Design TOOLBOX

IMAGE FIRST
Creative Sign Solutions

Contents

Introduction

Dear Fellow Designer,

William Blake once wrote, "I will not reason or compare; my business is to create". Unfortunately, this is not the case for the majority of us. We have the limitations of materials, price, and customer opinion to deal with. Despite such obstacles we have the responsibility of producing signs which visually communicate the proper message to their audience. To do so takes the combination of good design and product knowledge, things that take a great deal of reason and comparison.

The purpose of this Toolbox is to educate designers across the network by providing them with the information necessary to create successful designs. The information being provided was chosen to help creative minds turn concepts into achievable projects by understanding the basic processes, materials, functions, and standards used in producing exterior signs. Armed with this knowledge, they will be able to develop signs and sign systems that are not only aesthetically pleasing, but also durable and maintainable. We hope this becomes an open forum, allowing us all to ask questions and learn from each other.

The variety of methods used to construct an exterior sign are too numerous to mention, so the primary focus of the following tools will be the standard products of Image First, LLC, and the rationale behind their usage. These products were developed for the Corporate, Health, and Education industries and thusly, are an ideal starting point when beginning work on an exterior project. Inevitably, circumstances will dictate times when deviating from these standards are necessary, and our goal is to help you make informed decisions on such occasions.

Sincerely,
Design Department

IMAGE FIRST
Creative Sign Solutions

Design Process

When it comes time for you as the designer to begin working on a project there are some basic guidelines which may help you along the way.

Set an objective for your sign

Have a clear understanding of the sign's function. Without an objective, it is hard to recommend the right materials or design. Architectural signs fall into four categories:

Directional:
Indicates which way the viewer is supposed to go. May be for one destination or many with multiple directions, the number should be limited, however, for clarity.

Identifying:
Signs that name a place or thing: Campus ID, conference room, exits, etc.

Informational:
All signs by definition, give information, but these signs display a specific message such as business hours or special procedures.

Restrictive or Prohibitive:
A type of informational sign which restricts the viewer from doing something, such as Employees Only, or emphasizes danger, such as Do Not Enter or Danger.

Placement

The salesperson should conduct a field survey and permit questionnaire. Are you dealing with existing structures or new construction? What type of electrical power is available? Many of the decisions relating to signs and sign placement are limited by your local sign ordinances. Are there restrictions on height and square footage or set back requirements? Do channel letters have to be on a raceway? Always consult with the local government before planning your project.

Consider the sign's surroundings, and the overall image that your signage will project. While the sign should stand out on its own, it is important to examine neighboring signs, buildings, and monuments to make a determination on the colors, styles or sizes of your sign. Identify the distance and speed of the viewer your sign is meant to direct, and use the proper size, color, angle, lighting and placement for maximum visibility. Digital photos or site plans are extremely helpful in this stage.

10 Steps to Designing and Producing an Exterior Sign:

- → Initial meeting with Client
- → Site assessment
- → Confirm codes and zoning
- → Traffic counts
- → Computer aided sign design
- → Proposed costs
- → Present and revise as necessary
- → Contract
- → Permits
- → Fabricate and install

Visibility

Many of the decisions relating to visibility are limited by your local sign ordinances, so consult local authorities for this information prior to design. For good visibility, keep three elements in mind:

Speed of Travel:
Identify the type of traffic who will be viewing the sign (sidewalk traffic, downtown vehicles, or highway traffic, for example). Pedestrian oriented and motorist oriented signs have different criteria of design.

Viewer Reaction Time:
This represents the amount of time necessary for a driver to see a sign, read its message, process the information, and make the necessary maneuvers in response to the information.

Viewer Distance:
How far do you plan to display your sign from your viewer? Three feet or thirty feet? Design your sign accordingly, keeping in mind the individual with poor vision, rather than average sight.

Notes On Visibility and Legibility

- Legibility distance is about 85% of visibility distance. Studies show that visibility and legibility are not independent; conditions which reduce legibility will proportionately reduce visibility.
- Legibility distance at night is generally only 88% of daytime legibility. This proportion varies depending upon color of lettering and background.
- Lower case letters have a slightly greater legibility distance than capital letters. Capitals are seen more quickly, but lower case can be read more rapidly, a point to remember when preparing copy for motorist oriented signs.
- Inter-letter spacing increases letter and word legibility. This is especially important to motorist oriented signs.
- Stroke width affects legibility, but is related to letter size and spacing. Generally, a stroke width one-fifth (1/5) the height of a letter yields excellent legibility.

Letter Size vs. Distance / Viewing Exposure in Seconds

Character Height	Optimal Viewing Distance	Max Viewing Distance	Speed of Viewer				
			20 mph	30 mph	40 mph	50 mph	60 mph
3"	30'	100'	3.4	2.5	1.7	1.3	.9
4"	40'	150'	5.1	3.4	2.5	2.0	1.4
6"	60'	200'	6.8	4.5	3.4	2.7	1.9
8"	80'	350'	12.0	7.9	5.9	4.7	3.4
9"	90'	400'	13.6	9.0	6.8	5.4	3.8
10"	100'	450'	15.3	10.2	7.6	6.1	4.3
12"	120'	525'	17.9	11.9	8.9	7.1	5.1
15"	150'	630'	21.5	14.3	10.7	8.5	6.1
18"	180'	750'	25.59	17.0	12.7	10.2	7.3
24"	240'	1000'	34.1	22.7	17.0	13.6	9.7
30"	300'	1250'	42.6	28.4	21.3	17.0	12.1
36"	360'	1500'	51.1	34.0	25.5	20.4	14.6
42"	420'	1750'	59.7	39.7	29.8	23.8	17.0
48"	480'	2000'	68.2	45.4	34.1	27.2	19.4
60"	600'	2500'	85.3	56.81	42.6	34.1	24.3

The letter style used for measuring is a sans serif face with medium stroke, such as Arial Bold. Based on black letters on white background. Distance may vary 10% with various color combinations. Viewing ranges approximate.

Legibility

The legibility of a sign depends on the following:

Letterform:
For the greatest readability, bold, simple and clean fonts are best, such as, Helvetica and Clarendon. Limit your sign to a maximum of 2 typestyles and restrict the sign's message to essential information; a viewer typically has only 2-3 seconds to take in the message.

Negative space:
Proper letter kerning and leading have as much to do with legibility as letter size. Maintaining a high degree of white or negative space is important to keep the letters from running together or running into other distractions around the sign. A typical guideline is to make the negative space equal to three times the Letter Copy Area.

Letter Height:
The letter height of the signs in drawing "A" is the same. Notice how the letter height filling the sign severely degrades the legibility in the bottom sign. For a quick reference on what size letters are needed for your sign, examine the visibility chart on the previous page.

Color:
Letters that blend in with their background become illegible at moderate distances. This applies to polished metal letters that may reflect a similar color as the sign background making them unreadable: dark letters that may blend into a building brick or stone, or other letters where there is a small level of contrast between the letter color and the background. The amount and type of lighting (both artificial and natural) is important as well.

Proportion:
Proportion is often the most misunderstood and overlooked element when designing a sign. Text & graphics should be laid out with the output dimensions in mind. If you design copy that is more vertical than horizontal, your sign dimensions should reflect that.

A

LEGIBILITY

LEGIBILITY

Color & Finish

Contrast between colors is crucial for clarity of letter forms. Letters that blend in with their background become illegible at moderate distances. This applies to dark letters that may blend into a building brick or stone, or other letters where there is a small level of contrast between the letter color and the background. Color is the toughest thing to remember, so whenever possible get color samples and reference standard swatch systems, such as the ASI-Modulex color chart, the Pantone formula guide, or Matthews Paint system.

Be aware that certain shades of individual colors produce different reactions from the viewer:

- **Red or Orange= ALERT**
- **Blue, Green, or Purple= SOOTHING**
- **Yellow and Flourescents= EXCITING**

Best Color Combinations Used in Lettering of Outdoor Advertising Displays

1. Black on Yellow	9. White on Brown
2. Black on White	10. Brown on Yellow
3. Yellow on Black	11. Brown on White
4. White on Blue	12. Yellow on Brown
5. Yellow on Blue	13. Red on White
6. Green on White	14. Yellow on Red
7. Blue on Yellow	15. Red on Yellow
8. White on Green	16. White on Red

Ranked in order of legibility of letters from a distance. (Atmospheric and ambient light conditions as well as type of letter may affect the legibility of color combinations listed.) Source: Claus and Claus, 1974

Impression

It is important that your signs portray the right image for your client. Signs should be consistent with the image that letterheads, brochures, products, and locations project to the public. All aspects of proper layout must be considered to give viewers a good impression. The overall layout must have balance, eye appeal, and be consistent with the message.

Logos

Is there a logo that fits well with the sign copy? Inclusion of graphical elements or a logo should complement the sign message and sometimes encompass the entire sign. Some logos (such as McDonald's, Coca-Cola, etc.) are strong enough brands that virtually no text is needed for their sign, however, this is not typical, especially in architectural signage.

Use New Technology

The addition of a Time and Temperature display or an Electronic Variable Message Center can make a business a landmark in the community. Electronic message centers allow the customer to change the message on their sign as easily as they change their mind. With today's technology, signs are becoming more effective at delivering their owner's messages while also becoming more cost effective and energy efficient. While the up front cost may seem high, they'll be saving money in the long run thanks to the energy conservation.

Consider the budget

It is not always the lowest price that dictates the best value. Quality, design, readability, durability, and longevity all play major roles in value, however, having a price number to shoot for is beneficial. Having little experience with signing, some clients have no budget established and expect the designer to recommend one. Others may have budgeted an arbitrary amount, hoping that it will be sufficient, while a few want the job done properly, regardless of cost. In any case, the designer should defer any estimate of his own until he has assembled sufficient information to recommend a realistic one. A low budget may have repercussions and a high figure may convince a client to seek help elsewhere.

Necessary Information Required to Receive an Accurate Quote

- Quantities on each item Shape
- and overall dimensions Material
- and fabrication methods
- Drawing with the graphic application methods
- Lighting and electrical requirements

The more complete the information is, the more accurate the estimate can be. The more unusual or customized a sign system is, the more difficult it is to estimate, and the less accurate the estimate may be. Using standard products greatly aids in this process.

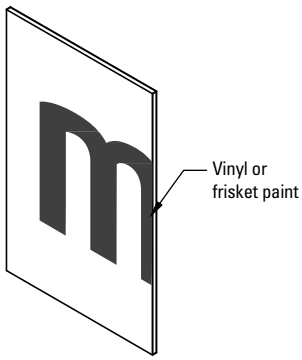
Quick Tips

According to a study in 1986 by a college of optometry, two simple elements can enhance the effectiveness of your sign design.

1. Adding a border to focus attention on your sign helps the viewer read it 26% faster.
2. By presenting special information in a second color, you increase the readers retention by 78%.

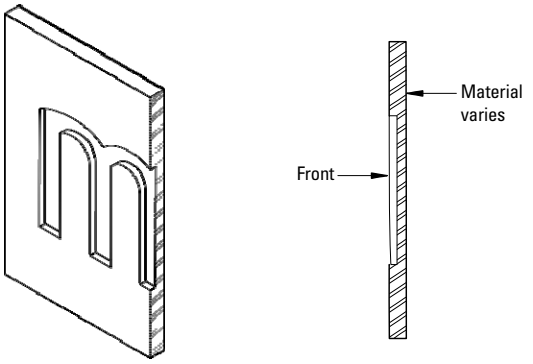
Commercial Signs VS Architectural Signs

		Commercial Signs	Architectural Signs
Client	**Type**	→ Retail Establishment	→ Hospitals, office buildings, hotels, education, corporate, public transportation
	Objectives	→ Biggest, most eye-catching sign, available, to stop traffic and attract walk-in business → Convey national identity for large chains → Price sensitve → Short time horizon - most businesses don't survive more than a few years.	→ Design & quality of sign reflects quality of facility's products and services → Complements architecture → Less price sensitve → Much longer time horizon, 5-10 years → Often involves a system of signs (Main ID, directionals, building ID's, regulatory signage, etc.)
Design	**Color Selection**	→ Eye-catching, bright, loud → Multiple colors → Gloss and semi-gloss finish → When illuminated, translucent background	→ Subdued, conservative, dignified → Matches or complements other architectural features → Matte finish → When illuminated, opaque background
	Layout	→ Imaginative, aggressive layouts → Copy as large as possible → Decorative, often distorted typestyles → Multiple typestyles & design elements → Vertical, curved, etc. lines and copy blocks	→ Conservative, standard layout & typestyle selection → Substantial negative (blank) space & margins → Limited number of typestyles & design elements → Horizontal copy blocks → Consistency within system is more important than functionality of given sign
	Shape	→ Functional, standard → Square or rectangular face	→ More creative & varied; three dimensional → Complements architectural features
	Mounting	→ High on pole or wall, to be better seen by distant automobile traffic	→ Ground Mounted → Landscaped → Features exposed materials & mounting hardware used elsewhere in project
Construction	**Materials**	→ Less expensive - wood, plastic neon, steel, flex face aluminum	→ Longer life, non-corrosive - fiberglass, aluminum, stone
	Craftsmanship	→ Low attention to detail → Viewed from automobile → Exposed fasteners & seams acceptable	→ High attention to detail → Viewed up close → More monolithic; minimal exposed fasteners & seams



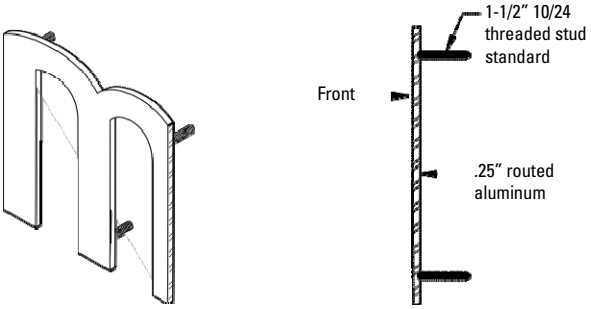
Flat Graphics

Frisket painted or opaque vinyl graphics, for a non-illuminated face. Translucent vinyl on acrylic or fiberglass for illuminated faces.



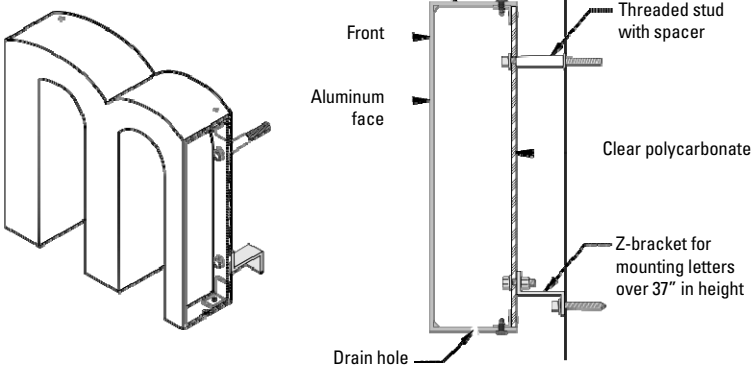
Incised Graphics

NOT A FACTORY STANDARD. Carved in wood, marble, or slate. Sandblasted in granite, marble, metal, glass, concrete or wood. Cast in place in concrete.



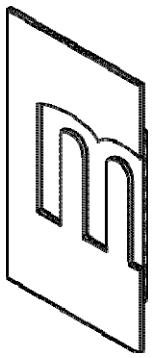
Flat Cut Graphics

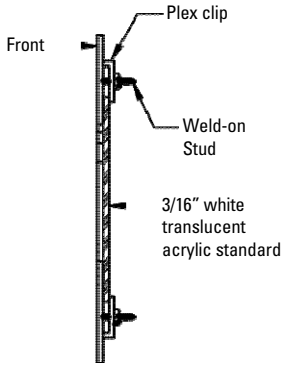
Routed .25" aluminum (standard) with threaded studs welded or drilled and tapped for mounting. Nuts used as spacers to reach stand-off distance. Can also be acrylic or Sintra®. 3M™ VHB™ adhesive transfer tape with adhesive 100MP is an option for flush mounting lighter materials.



Dimensional Letters

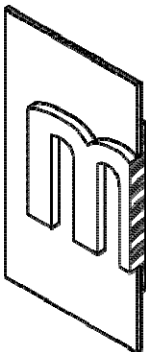
Hollow or built-up up construction. Typically fabricated from aluminum or acrylics. Can be stud mounted flush or stand-off of face of cabinet or wall.

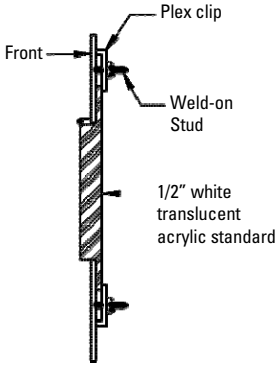




Routed Graphics

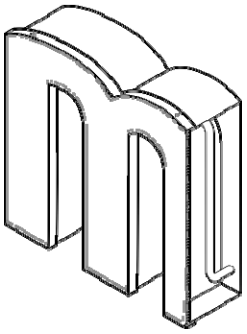
Routed .090 aluminum face (standard) backed with white translucent acrylic. Vinyl overlays used for alternate colors. VHB adhesive mount for smaller sizes, weld-on studs with clips for larger sizes.

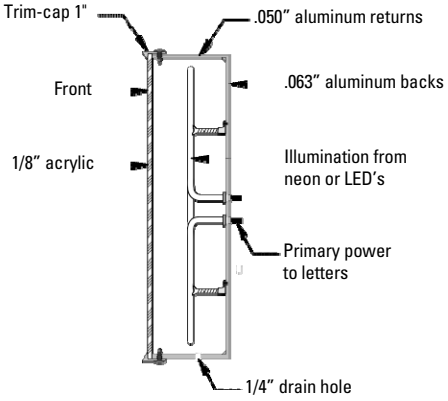




Push-thru Graphics

Routed .090 aluminum face (standard) with routed white or clear acrylic push-thru, to project 1/4", typical. Vinyl overlays used for alternate colors. VHB adhesive mount for smaller sizes, weld-on studs with clips for larger sizes.

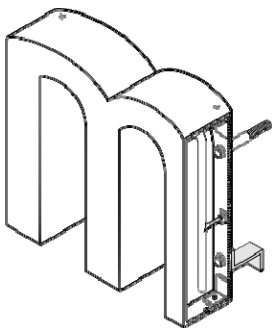


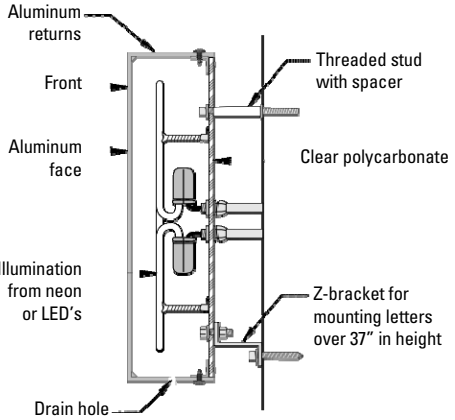


Face-lit Channel Letters

Aka. "Front-Lit channel letters", are illuminated from neon or LED's. Option of wall or raceway mounting. Can have self contained or remote mount tranformers. Aluminum construction can be pop riveted or welded.

NOTE: The stroke width of a neon channel letter should never be less than 1-1/2" thick, or arcing may occur, which could cause a fire.



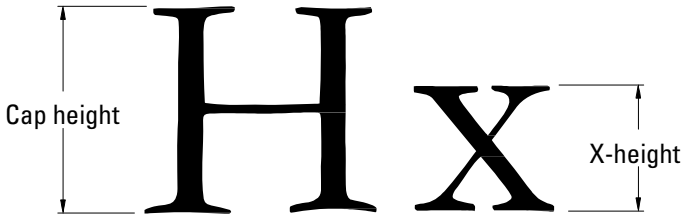


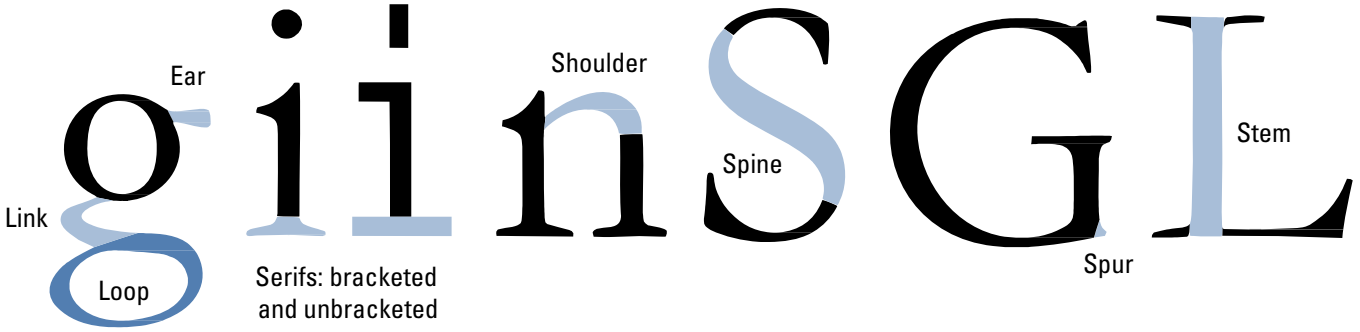
Halo-lit Channel Letters

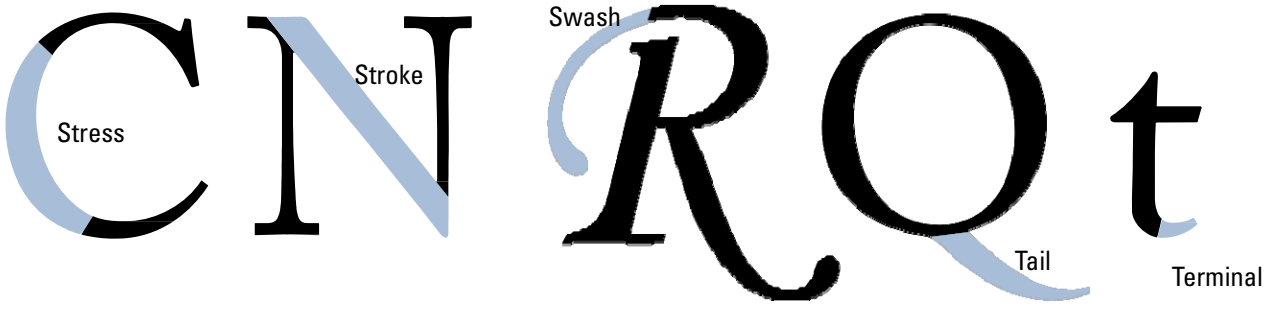
Aka. "Reverse-Lit channel lettters", are illuminated from neon or LED's. Various mounting methods (studs with spacers typical). Aluminum construction can be pop riveted or welded.

NOTE: It is recommended that a neon channel letter be no less than 12" in height, in order to prevent early failure of the neon tube.

Anatomy of a Letter







Windload

Factors

There are three factors that can cause the structural failure of a sign;

1) ***Gravity***, which pulls everything earthward
2) ***Unstable soil***, such as clay, sand, or silt
3) ***and Wind***, typically the most important consideration.

Without considering these forces, any sign you erect could, topple over of its own weight, bend and twist from the pressure, or completely blow to the ground.

Since the wind pressure on a sign is the largest toppling force we have to contend with, we engineer for the expected windload, and account for the other factors, such as solid ground. A 100 mph wind generates a pressure on a sign face of 40 to 45 pounds per square foot. In other words, a ten foot by ten foot panel (100 sq. feet) will have to withstand a force of 4000 pounds, or two tons. Obviously it requires a sturdy supporting structure to resist these pressures.

Wind pressure is called a live load because it varies from zero to its maximum in any given locality. Furthermore, a steady wind is less likely to occur than a gusty wind, which delivers a varying pressure on a sign face. Sign structures have to be strong enough to resist the highest expected windload as well as the buffeting and tugging of stormy winds.

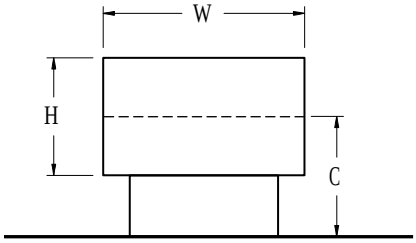
Formula for Wind Loading

$$\text{Section Modulus} = \frac{\text{Height} * \text{Width} * \text{Centroid Height} * \text{Wind Load} * 15.04}{\text{Tensile Strength} * \text{Number of Posts}}$$

H = Height of sign in feet
W = Width of sign in feet
C = Centroid Height in feet, Distance from grade to center of cabinet
WL = Windload in psf (lbs/square foot). (30 psf/90 mph standard)
TS = Tensile strength of material in (psi). Maximum load which the structural suport can withstand before failure
P = Number of posts used

TS =	Steel	36,000
	Aluminum	18,000
	Direct Burial Aluminum	24,000

Calculating the required section modulus, allows you determine the proper tube support needed to provide structural integrity to your sign

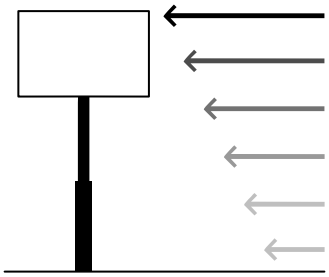


$$SM = \frac{H * W * C * WL * 15.04}{TS * P}$$

Wind Speed vs Wind Load

HEIGHT	*90mph*	*100mph*	*110mph*	*120mph*	*130mph*
0' - 15'	31	38	47	55	65
15' - 20'	33	41	50	59	69
20' - 25'	35	43	52	62	73
25' - 30'	36	45	54	64	75
30' - 40'	39	47	57	68	80
40' - 60'	42	52	63	74	87

Design Wind Pressure per UBC 1991 Edition, Exp.C (psf)



Height is Significant

Near the ground, the wind is slowed down by the ground itself, and by the weeds, foliage, grass, fences, houses, etc. Thus, at a slightly elevated level the wind is of greater strength than it is at the ground. Basically, the higher a sign is the greater the required structural strength.

The charts provided will help aid in a designer's calculations. We use a standard wind load of 30 psf, or 90 mph, but this will vary based on location. If you do not know what wind velocity is used by engineers in your area, you can find out by inquiring at your municipal or county office where the building inspectors and sign structure inspectors have their offices. The information will be made available at your request.

City codes (if any) typically specify what load (in pounds) a sign face should be able to withstand. However many cities have changed this call-out to wind speeds. The following chart converts wind speed to wind load. If no codes exist, you can use the included Wind Speed Map to obtain approximate wind speeds.

Wind Speed Map

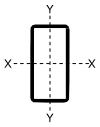
Location	V mph
Hawaii	105
Puerto Rico	145
Guam	170
Virgin Islands	145
American Samoa	125

Color	Wind Speed
	90 mph
	100 mph
	110 mph
	120 mph
	130 mph
	140 mph
	150 mph
	Special Wind Region (Per ASCE)

NOTES:

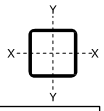
1) Values are nominal design 3-second gust wind speeds in miles per hour at 33 ft (10m) above ground for Exposure C category
2) Linear interpolation between wind contours is permitted.
3) Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area
4) Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5) This wind map is intended for general guidance only. Consult local engineering standards to determine exact wind loading for your application

Material content adapted from ASCE 7-95, Minimum Design Loads for Buildings and Other Structures.



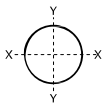
Rectangular Steel Posts

Section Modulus Y-Y Axis	Exterior Dimension	Wall thickness
1.75	4" x 2"	0.15"
2.65	4" x 2"	0.25"
3.13	4" x 2"	0.312"
2.45	5" x 2"	0.15"
3.77	5" x 2"	0.25"
4.49	5" x 2"	0.312"
3.85	5" x 3"	0.188"
4.91	5" x 3"	0.25"
5.86	5" x 3"	0.50"
5.03	6" x 3"	0.188"
7.74	6" x 3"	0.312"
11.06	6" x 3"	0.50"
7.82	6" x 4"	0.25"
9.43	6" x 4"	0.312"
13.58	6" x 4"	0.50"
11.41	7" x 5"	0.25"
13.83	7" x 5"	0.312"
20.26	7" x 5"	0.50"
11.9	8" x 4"	0.25"
14.45	8" x 4"	0.312"
21.23	8" x 4"	0.50"



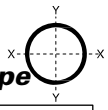
Square Steel Posts

SM	Exterior Dimension	Wall thickness
0.72	2" x 2"	0.188"
0.85	2" x 2"	0.25"
1.55	3" x 3"	0.15"
2.33	3" x 3"	0.25"
1.73	3" x 3"	0.312"
2.15	3-½" x 3-½"	0.15"
3.29	3-½" x 3-½"	0.25"
3.89	3-½" x 3-½"	0.312"
3.48	4" x 4"	0.188"
4.42	4" x 4"	0.25"
7.29	4" x 4"	0.50"
7.01	5" x 5"	0.25"
8.60	5" x 5"	0.312"
12.3	5" x 5"	0.50"
10.40	6" x 6"	0.25"
12.8	6" x 6"	0.312"
18.00	6" x 6"	0.50"
14.40	7" x 7"	0.25"
15.28	7" x 7"	0.312"
25.50	7" x 7"	0.50"
14.56	8" x 8"	0.25"
27.20	8" x 8"	0.375"
34.40	8" x 8"	0.50"



Schedule 40 (Standard) Steel Pipe

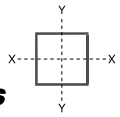
SM	Nominal Size	Actual O.D.	Wall thickness
0.561	2"	2.375"	0.154"
1.06	2½"	2.875"	0.203"
1.72	3"	3.5"	0.216"
2.39	3.5"	4"	0.226"
3.21	4"	4.5"	0.237"
5.45	5"	5.5"	0.258"
8.5	6"	6.625"	0.280"
12.2	7"	7.625"	0.301"
16.8	8"	8.625"	0.322"
29.9	10"	10.75"	0.365"
43.8	12"	12.75"	0.375"
53.25	14"	14"	0.375"
70.26	16"	16"	0.375"
89.62	18"	18"	0.375"
111.35	20"	20"	0.375"



Schedule 80 (Extra Strong) Steel Pipe

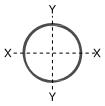
SM	Nominal Size	Actual O.D.	Wall thickness
0.7309	2"	2.375"	0.218"
1.339	2½"	2.875"	0.276"
2.225	3"	3.5"	0.300"
3.14	3.5"	4"	0.318"
4.271	4"	4.5"	0.337"
7.431	5"	5.5"	0.375"
12.22	6"	6.625"	0.432"
16.55	7"	7.625"	0.430"
24.51	8"	8.625"	0.500"
39.43	10"	10.75"	0.500"
56.7	12"	12.75"	0.500"
69.1	14"	14"	0.500"
91.5	16"	16"	0.500"
117	18"	18"	0.500"
145.7	20"	20"	0.500"

Square Aluminum Posts



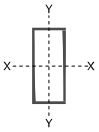
SM	Exterior Dimension	Wall thickness
.291	1.5" x 1.5"	.125"
.552	2" x 2"	.125"
.911	2" x 2"	.25"
1.32	3" x 3"	.125"
2.33	3" x 3"	.25"
2.43	4" x 4"	.125"
4.41	4" x 4"	.25"
5.64	6" x 6"	.125"
10.6	6" x 6"	.25"
14.9	8" x 8"	.188"

Round Aluminum Posts



SM	Exterior Dimension	Wall thickness
0.325	2" O.D.	.125"
0.444	2" O.D.	.188"
0.528	2.5" O.D.	.125"
0.735	2.5" O.D.	.188"
0.779	3" O.D.	.125"
1.10	3" O.D.	.188"
1.43	4" O.D.	.125"
2.05	4" O.D.	.188"
3.30	5" O.D.	.188"
4.22	5" O.D.	.25"
4.84	6" O.D.	.188"
6.23	6" O.D.	.25"
8.64	7" O.D.	.25"
5.99	8" O.D.	.125"
11.4	8" O.D.	.25"
13.0	8.5" O.D.	.25"

Rectangular Aluminum Posts



Section Modulus Y-Y Axis	Section Modulus X-X Axis	Exterior Dimension	Wall thickness
.332	.210	1" x 2"	.125"
.633	.307	1" x 3"	.125"
.978	.77	2" x 3"	.125"
1.49	.992	2" x 4"	.125"
2.11	1.37	2" x 4"	.188"
2.65	1.68	2" x 4"	.25"
1.96	1.67	3" x 4"	.125"
2.80	2.36	3" x 4"	.188"
3.53	2.96	3" x 4"	.25"
2.68	2.01	3" x 5"	.125"
3.85	2.86	3" x 5"	.188"
4.91	3.59	3" x 5"	.25"
3.48	2.36	3" x 6"	.125"
5.03	3.35	3" x 6"	.188"
10.0	5.49	3" x 6"	.25"

Extruded Aluminum Posts

Section Modulus Y-Y Axis	Section Modulus X-X Axis	Description	Section
.561	.709	2” sq. post	
1.31	1.44	3 1/4” sq. post	
.882	.967	3 1/4” rd. post	
.089	.123	Adjustable reveal	
.399	.739	2” sq. post	
.396	.759	3 1/4” radius post	
.510	.969	3 1/4” rect. post	
1.24	1.54	3 1/4” sq. post	
.348	.574	3 1/4” tri. post	
1.69	4.62	7” radius post	
2.15	5.59	7” rect. post	
1.86	3.69	7” tri. post	
.183	.757	Series 7 reveal	

Concrete Bases

To keep a sign from toppling over, it is set on a secure foundation of concrete, and either planted into the concrete or securely anchor bolted to it. Since the placing of a concrete base for the sign may precede the installation of the sign by days or even weeks, we have to give it prior consideration. It is sometimes necessary to place the concrete sign base prior to general paving by other contractors. Perhaps the general contractor has an over-ride in which he must be responsible for all concrete. In this case you must have your concrete sign base specifications in his hands at the time when he is pouring concrete on the site for the foundation, etc. For these reasons, the sign base often has to have the first consideration.

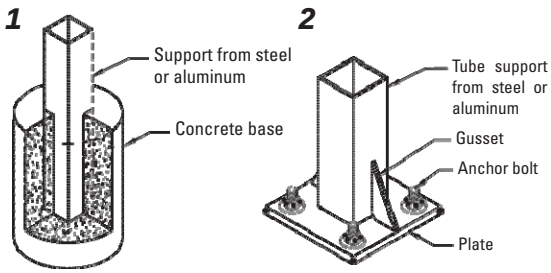
The minimum depth for a concrete sign base in the northern latitudes is 4 feet. The reason is that the bottom of the block of concrete must be below the mid-winter frost line, which can reach a depth of 42 inches. If the bottom of the concrete is below the frost line, then the concrete will not heave and shift out of place during the Spring thaw.

At that depth, four feet, the earth pressure of most impacted soils and clays is greater than the ballast effect of a block of concrete. This is to say, for every yard of concrete you drop into an excavation that is at least four feet deep, the earth pressure will supply an equal or greater amount of tipping resistance as compared to the tipping resistance of the concrete alone (because of its weight and inertia).

At depths of greater than four feet, the earth pressure increases substantially. For deep settings earth pressure alone supplies the tipping resistance.

NOTE: It is advisable to add re-bar to the base of any large sign.

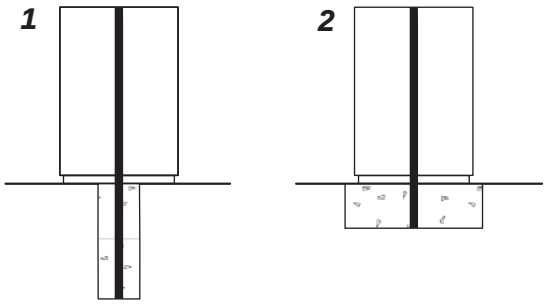
Types of Mounting



1) Direct Burial
Standard mounting method in which the sign support continues from the sign into the concrete base. Less connections mean there is less room for failure or error.

2) Flange or Base Plate
Mounting method in which the sign support has a plate of the same material welded to it for mechanical attachment to the base by way of anchor bolts and nuts.

Types of Sign Foundations



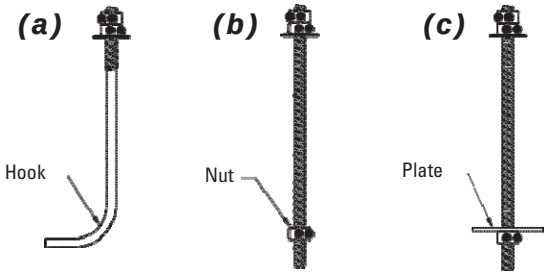
1) Drilled Concrete Pier
Standard sign foundation and most cost effective. Requires clay and/or shell soil (type 2) with approximately 2000 psi or more compression factor.

2) Spread or Slab Foundation
Foundation used in sandy loam areas (coastal) with low soil compression. Also used in rocky areas difficult to drill or in other areas where large augers are not available. Earth pressure need not be a consideration because the ballast weight of the concrete will act alone with sufficient stability to support the sign and withstand the windload.

Bolts and Electrical Feed

When the concrete is poured, two things have to be set while it is wet, the sign pole or bolts, and the tube for the electrical feed if it is to be fed underground. Bolts are the critical coupling between the rigidity of the support and the mass of the solid block of concrete. They can be the weak link because they are the most likely part of the system to be subject to human error and the most likely place for problems to arise during a severe storm.

The nuts have to be loaded equally and uniformly torqued to be certain that one or the other is not resisting an extra portion of the tipping force on the sign. A buffeting gusty wind will soon loosen any nuts that are not secured. It is suggested to use double nuts on each bolt with the second nut acting as a locking nut, keeping the first nut tight.



Typical Anchor Bolt Configurations
Anchor bolts are usually made from threaded A36 round rods with a yield stress of 36 ksi and an ultimate tensile stress fo 58 ksi. This rod is sold in virtually any length with diameters up to 8 inches. The anchor bolts are cast directly into the reinforced concrete footing, and may incorporate either a standard hook on the embedded ends or threads for attaching standard nuts. The hook shown in part (a) has been the typical shape of anchor bolts for many years. Recent research and experience suggest that, under full load, the bends may straighten, permitting the bolts to pull out of the concrete. The configurations shown in (b) and especially (c) are preferred because of the positive, non-slip, mechanical bearing of the nut head or plate on the concrete.

An anchor bolt embedded in concrete will fail in basically two ways. Either the steel in the bolt will fail due to a combination of tension and shear, or the bolt will pull out of the concrete. The former is strictly a function of bolt diameter; however, the latter depends on the embedded length of the anchor bolt in the footing, the spacing between anchor bolts, and the distance between bolts to the edge of the footing.

Illumination

Illumination is usually thought of as a functional element; it is a practical necessity which is largely taken for granted. But it can also be used a flexible design element. Because signs represent special lighting applications, we must create appropriate, custom-lighting schemes for each sign we design.

This process must incorporate the technical specifications that lamp manufacturers provide, such as color temperature, color rendering index (CRI), lumen output and wattage. But signage applications introduce many variables to the equation as well. These include the sizes and depths of sign cabinets, the number of lamps used, their spacing, and the effects of specific light sources on various translucent sign-face colors. Hence, determining the final lighting arrangement typically involves some trial and error.

Architectural projects are often floodlighted at night. A headquarters office building is part of the corporation's public image, and proper exterior lighting enhances that image. There are several basic lighting techniques which relate to the illumination of exterior signing for architectural projects. These are flood- or spotlighting, ambient lighting, internal lighting, and external lighting.

- *Flood- or Spotlighting*, is often an appropriate and subtle way to identify a dignified building, but great care should be taken when lighting dimensional letters of any thickness because shadows cast from the letters can interfere with legibility. The sun poses a similar problem in the daylight. The designer or project manager also needs to take the time and work with the lighting installer to prevent hot spots, glare and uneven illumination of the signage.

- *Ambient Lighting*, in the form of spill light from existing architectural lighting may produce adequate illumination for many pedestrian oriented signs. Address numbers, for example, are often visible enough from overhead entrance lighting. To enhance ambient light, directional signs will often use reflective vinyl graphics for better visibility.

- *Internal Lighting*, is often necessary in order to achieve legibility at night, and give the sign it's proper emphasis. This is done with routed faces backed with acrylic or acrylic push-thru graphics and opaque backgrounds, which give a subtle effect commonly used in architectural signage. This can also be done with translucent faces with vinyl graphics, which is often used in commercial applications because of the many bright color options.

- *External Lighting*, includes any technique utilizing a light source outside the sign, whether attached to it or located elsewhere. Floodlighting is one such technique. Others include the use of exposed neon tubes, clear or frosted incandescent bulbs, high intensity lamps, and various kinds of spot lights. Except for flood and spotlighting, most of the techniques are more appropriate for merchandising sign applications.

Lighting types

There are seven varieties of general-purpose lamps.

Incandescent lamps are still used for some externally illuminated signs. These lamps produce warm, inviting light with excellent color-rendering characteristics. But the major drawbacks of incandescent bulbs are short lamp life and high energy-consumption. For this reason, the percentage of signs illuminated with incandescent lighting has declined steadily over the years.

Tungsten halogen lamps are widely used in retail-store lighting, but their use in signage applications has declined in recent years. Still, sign companies sometimes use the long, clear, tubular variety of this lamp, commonly called a "quartz bulb." Tungsten halogen lamps are similar in color temperature and CRI to standard incandescent lamps. These lamps are slightly more efficient than standard incandescent bulbs. Tungsten halogen lamps also have a relatively short life span, and they must be handled carefully to prevent premature failure. Because the lamps are available in 300-, 500-, 1,000- and 1,500-watt sizes, they are frequently used in enclosed fixtures as floodlights.

Fluorescent lamps are, by far, the most common type of sign lighting because they combine efficiency with high CRI ratings. Also, a wide range of color temperatures (measured in Kelvins) is available. By varying the phosphor coatings on the inner walls of the tubes, fluorescent lamps can be produced in several colors.

The warmest fluorescent-lamp color typically used for sign lighting is "Cool White". "Sign White" lamps represent a mid-range choice, and "Daylight" lamps are the coolest color. The subjective terms "warm" and "cool" refer to the psychological effect of the light. In general, a "warmer" lamp emits a more yellowish light that renders flesh tones well. Cool lamp colors are quite effective for rendering various colors on translucent sign faces, but human faces take on pallid appearances in this light.

High Intensity Discharge (HID) lamps have become the most popular substitute for fluorescent lamps in large electric signs. Because mercury-vapor lamps were introduced before metal-halide lamps, HID lighting initially got the undeserved reputation of being unsuitable for signs.

The principal advantages of HID lamps are efficiency and long life. By increasing the sign cabinet's depth and incorporating diffusers, very large signs can be illuminated with only a fraction of the number of lamps required for fluorescent lighting. Also, because each HID lamp socket requires only a two-wire feed from the ballast, the number of secondary wires and connections is substantially reduced. Troubleshooting and maintenance of HID signs, therefore, is much simpler.

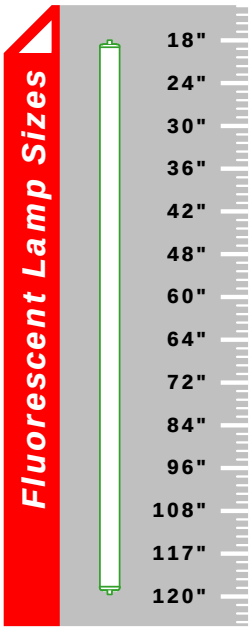
Mercury vapor lamps have low CRI ratings because they emit light that adds a blue-green cast to sign-face colors. The effects of this coloration can be mitigated somewhat by using white (coated) mercury lamps instead of clear lamps.

Metal-halide lamps, however, have much better color-rendering capabilities than mercury lamps. Although standard metal-halide lamps are rated at an acceptable level of 65-70 CRI, some of the latest types developed for retail-store lighting are rated as high as 96 CRI. Available in colors of 3,500-6,500K, these lamps cover approximately the same lighting range as fluorescent bulbs. Because metal-halide lamps emit very intense light, however, metal light-diffusers must be installed around each lamp to produce uniform illumination of signs.

In the past, ***high-pressure sodium (HPS) lamps*** have been suitable only for lighting certain architectural and rustic-theme signs. The typical CRI rating for these lamps (20-22) is not high enough to render colors effectively. In general, this characteristic makes HPS lamps appropriate only for externally illuminated signs with dominant white, yellow or brown colors.

Lamp Efficiency, Color and Durability

Lamp Type	Lumens per Watt (LPW)	Color Temp	Color Rendering Index (CRI)	Average Life (hours)
Incandescent	5-22	2,750-3,400K	95-100	750-2,000
Tungsten Halogen	12-36	2,850-3,000K	95-100	2,000-5,000
Compact Fluorescent	27-80	2,800-6,250K	80-85	9,000-10,000
Fluorescent	75-100	2,700-6,300K	48-90	12,000-24,000+
Mercury Vapor	50-60	3,300-5,900K	22-52	12,000-24,000+
Metal Halide	80-115	3,000-6,500K	65-96	10,000-20,000
High-Pressure Sodium	90-140	2,000-2,500K	20-82	10,000-24,000+

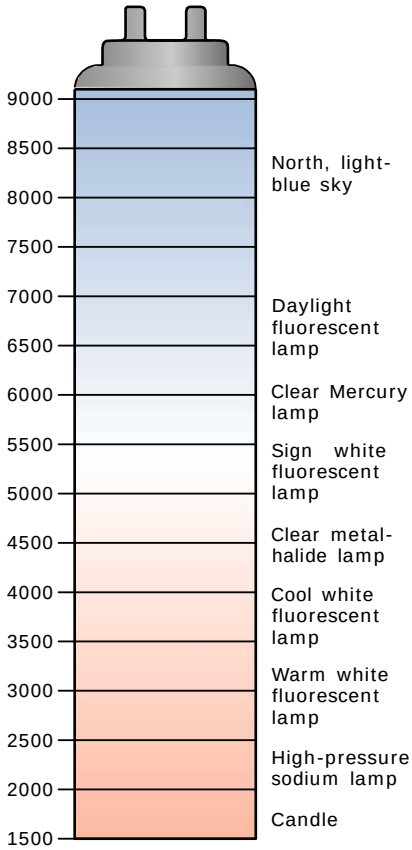


Cool White vs. Daylight Lamps

We use "cool white" lamps which are plain-old white with a color similar to average sunlight. The spectrum of "cool white" has a surplus of yellow and a shortage of green and red. Since mixing red light with green light makes yellow, the white light of a cool white lamp still looks white.

"Daylight" is a cooler, bluish white, and does not have a surplus of yellow as the other halophosphate whites. But it is also slightly dimmer.

NOTE: Fluorescent lamps only make full light output in a somewhat narrow temperature range. The fluorescents will probably not make full light when they first get started. They typically make more light after warming up for a few minutes, then may lose a bit of light output if they warm up past optimum temperature.



F - Fluorescent lamp. **G** means Germicidal shortwave UV lamp.
S - Style - no letter indicates normal straight tube;
C for Circline; **U** for U-lamp

WW=Nominal power in Watts. 4, 5, 8, 12, 15, 20, 30, 40, etc.

CCC=Color. **W**=White, **CW**=Cool white,

WW=Warm white, **BL/BLB**=Black light, etc.

HO=High Output, **T**=Tubular bulb.

DD=Diameter of tube in of eighths of an inch.
T8 is 1", T12 is 1.5", etc.

Fluorescent lamp labeling

The actual fluorescent tubes are identified by several letters and numbers and will look something like 'F40CW-T12' or 'FC12-T10'. So, the typical labeling is of the form FSWWCCC-TDD (variations on this format are possible)

Electronic Ballasts

These devices are basically switching power supplies with an integrated high frequency inverter/switcher. Current limiting is then done by a very small inductor, which has sufficient impedance at the high frequency. Properly designed electronic ballasts should be very reliable. Whether they actually are reliable in practice depends on their location with respect to the heat produced by the lamps as well as many other factors. Ballasts must generally be fairly closely matched to the lamp in terms tube wattage, length, and diameter.

Functions of a Ballast

I Provide the starting kick for the lamp

II Limit the current to the proper value for the tube you are using

Factor in Maintenance

Design around the lighting. Fluorescents are used in all cabinets, unless size is a major factor. Dimensions will vary depending on how a sign is lit. The interior must be structurally sound without causing a shadow in the graphics. Often times, it is difficult to predict exactly how a sign will light, and in order to eliminate eye sores like shadows or bright spots, additional alterations might be necessary once the sign is assembled.

It is recommended to change fluorescent lamps every 12 to 18 months, and access to all electrical components is necessary for UL listing, so a seviceable sign is a must. It is suggested to use standard products, since Image First, LLC has a wide variety of products which are pre-engineered with these factors in mind utilizing durable, low maintenance materials and techniques. If you are unable to use standard products, removable panels must be included for access to all necessary components. This often requires many visible fasteners, which is common in commercial signage, but frowned upon in architectural signs.

Determining Cabinet Sizes

Standard Cabinet Type	Size Over Lamp Length
SignComp Commercial	1"
SignComp Architectural	3/8"
ASI Modulex FRP body	2-1/2"
1 1/2" Tubeframe body	4-3/8"
2" Tubeframe body	5-3/8"
S/F Fold-up cabinet	1-1/2"

NOTE: It is recommended to lamp a cabinet vertically if inbound tube supports are to be used. If a cabinet is over ten feet in length or height, the fluorescent lamps will have to be staggered, requiring additional fabricaton time.

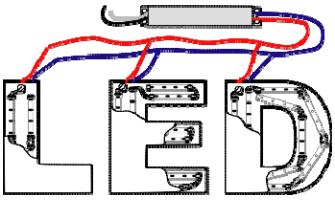
Notes on Lamp Spacing

- Lamp spacing should be no more than 2x the distance to the face ie: 4 x 2 = 8" lamp centers
- Lamp centers should not exceed 12".
- When lighting day/night plex, lamp centers should not exceed 6".
- First lamp is half the distance from end of cabinet.
- Lamp spacing should be uniform.
- Illuminated white faces may require reduced spacing.

What is an LED?

Simply put, the light-emitting diode is a solid-state device, much different than an incandescent lamp. It comprises an alloy crystal placed into a reflective cup and chemically bonded to tiny wires, then encapsulated in epoxy. When electric current runs through those wires, the crystal material is excited. That excitement is dissipated in the form of energy, a small part of which is heat, most of which is in the form of light. Different alloys produce different colors. Each has its own life span and brightness. Currently red and green are cost effective and widely used, while the brightness and color consistency of white is still unreliable and expensive in comparison.

One advantage is that some LED's are projected to last more than 100,000 hours with proper usage, but there's no solid answer to that question. With no moving parts, glass or filaments to break, LEDs are extremely rugged - tough enough for traffic-signal and automotive applications. They won't last forever, but an LED product won't fail with a pop and a flash like an incandescent lamp, they just fade away. Another advantage is that the cost of electricity for an LED display is only about 3% of incandescent usage, for comparable illumination. Also, LED modules can be directed to illuminate a channel letter face more efficiently.



Neon radiates light 360° around the tube, but in channel letters and building accent strips, much significant light is lost into the back of the enclosure.

The major disadvantages of LED technology is their initial cost and the fact that they haven't had widespread industry use, while neon parts are standard and easily attainable.

Underwriters Laboratories Inc.

In order to provide a safe and quality product ASI Modulex Manufacturing builds all of it's products to meet UL listing. The UL's Listing Service is one of the most widely recognized safety certification programs in North America. The UL Listing Mark on a product is the manufacturer's representation that samples of that complete product have been tested by UL to nationally recognized Safety Standards and found to be free from reasonably foreseeable risk of fire, electric shock and related hazards.

Products that bear the UL Classification mark have been evaluated for specific properties, a limited range of hazards, or suitability for use under limited or special conditions. Typically, our products Classified by UL fall into the general categories of building materials.

Design Resources

Fonts
www.philsfonts.com
www.letterheadfonts.com

Artwork
www.brandsoftheworld.com
www.artbitz.com

Design
www.signweb.com
www.signindustry.com
www.engineersedge.com
www.ul.com/signs/manual
www.signs.org
www.ussc.org
www.segd.org

Materials & Components
www.signcomp.com
www.abcsignproducts.com
www.permlight.com
www.gelcore.com
www.neoninstallationguide.com
www.chmetal.com
www.mcmaster.com
www.mcnichols.com

LED Message Centers
www.tlxcommercial.com
www.daktronics.com
www.adaptivedisplays.com
www.hitechled.com

CAD converting
www.guthcad.com

Books
Sign Structures & Foundations: A Guide for Designers and Estimators
By Peter B. Horsley

Engineering Sign Structures: An Introduction to Analysis and Design
By Benjamin Jones, PE

Minimal Design Loads for Buildings and Other Structures, ASCE 7-98
American Society of Civil Engineers

Architectural Signing and Graphics
By John Follis and Dave Hammer

Environmental Graphics: Projects and Process
By Wayne Hunt

Standard Cabinet Info

Standard Cabinet Type	Size Over Lamp Length	Maximum Internal Post	Maximum Plate Depth	Lamp Spacing Fiberglass or Day/Night	Lamp Spacing Aluminum
FRP 2500 12” Body	2 ½"	5 ½" O.D.	7"	10"	12"
HRP 1300 8” Body	2 ½"	3" O.D.	3"	6"	8"
SC 2015 Medium Body	1"	3" sq.	5"	6"	12"
SC 2005 Wide Body	1"	6" sq.	8 ½"	6"	12"
Series 7 S/F Hinge Body	3/8"	NA	NA	6"	8-9"
Series 7 Hinge Body	3/8"	2 ½" sq	3 ¼"	6"	8-9"
Series 12 Hinge Body	3/8"	4" sq.	7 ½"	6"	10"

Standard Cabinet Info

Standard Cabinet Type	Size Over Lamp Length	Maximum Internal Post	Maximum Plate Depth	Lamp Spacing Fiberglass or Day/Night	Lamp Spacing Aluminum
FRP 2500 12” Body	2 ½"	5 ½" O.D.	7"	10"	12"
HRP 1300 8” Body	2 ½"	3" O.D.	3"	6"	8"
SC 2015 Medium Body	1"	3" sq.	5"	6"	12"
SC 2005 Wide Body	1"	6" sq.	8 ½"	6"	12"
Series 7 S/F Hinge Body	3/8"	NA	NA	6"	8-9"
Series 7 Hinge Body	3/8"	2 ½" sq	3 ¼"	6"	8-9"
Series 12 Hinge Body	3/8"	4" sq.	7 ½"	6"	10"

Standard Cabinet Info

Standard Cabinet Type	Size Over Lamp Length	Maximum Internal Post	Maximum Plate Depth	Lamp Spacing Fiberglass or Day/Night	Lamp Spacing Aluminum
FRP 2500 12” Body	2 ½"	5 ½" O.D.	7"	10"	12"
HRP 1300 8” Body	2 ½"	3" O.D.	3"	6"	8"
SC 2015 Medium Body	1"	3" sq.	5"	6"	12"
SC 2005 Wide Body	1"	6" sq.	8 ½"	6"	12"
Series 7 S/F Hinge Body	3/8"	NA	NA	6"	8-9"
Series 7 Hinge Body	3/8"	2 ½" sq	3 ¼"	6"	8-9"
Series 12 Hinge Body	3/8"	4" sq.	7 ½"	6"	10"