26 gauge G90 hot-dip galvanized steel. Stucco embossed pattern. pre-painted with baked acrylic enamel. Thermal insulated foam with 2 lb. density.

Decking system - pre-painted ribbed steel. 36" wide interlocking panels sized to width of structure. One and one-half inch deep corrugation in 22 gauge panels 12' Greater widths are achieved with joists. rubber closure gaskets seal each end.

CEILING - Mineral board suspended ceiling panels with industrial duty white enameled t-bar grid and hanging wires. 2'x4' acoustical panels are random fissure finished. Lay-in design allows indirect troffer lighting. Panels guaranteed for dimensional stability and are rated class "A" non-combustible. Vinyl faced tiles are available.

DOORS AND FRAMES - Steel doors are 3' x 7' x 1-3/4" thick and are finished to match panels. edges are protected with aluminum molding. Factory pre-hung in panel to insure proper fit. One and one-half pair of hinges are installed in a mortised frame. Door thresholds and lockset are also provided.

GLASS - Glazed panels are picture window type, assembled in the frame and located 41" from floor. Tempered glass is standard and options include laminated, insulated, Plexiglas or lexan. Full height, side sliding or single hung are also available.

ELECTRICAL - Vertical raceways can be assembled in posts for standard switches, duplex outlets and AC outlets in accordance with layout. 2'x4' lay-in troffer type light fixtures (less bulbs) are provided. Optional pre-wired Wire-Pak™ system is available.

DESIGNING FOR EXTREME CONDITIONS

EXTREME HEAT

All National Partition® systems will handle temperatures to 120° Fahrenheit. Unusual heat would be defined as temperatures ranging from 120° - 200° Fahrenheit. Breaking down the components that make up a panel, the following list shows the maximum sustained and constant temperatures allowed.

MATERIAL	MAX TEMP
Polystyrene foam	167° F
Isocyanurate foam	200° F
Honeycomb	225° F
Vinyl Adhesive	140° F
Panel Adhesive	150° F
Contact Adhesive	120° F
Urethane Adhesive	200° F
Vinyl	
Hardboard	120° F
Gypsum	125° F
26 ga Steel	200° F

RECOMMENDED PANELS SYSTEMS

- To 120° F - All systems
- 120° to 167° F - Steel skin - Polystyrene core - Urethane Adhesive
- 167° to 200° F - Steel skin - Isocyanurate core - Urethane Adhesive

CORROSIVE ENVIRONMENTS

Corrosive areas usually have chemicals that will react on metal surfaces that have not been treated or painted with a special paint, since there are many different areas that have their own requirements, an "always" design is not appropriate. In these cases the user must tell National Partitions® what is acceptable, from that information NationalPartition® can design to most specifications.

General Information

1. All aluminum extrusions are anodized.
2. All steel posts, channels and skins are galvanized or galvanealed.
3. FRP (Fiberglass Reinforced Plastics) is an excellent non-corrosive panel surface.
4. Stainless steel is an excellent non-corrosive panel surface.
5. The Super Structure™ post system is the most flexible as far as alternative materials. This system can be Stainless steel, Unfinished galvanized steel or basically any rigid metal that can be purchased in sheets and bent. The other components such as window frames and door frames can be special fabricated out of the same material.
6. All aluminum systems and components can be coated with powder paint. Other paint types are available through various finishing suppliers.

HIGH HUMIDITY OR MOISTURE

Areas with high humidity, moisture or the possibility of getting wet should use our exterior system. The vinyl will delaminate on gypsum or hardboard panels in these extreme conditions. The standard roof

deck is not water tight, this could be sealed with a heavy plastic sheet when incidental "light" water contact is possible, in more extreme situations a roof panel with silicone caulking should be used. All panels should be laminated using an exterior type glue, the interior water base glue will not hold up.

COLD AND CONDENSATION

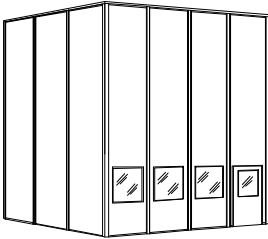
Most systems can be used for cold environments, however the best systems for cold rooms or coolers would include a foam core and metal skin to handle the sweating (condensation) that will occur. In designing a room where the ambient temperature is greatly different from the inside temperature "Thermal breaks" should be used wherever possible. Thermal breaks would include splitting the base channel and top cap so there is no continuous metal connection going from the outside to the inside. Areas where a thermal break is not available as a standard would be on door jambs and windows, however special fabrication could achieve this but may be too costly to be practical.

FOOD PROCESSING PLANTS

Most plants in this requirement are looking for USDA approved finishes. National's standard White steel skins use USDA approved paints, as an alternative skin FRP is an approved surface. All windows must use a shatter resistant polycarbonate pane such as Lexan.

HI-WALL™ INDUSTRIAL PARTITIONS

Hi-Wall™ is an industrial "floor-to-ceiling" partition available in heights of up to 30' to separate areas.



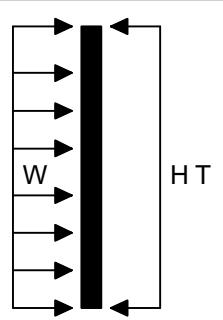
TYPICAL USES

- Security
- Temperature control
- Departmentalization
- Process separation
- Powder paint rooms
- Noise barriers
- Pressurization
- Dirt and dust control
- Containment areas
- Cleanrooms

National Partitions™ unique HI-WALL™ system is the answer for dividing in-plant areas economically using one-piece, pre-fabricated, 3" to 4" thick, four-foot wide, steel faced panels up to thirty feet in height. Panel walls are easy to handle and install. four-inch thick panel weighs only two and one-half pounds per-square-foot. They are movable, interchangeable, reusable and Class "A" fire rated.

CHOOSING THE RIGHT PANEL THICKNESS

MID SPAN DEFLECTION - HI-WALL™ PANEL HT SPAN IN FEET				
Panel Thickness	L/240		L/180	
	2 lb density 600 psi	1.5 lb density 450 psi	2 lb density 600 psi	1.5 lb density 450 psi
3" Panel	22	21.5	25	24.25
4" Panel	27	26.25	30	29.25
5" Panel	31.25	30.5	34.75	34.25
6" Panel	35	34.75	39.25	38.75



Horizontal load: W = 5 lbs. psf. Meets all seismic force zone requirements.

TOP CAP DESIGN

National Partitions® has developed custom-designed wall-to-ceiling attachments to accommodate the varied conditions required, whatever the condition may require special fabricated designs are available.

HEADER PANELS

Where ducts, plumbing etc. run along the ceiling small header panels are provided. These header panels are easy to handle and are faced in aluminum or steel allowing easy cutting for ducts, pipes, etc. with hand tools. Custom cover plates and various gasketing materials are available to seal around cut outs.

DOOR OPTIONS	SPECIAL OPENING OPTIONS	WINDOW OPTIONS
Security-Magnetic Lock	Conveyors	Sliding Glass
Single or Double Sliding	Ducting	Thermal Glass
Framed Glass (Store Front)	Fire Mains	Pass-Through
Rapid Roll-Up	Sprinkler Systems	Single or Double Hung
Impact Open	Electrical Busways	Tempered Safety Glass
Strip Curtain	Lift-Out Wall Sections	Wire-Reinforced Glass
Standard 3' x 7' (Single)	Vestibules	Tinted Glass
Standard 6' x 7' (Double)	Pipe Chases	Polycarbonate
Roll-Up Overhead Door	Product pass-thrus	Laminated Glass

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CONNECTING POSTS - Made from rugged, pre-finished 20 gauge steel. Two-piece design connected with bolts on 24" centers gives a non-progressive design which allows the removal of individual panels when needed. Trimmed with painted 26 gauge steel feature fillers that snap into posts on each side to conceal the fasteners. These posts also function as a housing for structural inserts for roof load requirements or to conceal any type of wiring needed for the structure. Progressive anodized aluminum H-mull posts are optional.

BASE CHANNELS - Continuous painted 20 gauge steel with optional anodized aluminum.

ROOFING

Panel system - 4" thick 3-ply sandwich construction with facings of 26 gauge G90 hot-dip galvanized steel. Stucco embossed pattern. pre-painted with baked acrylic enamel. Thermal insulated foam with 2 lb. density.

Decking system - pre-painted ribbed steel. 36" wide interlocking panels sized to width of structure. One and one-half inch deep corrugation in 22 gauge panels 12' Greater widths are achieved with joists. rubber closure gaskets seal each end.

CEILING - Mineral board suspended ceiling panels with industrial duty white enameled t-bar grid and hanging wires. 2'x4' acoustical panels are random fissure finished. Lay-in design allows indirect troffer lighting. Panels guaranteed for dimensional stability and are rated class A non-combustible.

WARRANTY

The warranty period for all interior buildings is 10 years and exterior buildings 1 year.

LIMITED WARRANTY - All Products sold, except those manufactured by other companies shall have the following limited warranty:

Manufacturer Warrants That the products furnished by the manufacturer under this contract will be free from defects in workmanship and material for ten (10) years on interior buildings and one (1) year on exterior buildings after delivery to the end user. Written notice on any claim defect must be furnished to manufacturer in writing within thirty (30) days of knowledge of same. Upon satisfactory demonstration of the merits of the claim, manufacturer will, within a reasonable time, make any necessary repair or corrections, or at the option of the manufacturer, replace defective article free of charge. Charges for correcting defects will not be allowed, unless manufacturer is first notified in writing and the correction is authorized in writing. Any and all charges to correct an item shall be limited to the amount charged for that item, all amounts in excess of that amount shall not be covered by this warranty or reimbursed by the manufacturer. This warranty will not apply to defects caused by improper installation or to any of manufacturers products which shall have been repaired or altered by anyone other than manufacturer, without manufacturer's written consent, or which have been subject to misuse, neglect or accident. NO FURTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT SPECIFIED HEREIN, ARE MADE BY THE MANUFACTURER, and this paragraph sets forth the full extent of the liability arising from the manufacture, use or sale of the products and materials sold hereunder. No allowances will be made for delays or loss of profit, nor for any other special, indirect or consequential damages or injuries, whether based on tort or contract.



**NATIONAL
PARTITIONS**

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