The Adams & Westlake Company

New York CHICAGO Philadelphia

SIGNAL GLASS

ADLAKE

SIGNAL LENSES

A signal lens is used to control the distribution of light in a signal lamp. It does not increase or diminish the volume of light at the source. Without a lens, the rays diverge so that only a small portion of the light reaches the eye of the observer. It would be possible to design a lens so that all the light falling on it could be concentrated on one spot. This is not desirable in signal service, since an indication must be visible from more than one position.

On tangent track, where the engineer's eye maintains practically the same direction with respect to the signal, it is possible to concentrate the light in a narrow beam and make it visible to a maximum distance. Should it be desirable not to diminish the spread of the beam horizontally, as in Fresnels for marine service, all that can be done is to converge the light toward the horizontal plane. Obviously the wider the area over which the light is distributed, the shorter will be the distance at which the signal can be seen. For comparison, a 5⅜-inch Standard Optical Lens gives 69 Beam Candle Power, while an 8-inch Fresnel, with the same source of light, gives only 9.1 Beam Candle Power, or less than one seventh as much.

It should be borne in mind that with the same flame and lenses of the same design and focal length, the beam candle power of the signal increases or diminishes in proportion to the square of the diameter of the lens,—in other words, in proportion to the area. Thus the advantage of using a large lens is apparent. For example,—by increasing from a 5-inch to a 5⅜-inch lens, the candle power is raised from 57 to 69, or twenty per cent, and the effectiveness of the signal is increased proportionately.

Further, the spread will increase as the dimensions of the source of light increase, and as the focal length decreases.

Atmospheric conditions largely determine the distance at which any signal is effective. Under like conditions, the range of visibility varies in proportion to the square root of the candle power of the beam.

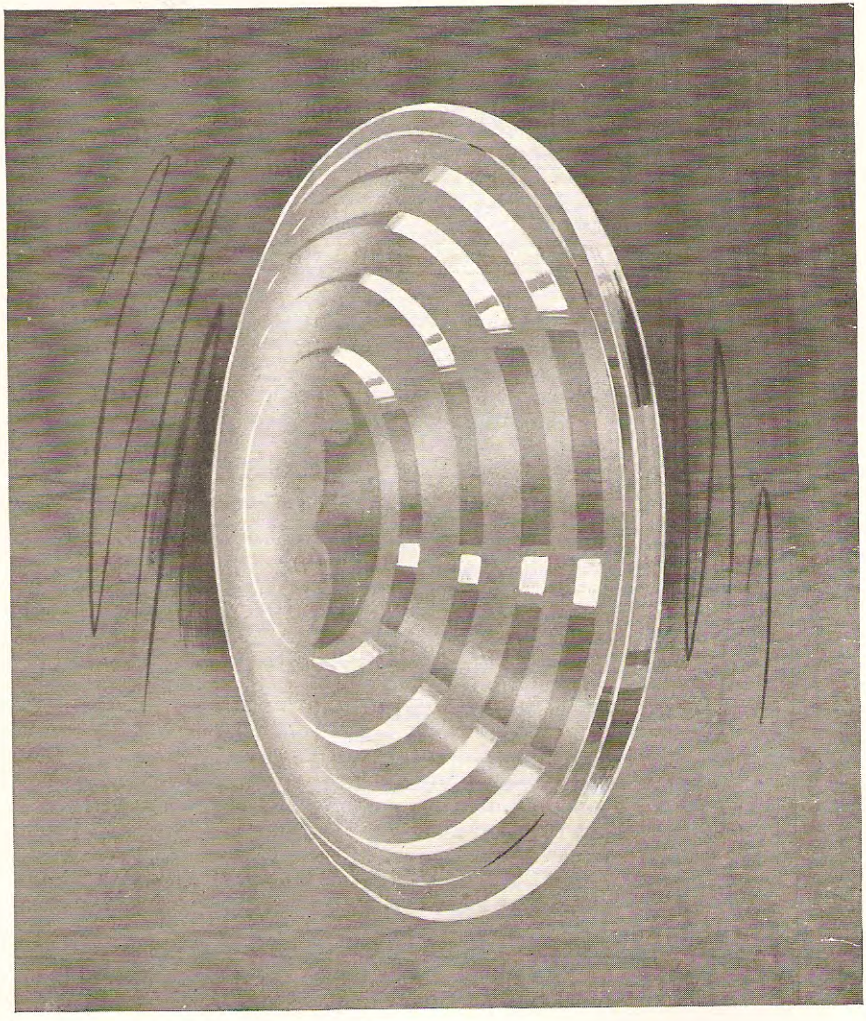
On the following pages are tables showing the sizes, foci, candle power, and spread in feet per hundred with one-day and long-time burners of the various types of signal lenses now in use. In securing the figures, the flame of the one-day burner was adjusted to give 2 Candle Power, and that of the long-time burner to give 1 Candle Power. The spread was measured at right angles to the axis of the beam at one hundred feet, and

the figure given is the extreme spread in feet at that distance. The same ratio is maintained at all distances,—that is, a spread of fifteen feet at one hundred feet indicates a spread of one hundred fifty feet, one thousand feet from the lamp.

In obtaining these figures, the flame was set at right angles to the axis of the lens. About twenty-five percent more candle power can be obtained along the axis by setting the flame at a 45° angle to the lens axis,—as is the practice in four way switch lamps,—but there is a corresponding loss in spread.

It will be seen that with most lenses the long-time burner gives a beam of greater candle power than the one-day. This is due to the greater intrinsic brilliancy of the long-time burner flame because of more perfect combustion.

Experience in building signal lamps for more than half a century qualifies The Adams & Westlake Company to advise regarding the selection of lenses to meet any conditions.



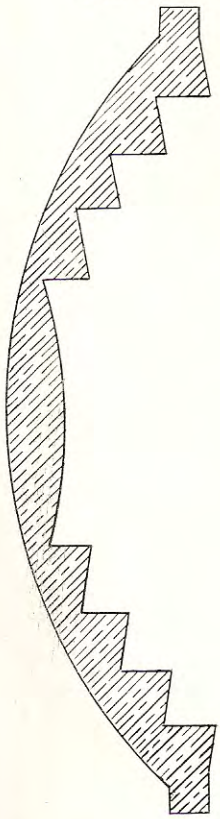
Standard Optical Semaphore Lens

Burner	Candle Power along axis	Spread in feet per 100
Adlake One-day (2 c. p.)	56.2	22.6
Adlake Long-time (1 c. p.)	69	14

(Based on use of 5⅜-inch lens)

Standard Optical Semaphore Lens

Cross Section



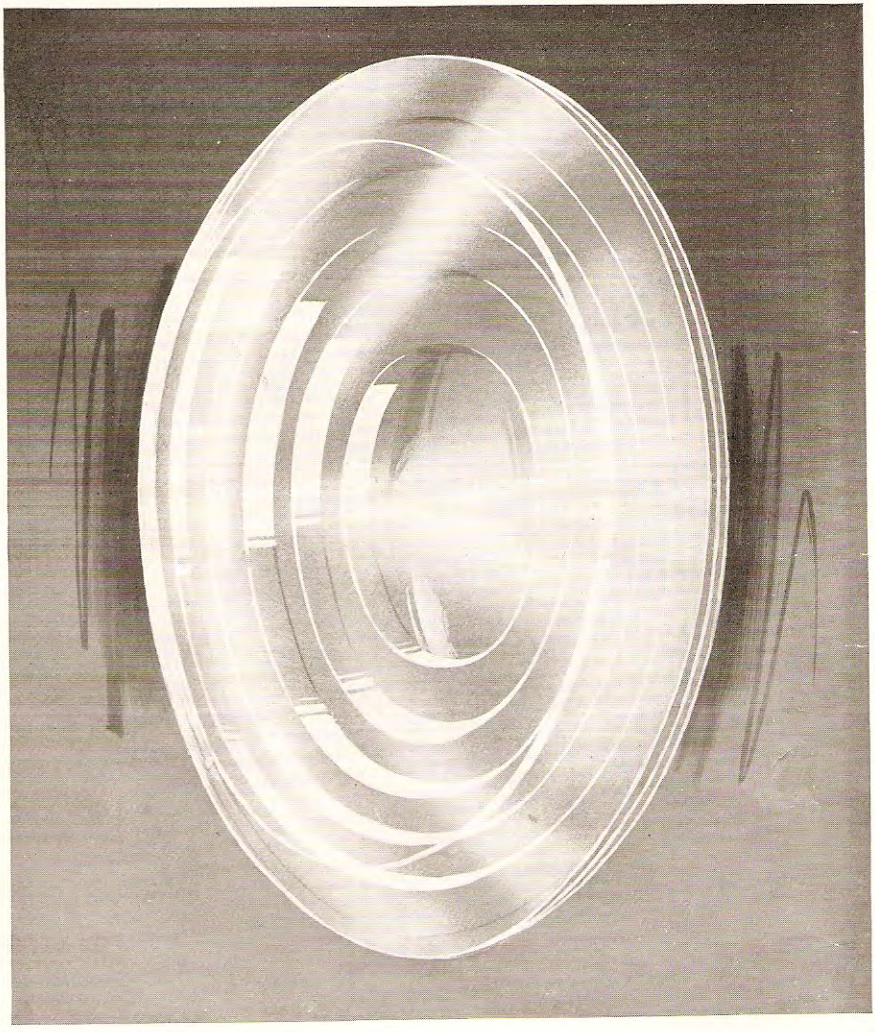
The Standard Optical Semaphore Lens has been in universal use since 1905 in practically all types of railroad signal lamps. It is so designed that the greatest possible amount of light falling upon its surface is utilized, and it directs this light in a concentrated beam so that the signal can be seen for a maximum distance. These lenses have sufficient spread to insure the signal being picked up at long range, provided the lamps are not set at points where the track curves sharply.

This lens can be furnished in any desired color.

DATA FOR OPTICAL SEMAPHORE LENSES

Diameter	Focus	One-day Burner (2 c. p.)		Long-time Burner (1 c. p.)	
		C. P.	Spread	C. P.	Spread
4"	2¾"	30.6	26.7	37.5	16.6
4⅛"	2¾"	32.3	28.1	39.6	17.4
4½"	3"	36.3	24.7	44.5	15.3
	3½"	38.5	22.7	48	14.1
5"	3½"	46.5	22.3	57	13.8
5⅜"	3½"	56.2	22.6	69	14
6"	3¾"	67.1	20.3	82	12.6
6⅜"	3¾"	74.2	20	90.5	12.4

No. 187 Adlake Engine Classification Lamp with Standard Optical Semaphore Lenses



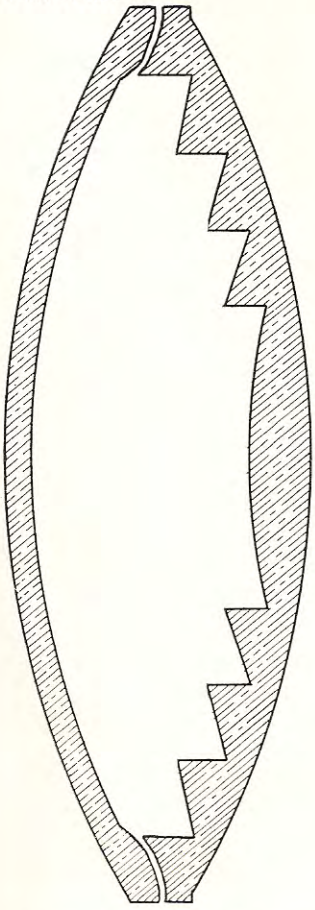
Inverted Lens with Cover Glass

Burner	Candle Power along axis	Spread in feet per hundred
Adlake One-day (2 c. p.)	55.3	30.3
Adlake Long-time (1 c. p.)	66.8	16.75

(Based on use of $5\frac{3}{8}$-inch lens)

Inverted Lens with Cover Glass

Cross Section



The Inverted Lens with cover glass was designed to meet the demand for a lens with greater spread and approximately the same range as the optical type. This lens without the cover glass has practically the same candle power as the optical lens, and with the cover glass it has within 10% of the candle power of the optical lens, at the same time giving an increase in extreme spread of approximately thirty-five percent. When used with a cover glass, it presents two smooth and easily cleaned surfaces. The inverted lens is being adopted for use in many signal lamps where special conditions make increased spread advantageous.

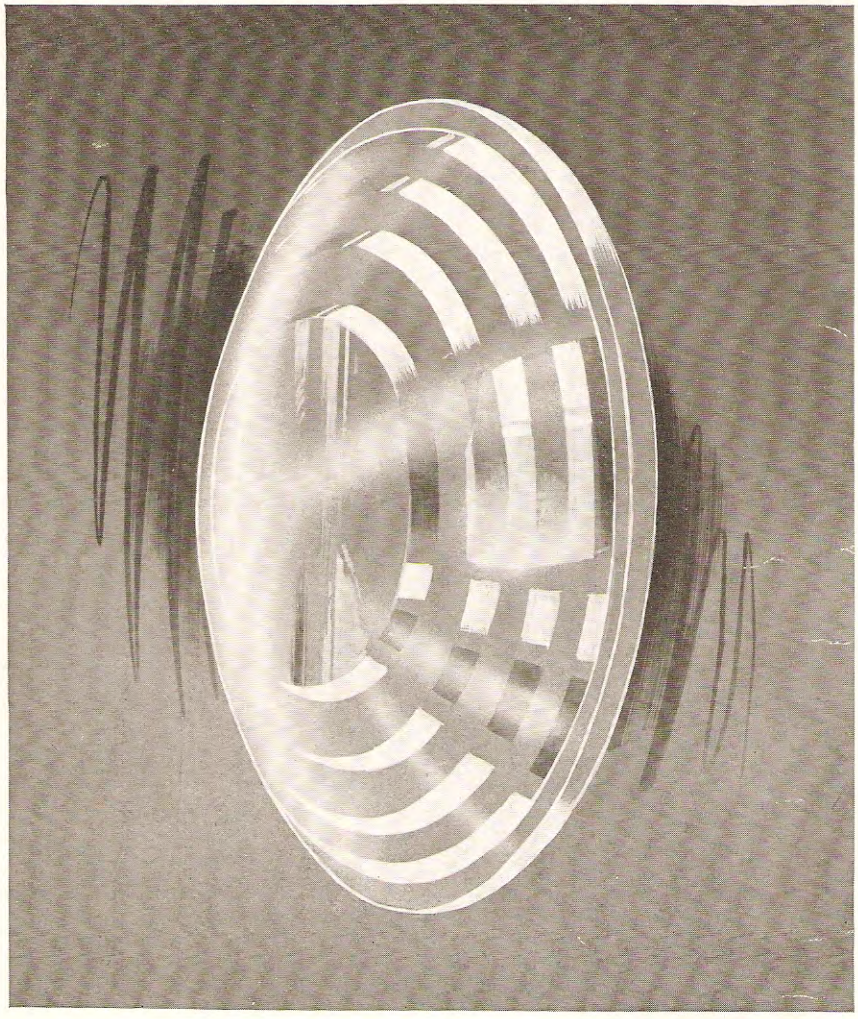
The inside corrugated lens can be furnished in any desired color. The cover glass is invariably furnished in clear glass unless specifically ordered otherwise.

DATA FOR INVERTED LENSES WITH COVER GLASSES

Diameter	Focus	One-day Burner (2 c. p.)		Long-time Burner (1 c. p.)	
		C. P.	Spread	C. P.	Spread
4 1/8"	2 3/4"	34.2	38.3	42	21.1
4 1/2"	3"	42.3	35.7	51.8	19.8
5"	3 1/2"	51	32.1	62.5	17.75
5 3/8"	2 1/4"†	48	53	59	19.3
	3 1/2"	55.3	30.3	66.8	16.75
6 3/8"	3 3/4"	73.2	29.6	89.8	16.5

† This is a special short focus lens. Note the increased spread obtained.

No. 83 Adlake Tail or Marker Lamp with Inverted Lenses and Cover Glasses



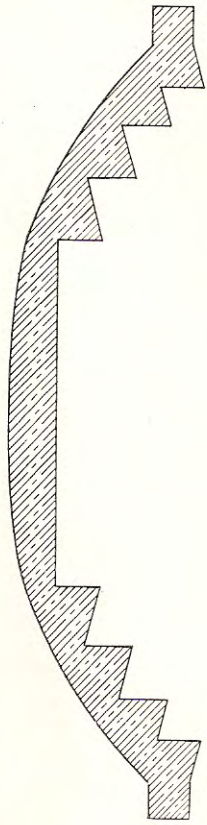
Wide-Angle Lens

Burner	Candle Power along axis	Spread in feet per 100
Adlake One-day (2 c. p.)	16.6	44.5
Adlake Long-time (1 c. p.)	11.5	34

(Based on use of $5\frac{3}{8}$-inch lens)

Wide-Angle Lens

Cross Section



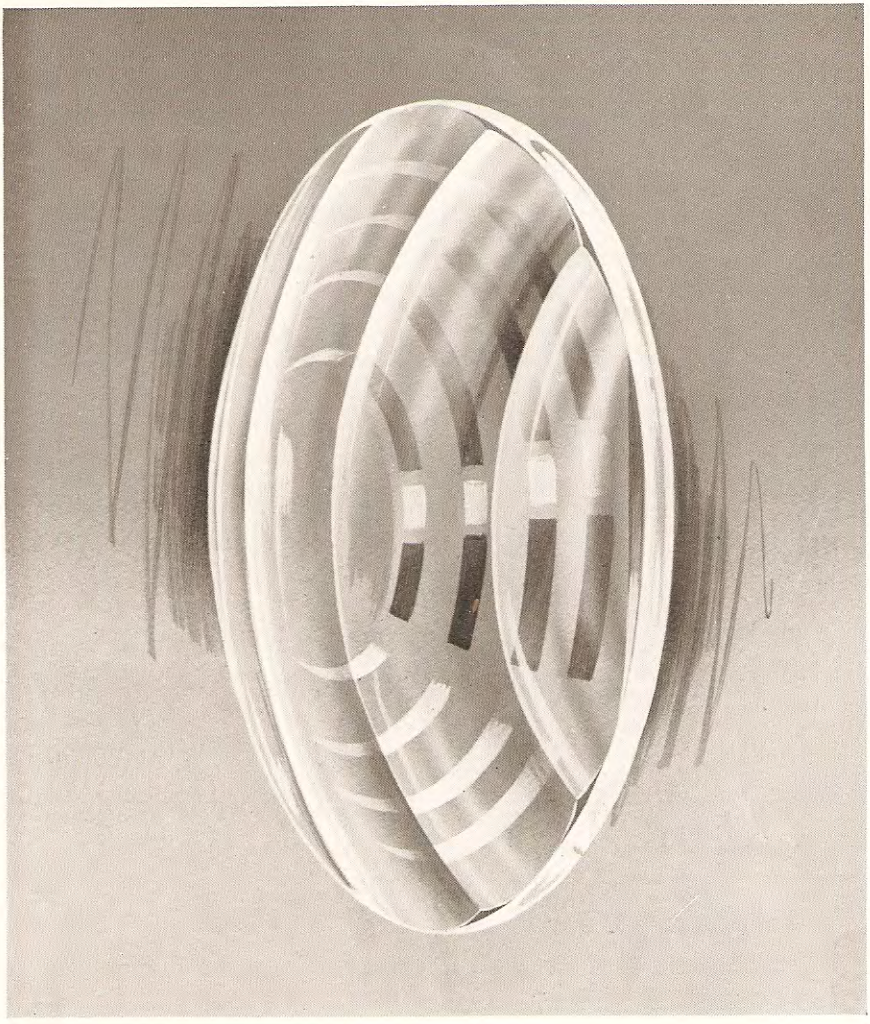
The Wide-Angle Lens, although similar to the optical lens in general appearance, is designed to spread the beam over a wider area so that by placing the lens in the standard lamp, the signal will be visible through a wider angle, but with reduced intensity and range. It is well adapted to switch lamps in a yard where high intensity of light is not required, but where a rather wide spread is desirable. Below is a table showing the candle power of these lenses when put in standard lamps. Wide-angle lenses are not recommended for long range service.

Can be furnished in any desired color.

DATA FOR WIDE-ANGLE LENSES

Diameter	Focus	One-day Burner (2 c. p.)		Long-time Burner (1 c. p.)	
		C. P.	Spread	C. P.	Spread
4"	2¾"	13.6	47.5	9.4	35.5
4½"	3"	12.1	50.8	9.5	39.5
5"	3½"	13.1	49	10	37
5⅜"	3½"	16.6	44.5	11.5	34

No 175½ Adlake Switch Lamp with Wide-Angle Lenses and Day Signal Disks



Spreadlite Lens

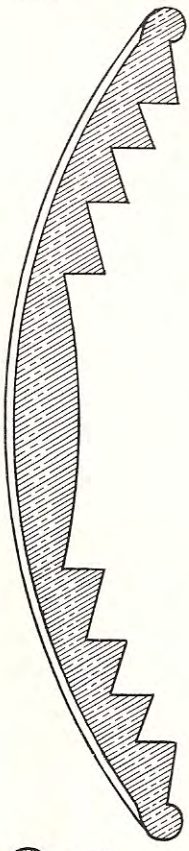
("Smooth Face" Type)

TYPE	"SMOOTH FACE"		INVERTED WITH COVER GLASS	
Burner	C. P. along the Axis	Spread	C. P. along the Axis	Spread
Adlake One-Day (2 c. p.)	33.3	65	40.2	63.2
Adlake Long-Time (1 c.p.)	27	60	32.7	61.6

(Based on use of 5⅜-inch Lenses)

Spreadlite Lenses

Vertical Section

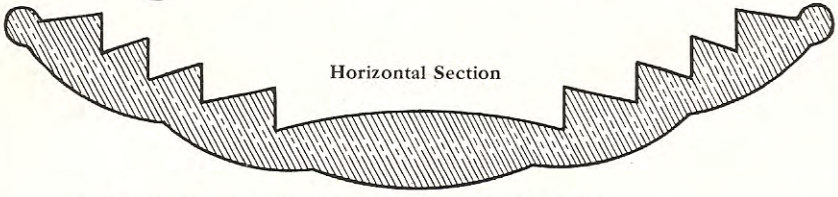


Spreadlite Lenses are the latest modification of the series of round lenses. They afford a compromise between the high candle power of the Optical and Inverted Lenses and the relatively diminished candle power of the Wide Angle Lens.

Convex panels on the convex face produce an elongated spread of nearly 35°,—in other words, sufficient to cover a 3° curve at twenty-five hundred feet.

Spreadlite Lenses have been designed in "Smooth Face" and Inverted types, and have more than double the intensity on the axis possible with a Fresnel Lens. The visible illuminated area of this lens being far greater than that of the Fresnel produces a very effective signal, and is equally satisfactory with long-time and one-day burners. A further advantage in the use of these lenses lies in the fact that they do not require special lamp bodies, and can be substituted for lenses of the same size now in service where a wider spread is considered advantageous.

Can be furnished in any desired color.

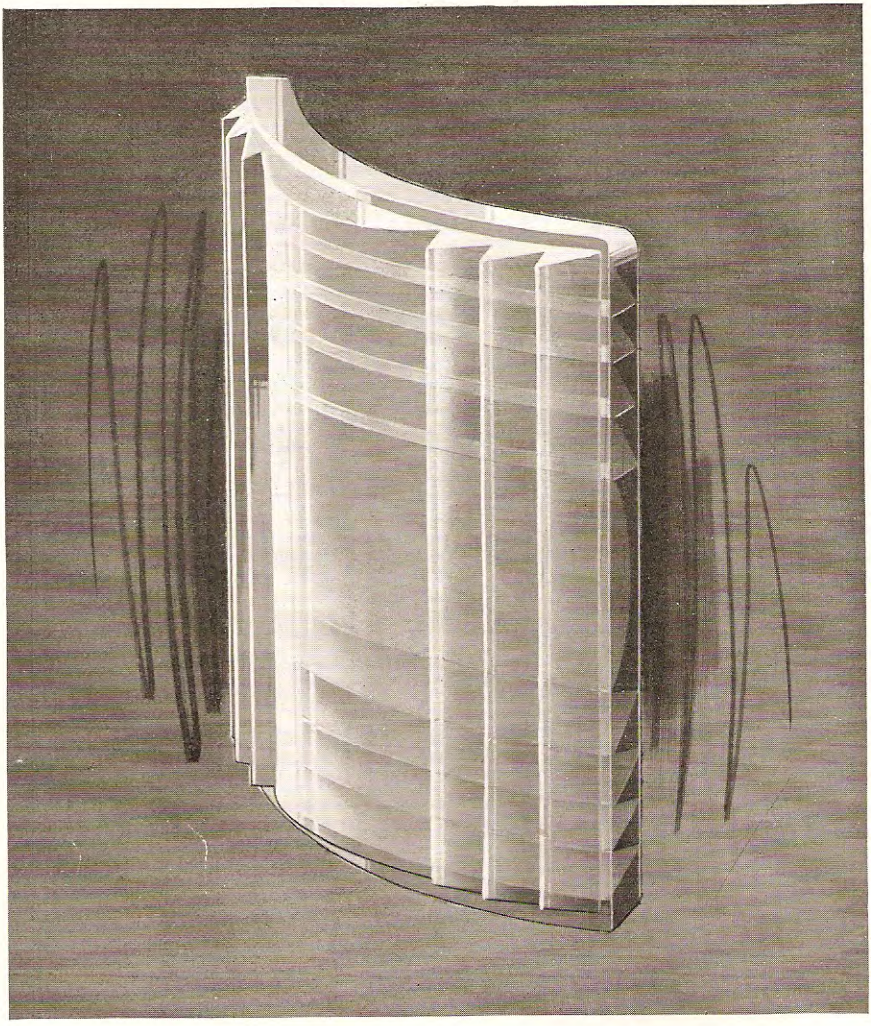


Horizontal Section

DATA FOR SPREADLITE LENSES

Type	Diameter	Focus	One-day Burner (2 c. p.)		Long-time Burner (1 c. p.)	
			C. P.	Spread	C. P.	Spread
"Smooth Face"	4½	3	23	68.8	18.9	63.4
	5	3½	28.9	66.2	23.5	61.5
	5⅜	3½	33.3	65	27	60
Inverted with Cover Glass	4½	3	28.5	66.5	22.8	64.9
	5	3½	35	64	28.4	62.7
	5⅜	3½	40.2	63.2	32.7	61.6

No. 175 Adlake Switch Lamp with Spreadlite Lenses



Duplex Lens

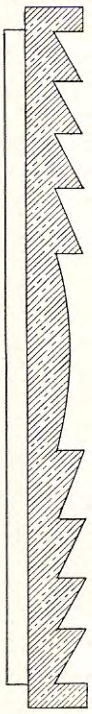
Burner	Candle Power along axis	Spread in feet per 100
Adlake One-day (2 c. p.)	27.5	61
Adlake Long-time (1 c. p.)	13.7	52

(Based on use of 5-inch lens)

Duplex Lens

There has been discussion as to the advisability of equipping some lamps with lenses of wider spread. Experience has shown that the Inverted and Spreadlite Lenses, previously described, fulfill all requirements. The Wide-Angle Lens is also useful under certain conditions. All these Lenses have the marked advantage that they fit the present standard lamps.

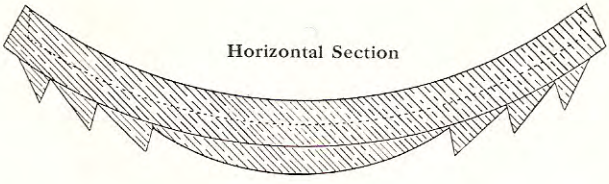
Vertical Section



To meet special cases where a wide spread of relatively high intensity is required, a special type of fresnel known as the "Duplex" Lens has been designed. This lens is for its size the most powerful type of fresnel which has ever been produced. By means of suitable prismatic corrugations, it confines the light received on 70 degrees of its cylindrical surface to a spread of approximately 35 degrees, thereby affording double the intensity of illumination possible with a fresnel of similar dimensions. The "Duplex" Lens prevents any possible confusion of signals, such as is likely to occur where fresnels having an excessive spread of beam are used in lamps which are inaccurately aligned. The utmost care must necessarily be exercised with wide spreading fresnels to prevent false indications, especially on curves. Too much spread is worse than too little.

Can be furnished in any desired color.

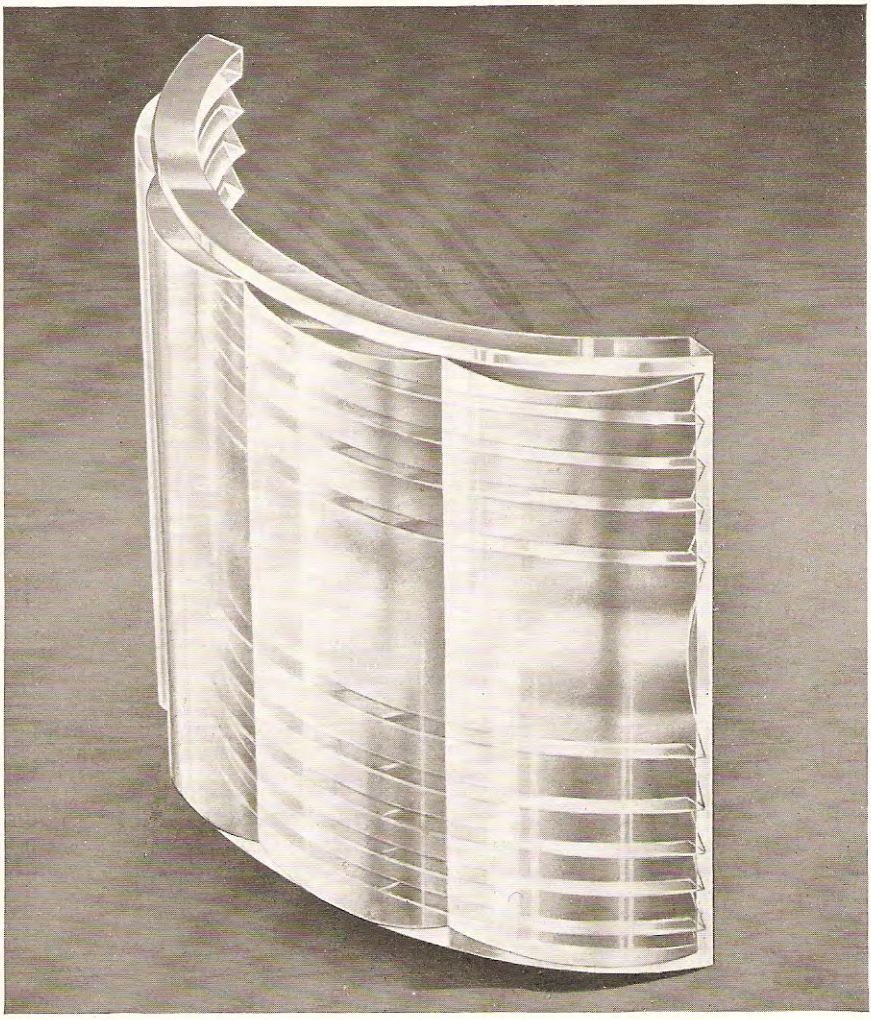
Horizontal Section



DATA FOR "DUPLEX" LENS

Height	Focus	Angle of Light Utilized	One-day Burner (2 c. p.)		Long-time Burner (1 c. p.)	
			C. P.	Spread	C. P.	Spread
5"	3¼"	70°	27.5	61	13.7	52

No. 155 Adlake Switch Lamp with Duplex Lenses



120 Degree Compound Fresnel Lens

Burner	Candle Power along each axis	Spread in feet per 100 of each beam
Adlake One-day (2 c. p.)	22.5	45.5

This lens projects four beams equal to the above — 30° apart

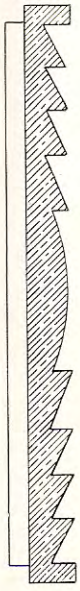
(Based on use of 5-inch lens)

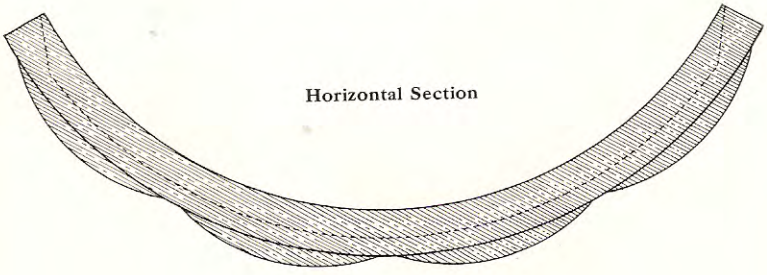
120 Degree Compound Fresnel Lens

The design of this lens presents a novel type of sectional fresnel, and was primarily made for use in classification signal lamps to meet the suggestion that an observer might pick up classification signals more readily if there were several beams of light in place of only two, as on the standard classification lamp. Of necessity the beams of this new lens are weaker than those of the standard optical semaphore lens, but four separate beams are projected. One beam is parallel to the track, one is at a right angle to the track, while the other two are spread intermediately between. This fresnel has a smooth outer surface, and consequently has no ledges to collect dirt, snow or sleet.

Can be furnished in any desired color.

Vertical Section





DATA FOR COMPOUND FRESNEL LENS

Height	Focus	Angle of Light Utilized	One-day Burner (2 c. p.)	
			C. P.	Spread of each Section
5"	3¼"	120°	22.5	45.5

This lens projects four beams equal to the above — 30° apart.

No. 128 Adlake Engine Classification Lamp with Compound Fresnel Lenses

Smooth Face Fresnel Lens

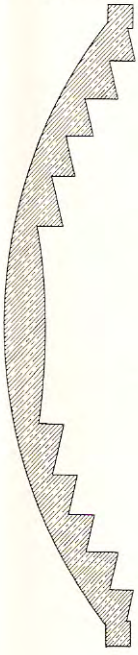
Burner	Candle Power	Spread in feet per 100
Adlake One-day (2 c. p.)	12.5	200
Adlake Long-time (1 c. p.)	10.2	200

(Based on a 90° Lens, 7" high)

Smooth Face Fresnel Lens

The Smooth Face Fresnel Lens was introduced in 1906 for use in a rear end platform lamp to secure a maximum spread. By having the corrugations on the inside and a smooth surface on the outside, no snow or dirt can collect upon the outer surface. Due to its short range of visibility, it is not recommended except with a high candle power burner. In combination with a powerful 10 C. P. burner, it has produced excellent results. It may be used to supplement the standard tail or marker lamps with their penetrating signals, if extremely sharp curves are to be considered.

Vertical Section



At present it is made in two sizes,—45 and 90 degrees, 7 inches high.

Can be furnished in any desired color.

DATA FOR SMOOTH FACE FRESNEL LENSES

Height	Focus	Angle of Light Utilized	Adlake No. 2 Dual Burner with 6" Chimney (9.5 c. p.)	
			C. P.	Spread
7"	4"	90°	33	200
7"	4"	45°	33	82

No. 33 Adlake Platform Tail Lamp with 7", 90° Smooth Faced Fresnel Lens and Adlake No. 2 Dual Burner

Fresnel Lens

Burner	Candle Power	Spread
Adlake One-day (2 c. p.)	11.5	Can be seen through as wide a horizontal angle as the degrees subtended by the lens.
Adlake Long-time (1 c. p.)	9.1	

(Based on use of 8-inch Lens)

Fresnel Lens

Fresnel Lenses are seldom used in railway service, except as required in lamps on bridges over navigable rivers. Eight inches is the standard height as called for by the United States Light House Commission. All such lenses are furnished in exact conformity with their requirements.

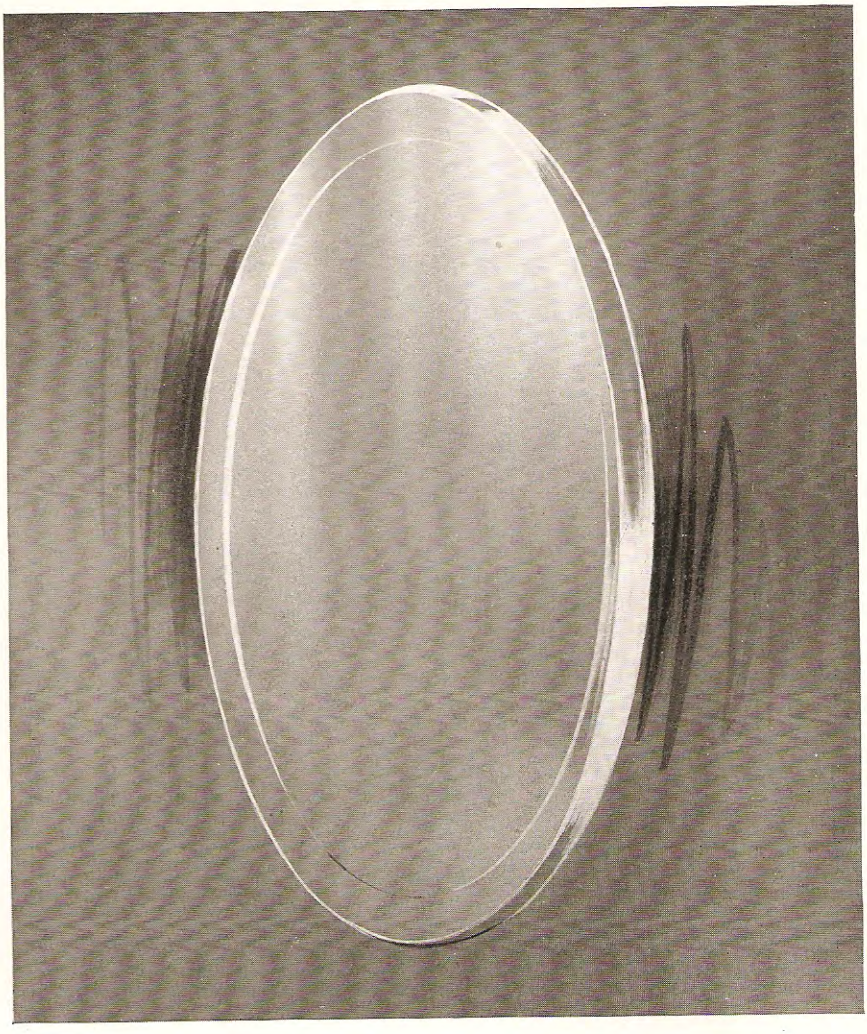
Vertical Section

Can be furnished in any desired segment of a circle and in any desired color.

DATA FOR SHIP'S FRESNEL LENSES

Height	Outside Diameter	Candle Power		Spread
		One-day Burner (2 c. p.)	Long-time Burner (1 c. p.)	
6"	5½"	9.8	7.5	Equal to degrees in segment.
8"	7½"	11.5	9.1	

No. 199 Adlake Bridge Lamp with 8" white Ship's Fresnel Lens and four Roundels



Roundel

(N. B.) Roundels are not lenses, and do not alter the distribution of light from a lens. They are used in connection with lenses where changes of color are necessary.

Roundels

Cross Section

Roundels are discs of the same color and glass as the standard lenses, insuring a uniformity of colors in all signals. Since they are molded, they are structurally very strong. They can be furnished in all standard colors and sizes called for in present day signal practice. At the present time, all colors for lenses as well as Roundels are being furnished according to the Railway Signal Association Specifications.

Further developments are in progress, which will shortly insure still greater efficiency. During this development, the necessity for distinct color with maximum intensity has been kept in mind at all times, and in consequence the new glasses are called "High Transmission" colors.

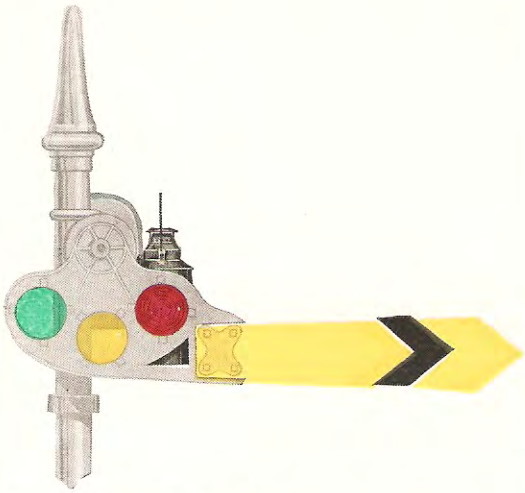
We list only Roundels of circular shape.

Special forms can be supplied when desired.

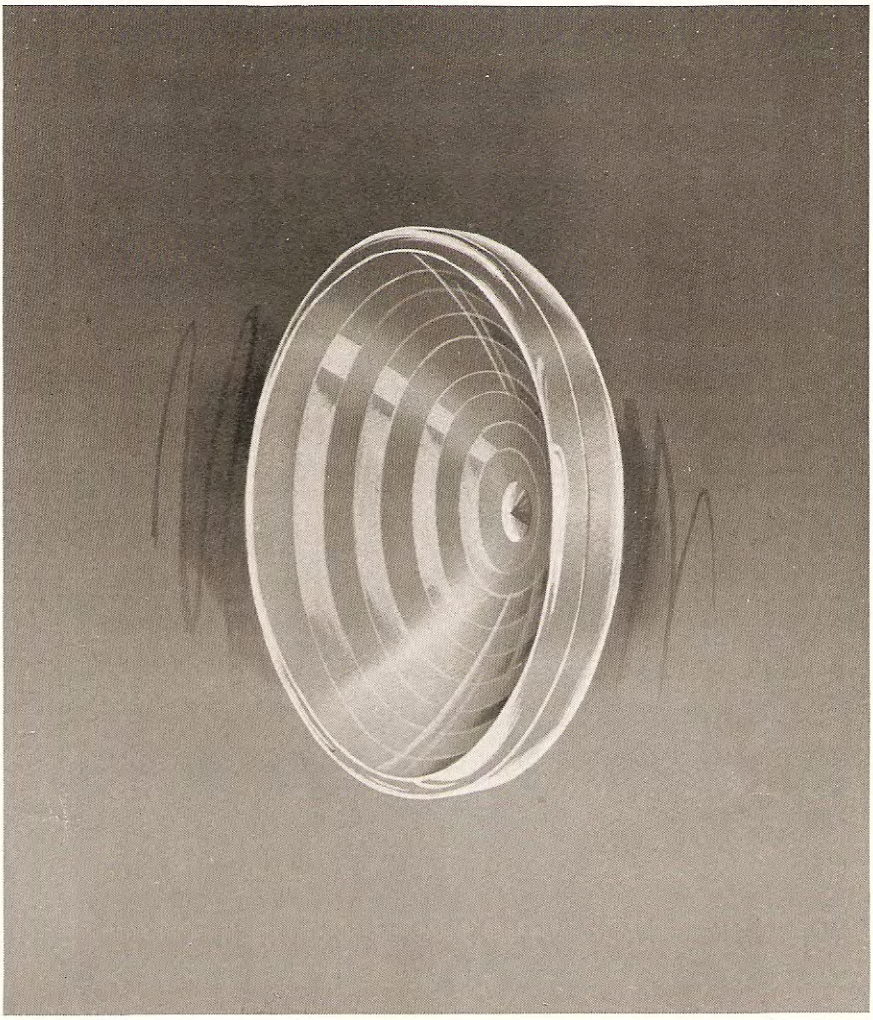
DIAMETER:

2½"	4½"†	6½"†
3"†	4¾"	6¾"
3⅜"	5"	7"†
3½"†	5⅜"†	8"
4"	5½"	8¼"
4⅛"	6"	8⅜"†
4¼"	6⅜"	8¾"
4⅜"		9¾"

† These sizes are the standards most widely used.



No. 254 Adlake Standard Semaphore Lamp with Standard Optical Semaphore Lens and Roundels in the Spectacle



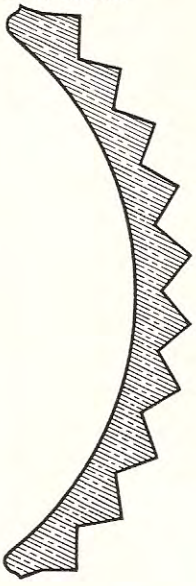
Prism Glass Reflector

(N. B.) Prism Glass Reflectors used in combination with lenses increase their signal efficiency fifteen to twenty percent by reflecting through them some of the light given off by the burner, which would not otherwise fall on the lens.

Prism Glass Reflectors

The use of a reflector with a lens imposes special requirements. It is necessary to redirect the light falling upon the reflector in such a way that it passes back through the source and the lens.

Cross Section



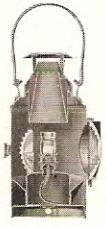
This the Prism Glass Reflector does in a most efficient manner.

The increase in signal efficiency effected by the use of the Prism Glass Reflector varies with the size and focus of the lens and reflector, so that without specific sizes it is impossible to give a definite percentage of increase. The size commonly used in railway semaphore lamps is 3⅜-inch diameter and 1¼-inch focus, and we show data covering this size, which will give a working idea of the value of the reflector.

The Prism Glass Reflector has a further advantage over metal reflectors in that it will not tarnish and lose its reflecting properties. Should it become soiled, it can always be restored to its initial efficiency by washing.

DATA FOR PRISM GLASS REFLECTORS

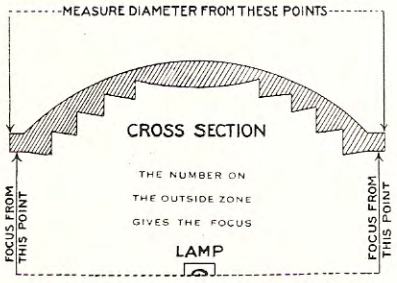
Standard Optical Semaphore Lens		Prism Glass Reflector Diameter 3⅜", Focus 1¼"			
		One-day Burner (2 c. p.)		Long-time Burner (1 c. p.)	
Diameter	Focus	C. P. with Reflector	C. P. without Reflector	C. P. with Reflector	C. P. without Reflector
5"	3½"	55	46.5	68.3	57
5⅜"	3½"	66.8	56.2	82.5	69



No. 254 Adlake Semaphore Lamp in section—to show Prism Glass Reflector

List of Sizes

ROUND LENSES



The diagram on the left shows the method of measuring the diameter and focus of round lenses.

These can be furnished in clear, lunar white, green, yellow, blue, purple or ruby. Cover glasses are furnished clear unless specifically otherwise ordered.

Moulds for all these sizes in the Standard Optical Semaphore type are always on hand. Moulds for other types are carried in all the common sizes and made in special dimensions as required.

Standard Optical Semaphore Lenses
Inverted Lenses
Wide Angle Lenses
Spreadlite Lenses

Diameter	Focus
3	3
3 1/2	2 1/4
3 3/4	2 1/2
3 7/8	2 3/4
4	2 3/4
4	3 1/2
4 1/8	2 3/4
4 1/8	3 1/2
4 1/4	2 3/4
4 1/2	3
4 1/2	3 1/2
5	3 1/2
5 3/8	3 1/2
6	3 3/4
6 3/8	3 3/4
7	4
7 3/8	4
8	4 1/2
8 3/8	5
9	5 1/2
10	6
12	7
14	8
16	9

List of Sizes (*Cont.*)

DUPLEX LENSES

Height	Focus	Horizontal Angle of Light Utilized
5"	3¼"	70°

120° COMPOUND FRESNEL LENSES

Height	Focus	Horizontal Angle of Light Utilized
5"	3¼"	120°

SMOOTH FACED FRESNEL LENSES

Height	Focus	Horizontal Segment
7"	4"	90°
7"	4"	45°

FRESNEL LENSES

Number	Old Designation		Angular Measurem't	Height	Outside Diameter
5554—A	6"	Whole	360°	5⅝"	5½"
5554—C	6"	½-Section	180°	5⅝"	5½"
5554—D	6"	⅓-Section	120°	5⅝"	5½"
7374—A	8"	Whole	360°	7⅜"	7½"
7374—C	8"	½-Section	180°	7⅜"	7½"
7374—D	8"	⅓-Section	120°	7⅜"	7½"

ROUNDELS

Roundels are furnished one-quarter inch thick, unless otherwise ordered. Can be supplied one-eighth inch thick if preferred.

DIAMETERS							
2½"	*3" 3⅜" *3½"	4" 4⅛" 4¼" 4⅜" *4½" 4¾"	5" *5⅜" 5½"	6" 6⅜" *6½" 6¾"	7"	8" 8¼" *8⅜" 8¾"	9¾"

* These sizes are the standards most widely used.

PRISM GLASS REFLECTORS

Diameter	Focus
3⅜"	1¼"
6"	3"


ADLAKE