

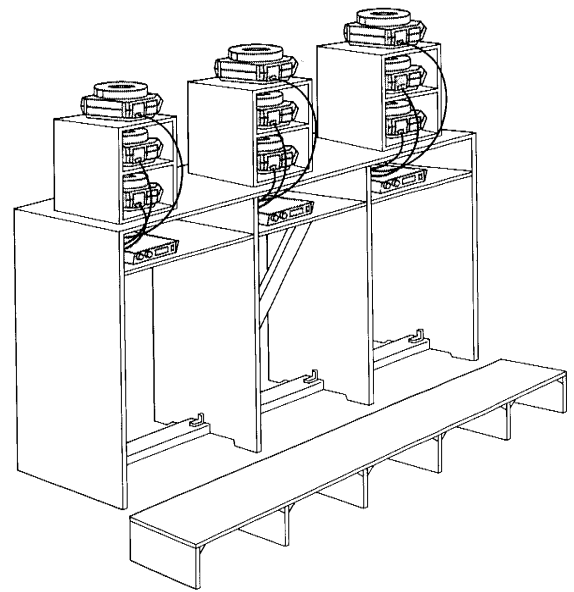
# PART VI

## Detailed Plans for Helpful Home-Built AV Projects

### INTRODUCTION

In Part VI of *The Source Book*, we have provided easy-to-understand plans for the construction of the following useful items:

- Sound-deadening projector blimps
- Two-projector piggyback stands
- A convenient, easy-to-build projection table (with a step-up bench)
- A companion shelf unit

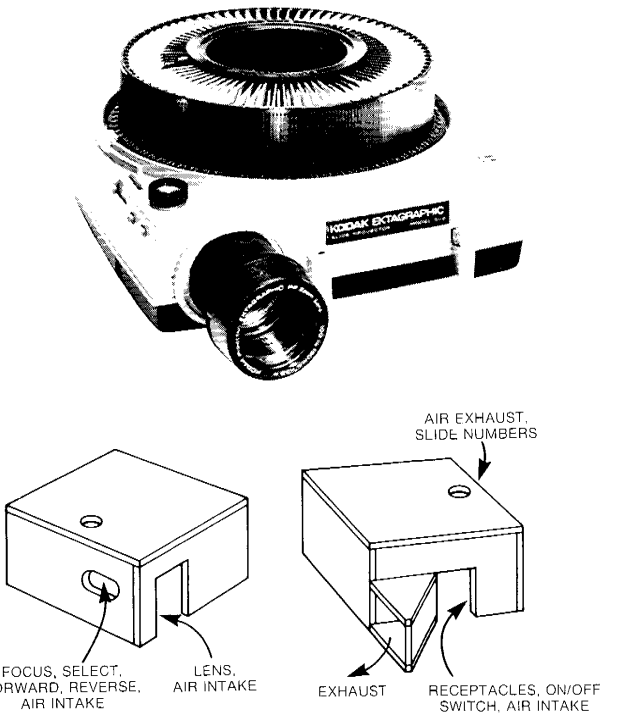
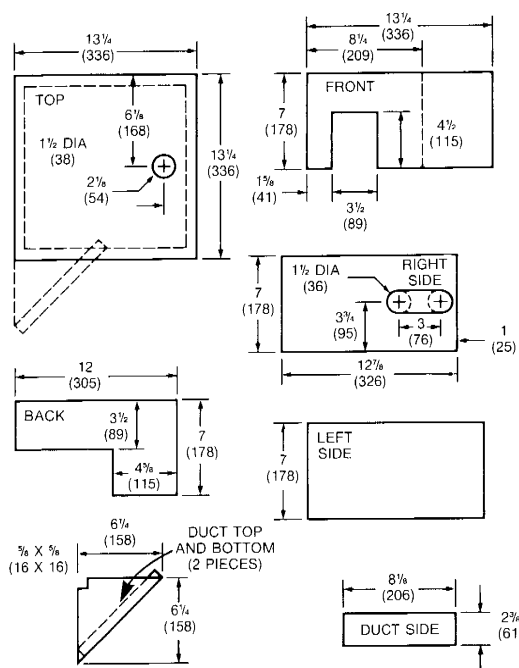


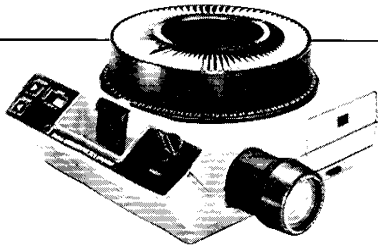
### MAKING BLIMPS FOR EKTAGRAPHIC SLIDE PROJECTORS

The blimp designs that follow should be used only as examples; the dimensions shown apply to typical EKTAGRAPHIC Slide Projectors.

**NOTE:** No blimp plan exists that can accommodate every projector under all conceivable operational conditions.

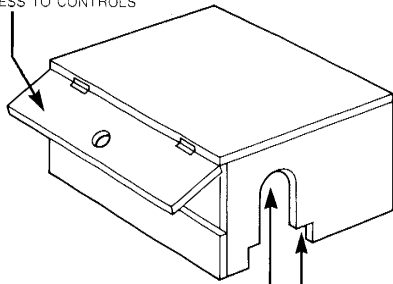
These two drawings show a blimp that can be placed over a KODAK EKTAGRAPHIC Slide Projector, Models E-2, B-2, B-2AR, AF-1, AF-2, or AF-2K. This blimp permits adequate ventilation and provides access to the projector controls and projector remote-accessory receptacle.





## MAKING BLIMPS FOR EKTAGRAPHIC III PROJECTORS

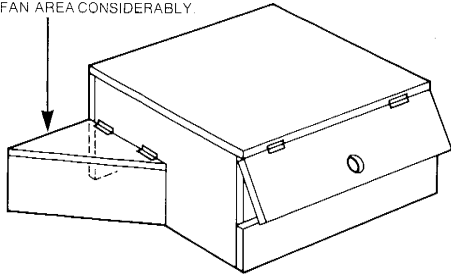
HINGED DOOR PROVIDES  
ACCESS TO CONTROLS



FOR LENS,  
LIGHT BEAM

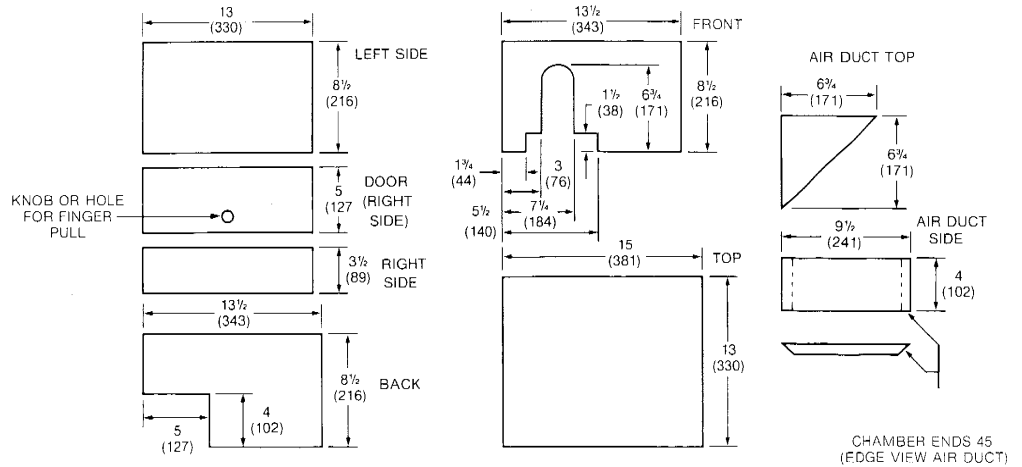
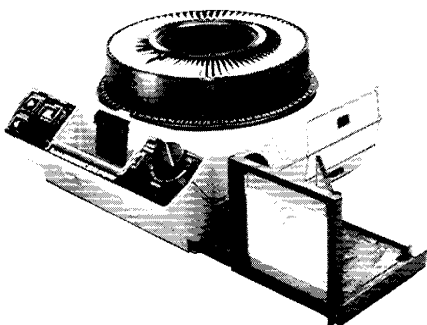
NOTCHES PERMIT USE OF  
BUILT-IN PREVIEW SCREEN

AIR DUCT ADDED IN BACK REDUCES NOISE  
FROM FAN AREA CONSIDERABLY.



The air duct in back reduces noise from the projector fan considerably. The duct can be hinged to permit raising it for access to the projector receptacles or it can be permanently attached (requiring lifting the entire blimp off for access to the projector).

The two notches at the bottom of the arch permit using the built-in viewing screen of *EKTAGRAPHIC III* Projectors having that feature. If the built-in viewing screen of the projector will be used, the front wall thickness of the blimp should not exceed  $\frac{3}{4}$  inch (19 mm). The elevation foot must be retracted if the built-in screen is used.



The inside of the blimp should provide a space 11 1/2 inches (292 mm) long, front to back; 13 1/2 inches (343 mm) wide; and 8 1/2 inches (216 mm) high. These dimensions will permit using the leveling foot and will allow full elevation of the projector, if desired.

If only slight projector elevation or no elevation is required, the height can be reduced 1 inch (25 mm) to 7 1/2 inches (191 mm), and the height of the door can be reduced from 5 to 4 inches (127 to 102 mm).

The arched opening in the front can be squared off, if desired; it will fit over lenses that extend from the front of the projector. The opening provides space for the projector light beam.

**NOTE:** A few commercially available very large diameter lenses (not manufactured by Kodak) may require that you enlarge the opening.

The primary air intake for these projectors is located at the front; the primary exhaust is at the back, with the projector exhaust airstream exiting at approximately a 45-degree angle from the back grill.

**IMPORTANT:** Do not allow either opening in the blimp to be obstructed or restricted.

The two-piece optional air duct at the back will provide additional silencing. Hinging the duct permits raising it for access to the receptacles at the back of the projector, and for viewing the green standby light on *EKTAGRAPHIC III* Projectors.

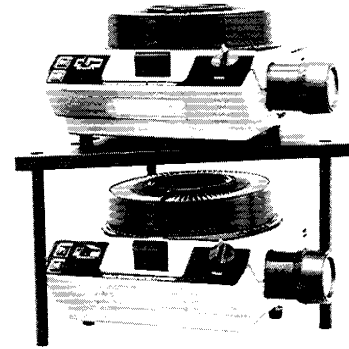
Opening the side door allows direct access to the projector control panel. Use of a remote control for forward, reverse, and focus will allow the door to remain closed for maximum sound deadening.

High-density materials are generally the best for preventing sound transmission. Plywood or chipboard  $\frac{3}{4}$  inch (19 mm)-thick will provide appreciable quieting.

Normally, the projector will be set up for operation and the blimp will then be put over it. The top of the blimp (or a portion of it) can be left unattached or hinged to permit changing trays without removing the blimp. The exterior surfaces of the blimp can be painted, stained, or finished as desired. If the interior has loose particles on the surface (as some insulation board and plywood does), paint it to reduce the chance of dust and particles getting in the slides and into the projector.

## SIMPLE PIGGYBACK PROJECTION STANDS

We suggest that you include in your plans for your next two- or three-projector, single-screen, dissolve show (or two-screen, side-by-side show) a piggyback stand. These stands conserve table space, reduce keystoneing, and simplify image alignment.



### Building a Metal Piggyback Stand

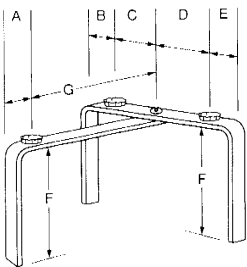
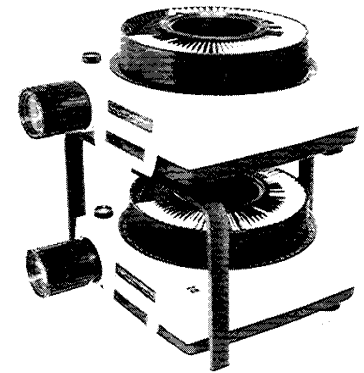
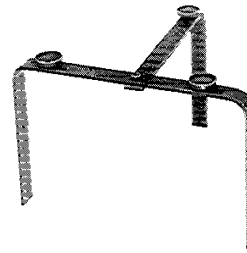
A three-legged piggyback stand can be made from a piece of soft aluminum, 0.25 in. x 1 in. x 6 ft (6 mm x 25 mm x 1.8 m). This material is available at most hardware stores and can be cut with woodworking tools. If you are inexperienced in metalworking, make the pieces a little too long, bend them, and saw them off to fit.

Dimensions for the stand shown here appear in the table below. The dimensions apply to most current projectors.

Either rivet the two pieces together permanently or use a single bolt and wing nut that can be loosened to permit folding the stand. Cups for the projector feet should be at least 0.88 in. (22 mm) in diameter and 0.13 in. (3 mm) deep and riveted or bolted to the bar stock; metal or plastic sliding-door pulls or bottle caps can be used.

Accuracy to within 0.03, or  $\frac{1}{32}$  inch (1 mm), will be sufficient.

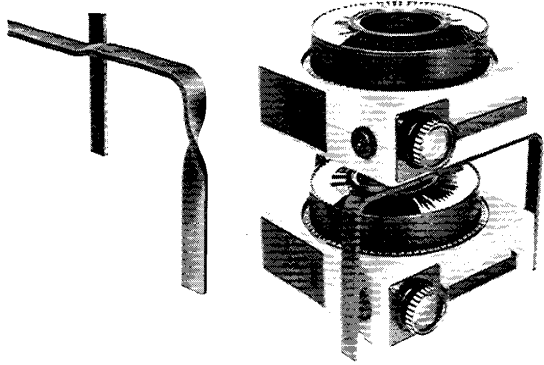
Putting slots in the bar and fastening the cups with screws, washers, and wing nuts will allow you to adapt the stand for all three body styles.



Projector Style	Dimensions						
	A	B	C	D	E	F	G
<b>KODAK EKTAGRAPHIC III Projectors</b>	1.19 (30)	1.38 (35)	4.52 (115)	4.23 (107)	1.38 (35)	8.80 (224)	8.69 (220)
<b>Most KODAK EKTAGRAPHIC Slide Projectors</b>	1.50 (38)	1.75 (44)	3.38 (86)	4.63 (118)	1.75 (44)	8.00 (203)	8.31 (211)
<b>KODAK EKTAGRAPHIC S-AV Projectors</b>	1.56 (40)	0.88 (22)	4.87 (124)	4.87 (124)	0.88 (22)	8.00 (203)	8.25 (210)

Dimensions are in inches and (millimetres).

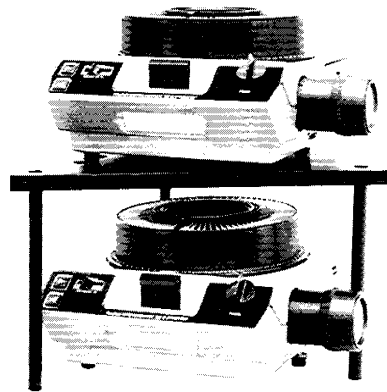
If you do not intend to use S-AV Projectors, you can make the L-shaped front leg 0.25 in. (6 mm) shorter than the back legs, giving a slight downward tilt to the projector.



### Dimensions for Wooden Stand

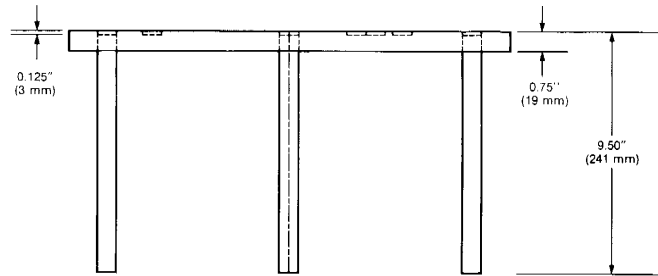
Projector Model	Style	Distance (in./mm)
<b>KODAK EKTAGRAPHIC III Projectors</b>	A-C	8.75 (222)
<b>Most KODAK EKTAGRAPHIC Slide Projectors</b>	A-B	8 (203)
<b>KODAK EKTAGRAPHIC S-AV Projectors</b>	A-D	9.75 (248)

When using the *EKTAGRAPHIC* Slide Projector, Model S-AV2030 or Model S-AV2050, reverse the position of the stand so that the single leg is located at the back. This is necessary because there are two leveling feet at the front of these projectors, while there is just one at the front of Kodak slide projectors made in the U.S. and Canada. (If you turn the stand around for S-AV Projectors, put something under the short leg and twist the short leg 90 degrees as shown, to prevent blockage of the projector exhaust.)



To prevent the stand from scratching the surface of the table or counter, file the leg ends smooth, cover them with tape or 0.25 in. (6 mm) channel (used to set plate-glass windows), or dip them in air-curing plastic.

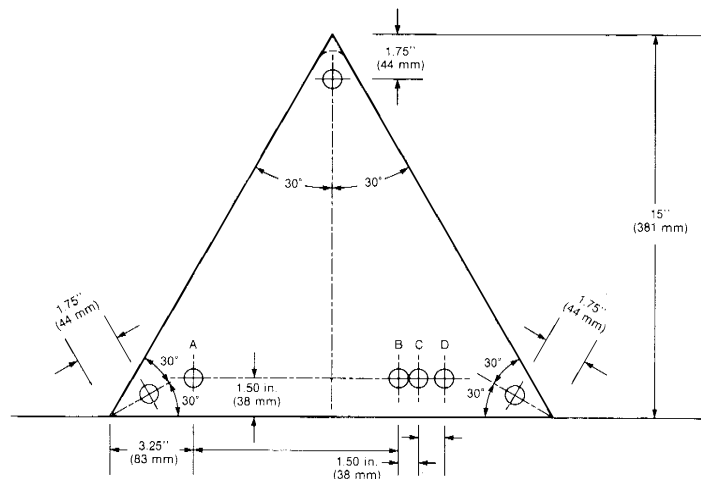
For two-screen (side-by-side) projection (instead of single-screen projection with superimposed images), be sure to align the top projector for the left screen. The space under the stand permits aligning the lower projector for the right screen and changing trays from the rear. (If you attempt to align the lower projector for the left screen, the front leg of the stand may get in the way.)

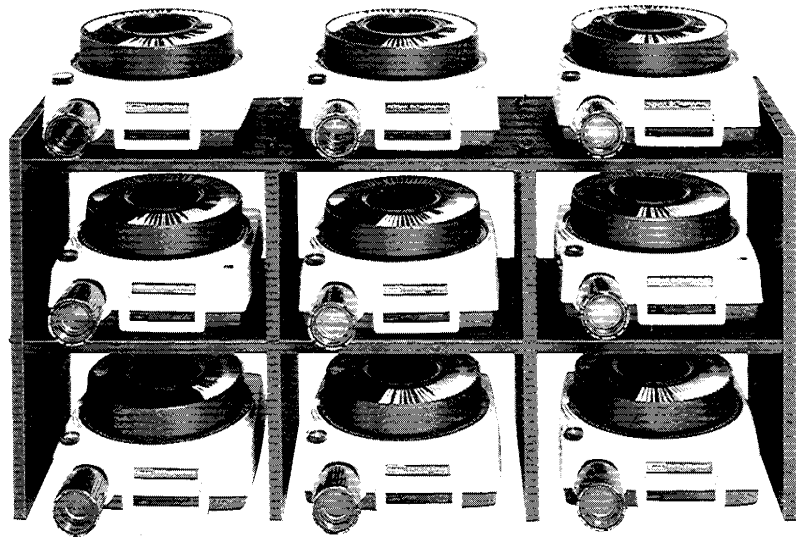


### Building a Wooden Stand

The top of the wooden stand is an equilateral triangle, approximately 17.25 in. (438 mm) on each side, made of 0.75 in. (19 mm) plywood. The legs are 0.75 in. (19 mm) hardwood dowel, each 9.38 in. (238 mm) long. Drill 0.75 in. (19 mm) holes through the top for the legs; glue the legs in with a 0.13 in. (3 mm) recess on top if you want to stack a second stand on top (for a three-projector dissolve show, or a two-projector show with a third projector for background or title slides, etc).

The dimensions appear below.



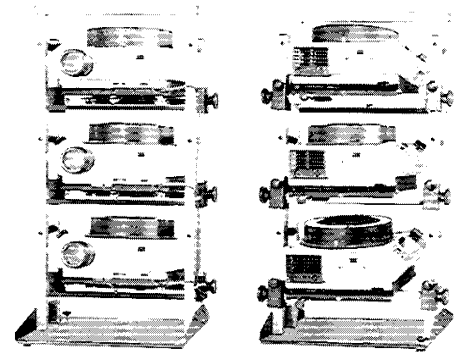


Wooden stands can also be made for large multi-image presentations.

### Commercially Available Projector Piggyback Stands

Piggyback stands for *KODAK* Slide Projectors are made and distributed by these companies. (Not all stands will accommodate S-AV models.)

**NOTE:** Check to see if your projectors will need to be stacked close to or against a back wall, requiring projector alignment (piggyback-stand adjustment) from in front of the stand. (Not all stands have projector-alignment controls in back *and* in front of the stand.)



Two- and three-projector piggyback stands are available in designs similar to the one shown here, manufactured by Chief Manufacturing, Inc.

American Professional Equipment Co.  
2802 South MacDill Ave.  
Tampa, FL 33609

Audio Visual Contractors Co.  
6875 Evans Ave., East  
Denver, CO 80224

Buhl Optical Co.  
1009 Beech Ave.  
Pittsburgh, PA 15233

Chief Manufacturing Co.  
12002 Riverwood Dr.  
Burnsville, MN 55337

Da-Lite Screen Co.  
P. O. Box 137  
3100 State Rd. 15 North  
Warsaw, IN 46580

General Audio-Visual, Inc. (GAVI)  
333 West Merrick Rd.  
Valley Stream, NY 11580

Harry Joseph and Assoc.  
110 West 94th St.  
New York, NY 10025

Kimchuck, Inc., AV Division  
34 Del Mar Dr.  
Brookfield, CT 06804

MacKenzie Laboratories, Inc.  
P. O. Box 3029  
5507 North Peck Rd.  
Arcadia, CA 91006

Media Equipment, Inc.  
7326 East 59th Pl.  
Tulsa, OK 74145

Optisonics HEC Corp.  
1802 West Grant Rd., 101  
Tucson, AZ 85745

Sauppe Media, Inc.  
13034 Saticoy St.  
North Hollywood, CA 91605

Singer Education Systems  
P. O. Box 1371  
3750 Monroe Ave.  
Rochester, NY 14603

Welt Safe-Lock, Inc.  
2400 West 8th La.  
Hialeah, FL 33010

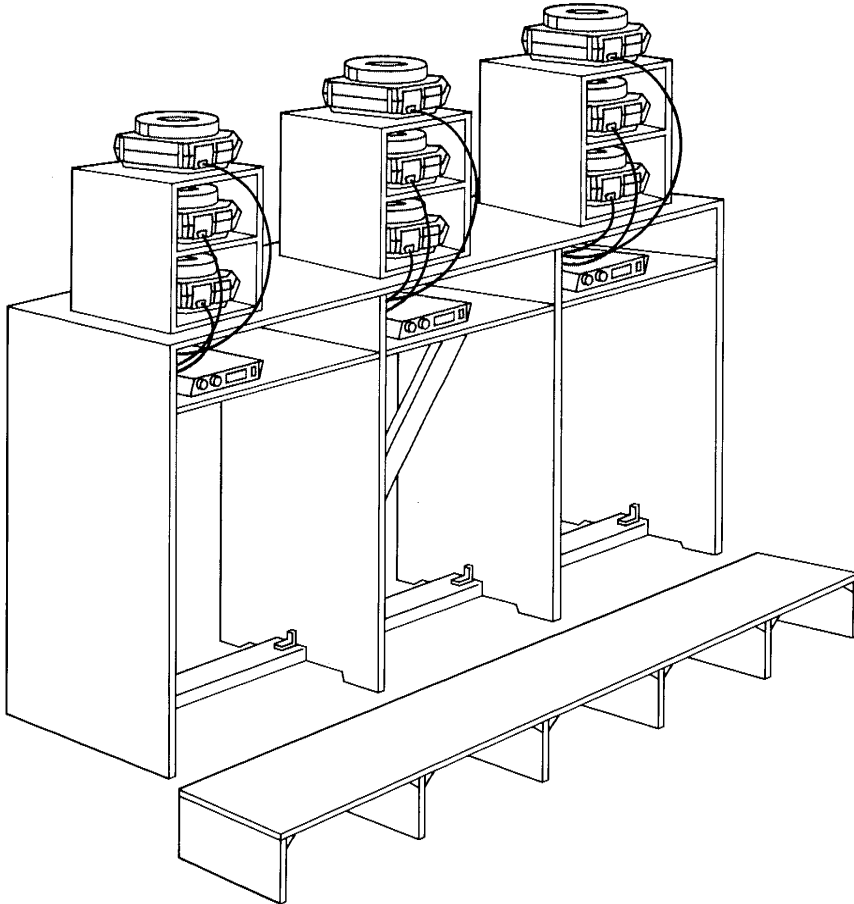
WTI, Incorporated  
22951 Alcade Dr.  
Laguna Hills, CA 92653

## A TABLE AND STEP-UP BENCH FOR MULTI-IMAGE PROJECTION

This projection table can be used almost anywhere that a number of slide projectors are needed to present an audiovisual presentation—from a simple two- or three-projector dissolve show to a dazzling multi-image presentation using 15 projectors.

Of course, any table of sufficient height and length would be acceptable, but such tables are usually hard to find.

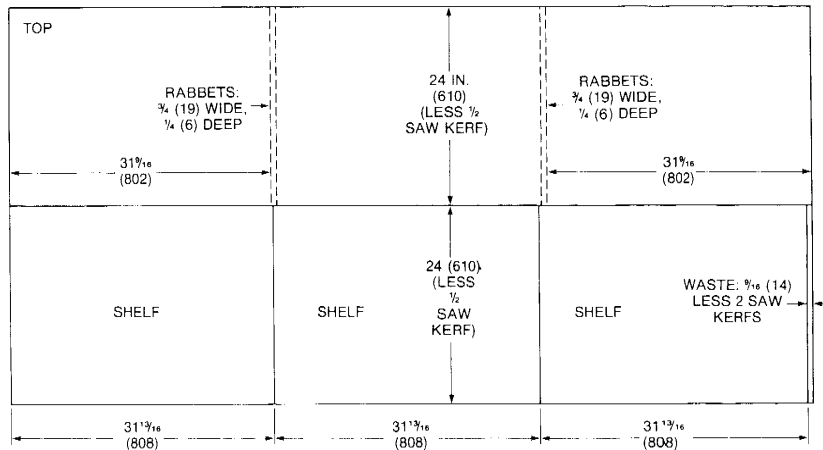
If a very wide projection screen is being used (such as 40 feet [1.22 metres]), more than one of these tables will be needed—unless curved screens are being used.



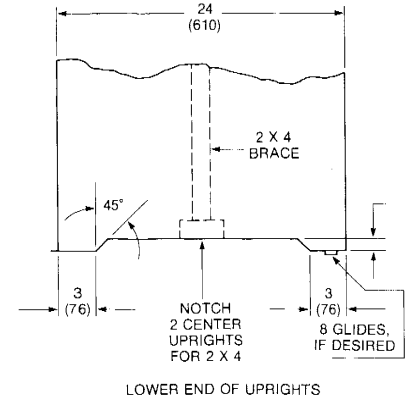
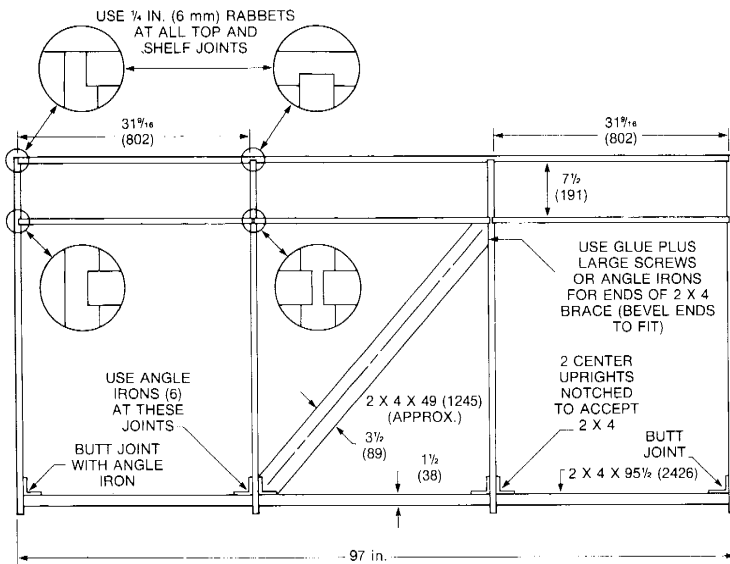
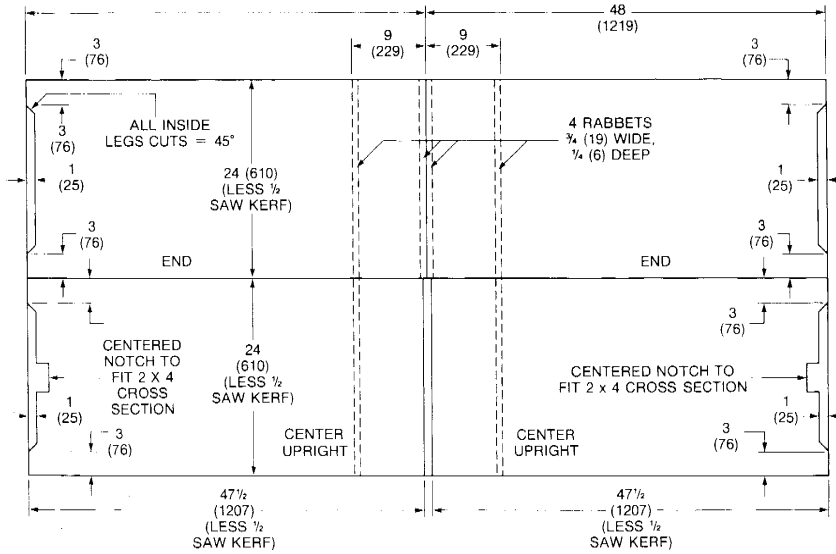
### Materials:

- Two sheets of plywood, 4 x 8 ft. x  $\frac{3}{4}$  in. (1.22 m x 2.44 m x 19 mm)
- One 2 x 4 (nominal) x 95½ in. (38 mm x 76 mm x 2.42 m)
- One 2 x 4 (nominal) x approximately 49 in. (12.45 m) for the brace.
- glue, nails, screws, six angle irons.

The table top will be 48 in. (1.22 m) above the floor. The shelf is normally used for the dissolve-control equipment. The rabbeted joints should be glued and nailed. If desired, enclose the front of the table and paint it; or drape the front and ends.



**MULTI-IMAGE PROJECTION TABLE: CUTTING DIAGRAM FOR  $\frac{1}{4}$  IN. X 4 FT. X 8 FT. PLYWOOD SHEETS**



NOTE: All dimensions are in inches and (mm).

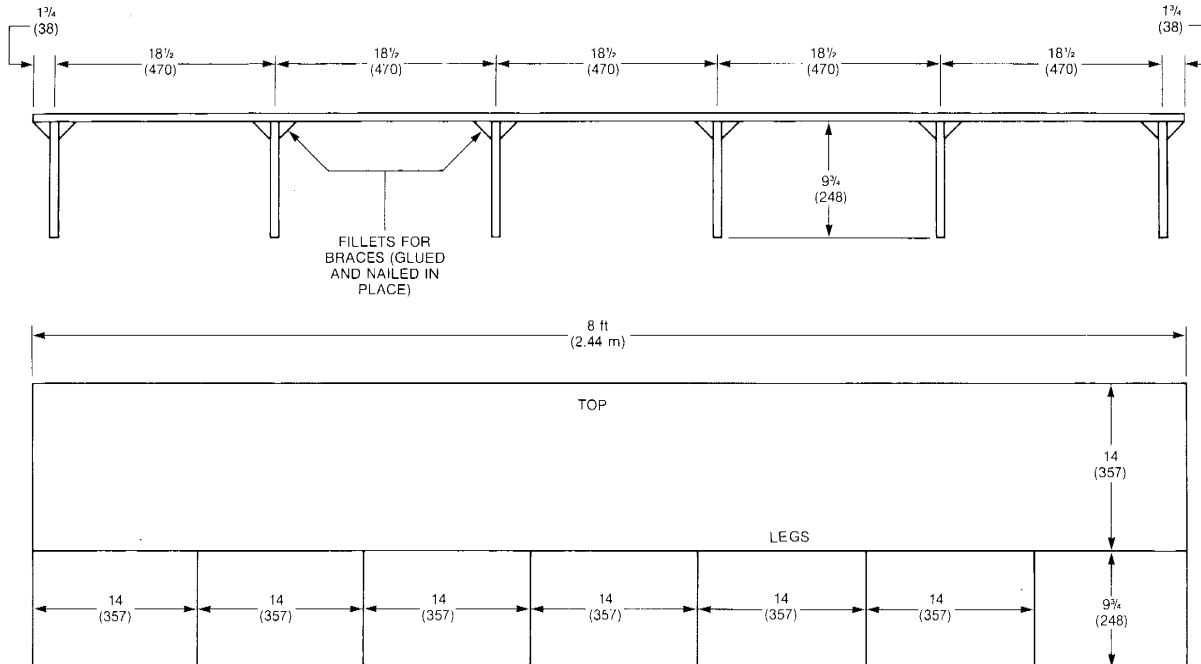
## Step-Up Bench

This 10½-inch (267 mm) high step-up bench allows a sufficient height for the projectionist to reach the top-most stacked projectors for alignment and focusing, changing trays, operating projector controls, etc. Obviously, the height of the step-up bench can be modified depending upon how high the projectors are stacked, how tall the projectionists are, etc.

### Materials

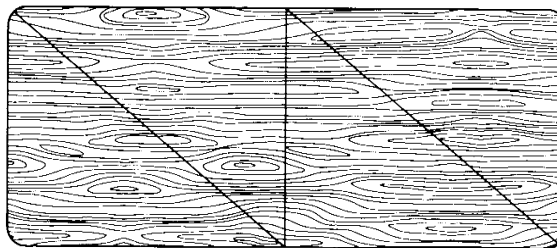
- One piece of plywood, 2 ft. x 8 ft. x ¾ in. (6.10 m x 2.44 m x 19 mm)
- One piece of 2 x 4 (nominal) x 42 in. (1.06 m)
- glue, nails
- paint, if desired

**NOTE: The height of the bench can be modified, depending upon how high the projectors are stacked.**



**CUTTING DIAGRAM FOR ½ SHEET OF 4 X 8 FOOT SHEET OF PLYWOOD RIPPED LENGTHWISE**

**NOTE: Rip 2 X 4 X 42 inch (1067 mm) as indicated to make fillets for bracing the legs. Twelve pieces are needed, each approximately 14 inches (357 mm) long.**





## Mirror, Mirror, on the Floor

Using mirrors for viewing a projected image has some interesting possibilities for application in exhibits, planetarium programs, multi-image displays at expositions, and disco and light shows.

To illuminate the point, Kodak used projectors and mirrors in an audiovisual program called "The Image Pit." at the National Audiovisual Association and Association for Education Communications and Technology conventions in recent years.



The Image Pit takes advantage of a basic characteristic of flat mirrors: They create an illusion of depth equal to the distance between a mirror and a mirrored subject. Slides are projected onto the ceiling, but the audience sees them on mirrors placed on the floor.

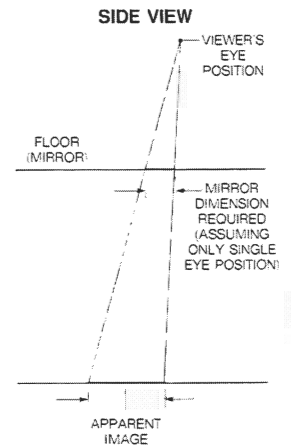
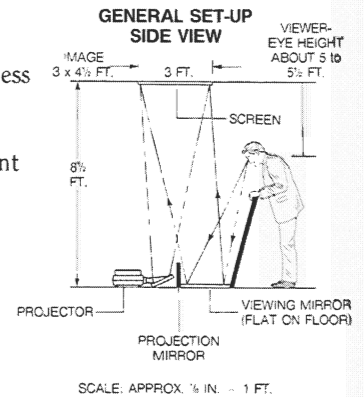
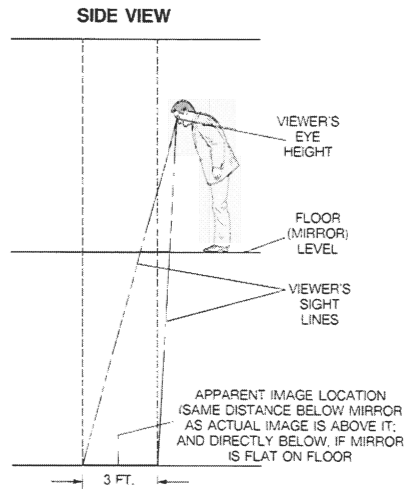
The Image Pit consisted of a mirrored floor (with a railing around it) 9 feet (2.74 m) square, and 12 *EKTAGRAPHIC* Slide Projectors in the center. Spectators looked over the railing and into the mirrors to see the reflection of a multi-image slide program, "Reflections on Professionalism," projected by the 12 projectors onto mirrors located in front of the lenses and then onto a ceiling screen. Because of the mirrored floor, images appeared to be projected on a screen 12 feet (3.6 m) below the floor. (Audio was provided by a four-channel reel-to-reel tape played through loudspeakers located near the ceiling and aimed down toward the audience.)

Planning and building such a mirrored viewing area is adaptable for smaller single-projector and two-projector dissolve programs as well as for more complex multi-image presentations.

Here are the most important considerations to keep in mind when determining mirror sizes and locations for a projection system that uses mirrors for viewing a projected image.

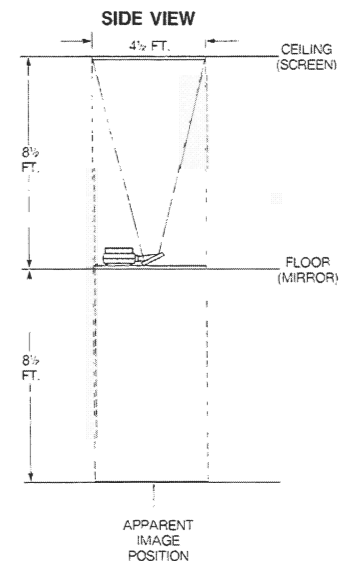
The important dimensions and locations are the viewers' eyes and the apparent image position. (The apparent image position will remain the same, regardless of viewer position.)

The size of the mirror required is determined by where lines from the observer's eyes cross the apparent image location.



If the minimum-size mirror were used, head movement would cut off at least some of the image. The solution is to diagram the *extreme* eye positions expected, and then determine mirror size and location from them, as shown here.

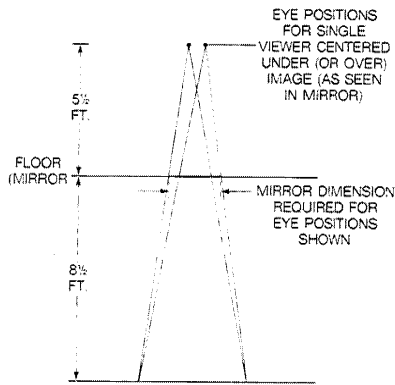
The other dimension of the mirror is determined in the same way.



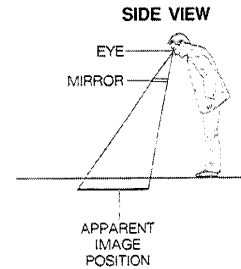
Again, only the viewers' eye position, the mirror plane (floor), and the apparent image position are necessary for the diagram.



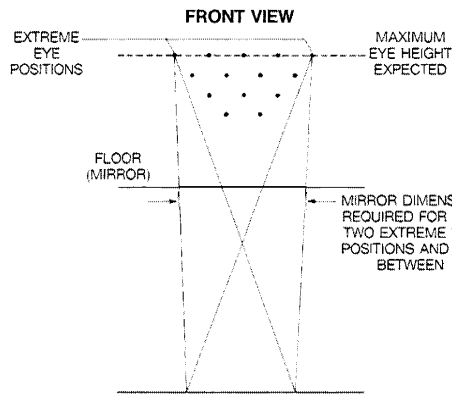
**EKTAGRAPHIC Slide Projectors** were used in "The Image Pit."



The mirror size is calculated in the same way. If the mirror is 4 ft above the floor, the screen will be 4 1/2 ft from the mirror, so the apparent image position will be 4 1/2 ft behind (below) the mirror, or 6 inches under the floor.



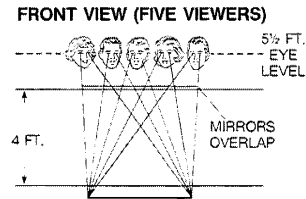
Multiple viewing positions can be indicated, with the extreme positions determining mirror size and location. Note that if the extreme positions are directly over the ends of the apparent image, the mirror needs to be as large as the image. If eyes are outside of the apparent image area, the mirror must be larger than the image dimension in order for the complete image to be seen by people standing to one side.



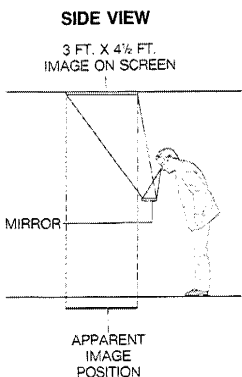
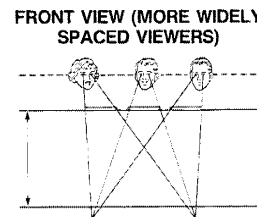
Note that because the mirror is relatively close to the viewer's eyes, his or her height will have relatively more effect on the mirror size required. Thus, a short person would require only a very small mirror; a taller person would require a larger one.

The mirror width can be calculated the same way, remembering that our eyes are about 2 1/2 in. apart, so the mirror will need to be a little wider because of the two different eye locations affecting width.

With several smaller mirrors, keeping the plane of each mirror parallel to the plane of the screen is preferable, to avoid apparently skewed viewing of the image.



If several viewing positions are located close together, a single wide mirror may be required, since all the small mirror positions would overlap. But if the viewing positions are spaced more widely, several small mirrors may be used. The other dimension of the mirror or mirrors would be about the same in either case.



Making the mirrors a couple of inches or so larger than calculated is desirable, to allow for small misalignments in various system components. Note that raising the mirror will reduce the size required somewhat—but this will also mean a new location for the apparent image position (because the mirror-to-screen distance will be reduced). If the mirrors are angled, calculating apparent image position requires somewhat more complicated diagrammatic solutions.

Another possibility is to use several small mirrors—one for each viewer. Each viewer would be positioned to see the complete image in "his" or "her" mirror.

For example, with the same image size (3 ft x 4 1/2 ft) and screen height (8 1/2 ft) a small mirror at a 4 ft height would permit a viewer to see the whole image. Another small mirror, a little further to one side, would accommodate another viewer.

## Keystoning

Wherever multiple projectors are used to display images, keystoning will always be a consideration.

Keystoning is the result of projecting an image onto a screen that is not perpendicular to the light path. It is defined by the angle between a normally rectangular oriented image and the actual one. The resulting image can appear in many forms of geometrical distortion.

Three factors responsible for the amount of keystoning of by an image:

- The angle between the screen and the projection beam.
- The angle of light spread, which is determined by lens focal length.
- The image format (square or rectangular).

In both cases involving angles, the smaller angle gives less keystoning. In the case of the image format for images the same height, the more nearly square the image, the less keystoning there will be.

The mathematical relationship between the parameters is complex, but may be summarized as follows:

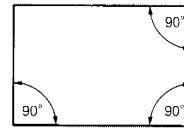
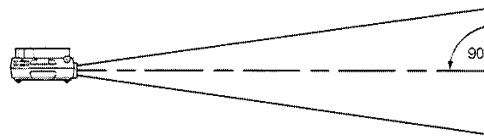
- For images of the same height, the more nearly square they are, the less the keystoning. A slide image with a height-to-width ratio of 2:3 can increase keystoning by 50% over a square image. In other words, an image that keystonees  $5^\circ$  for a square image will keystonee  $7.5^\circ$  for a 2:3 image.
- Lenses decrease keystoning in proportion to their focal length. A 4-inch lens will keystone half as much as a 2-inch lens.
- Changing the angle between the projection beam and the screen has an effect equal to equivalent changes in focal length. Halving the angle from  $20^\circ$  to  $10^\circ$  for a 3-inch lens used with a slide projector changes the keystoning from  $4.4^\circ$  to  $2.2^\circ$ , while doubling the lens focal length to a 6-inch lens at  $20^\circ$  gives the same result:  $4.4^\circ$  to  $2.2^\circ$ . Both halving the angle *and* doubling the lens focal length decreases keystoning from  $4.4^\circ$  to  $1.1^\circ$ .

How much keystoning is tolerable? There is a tendency to answer this question with another one: compared with what?

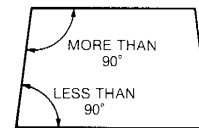
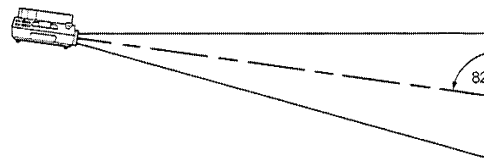
Keystoning may be quite noticeable where images are projected side by side. However, it may not be noticeable for conventional single-image projection. Keystoning can be masked (or hidden) by spilling the image off the screen onto a matte-black border. This technique is often used in large theatres to mask the keystoning caused by high-elevation projection booths. In situations where the keystoning is well masked by overspilling the screen, often the only way to detect the effect is by the subject matter in the image (i.e., the exaggerated lean of a picket fence running across an image could indicate keystoning).

Here are the most important keystoning considerations:

- If the center of the projector beam is at  $90^\circ$  to the screen surface, the image will be rectilinear (correctly appearing).



- If the projector is tilted up or down, or angled sideways, the sides of the image will no longer be parallel.



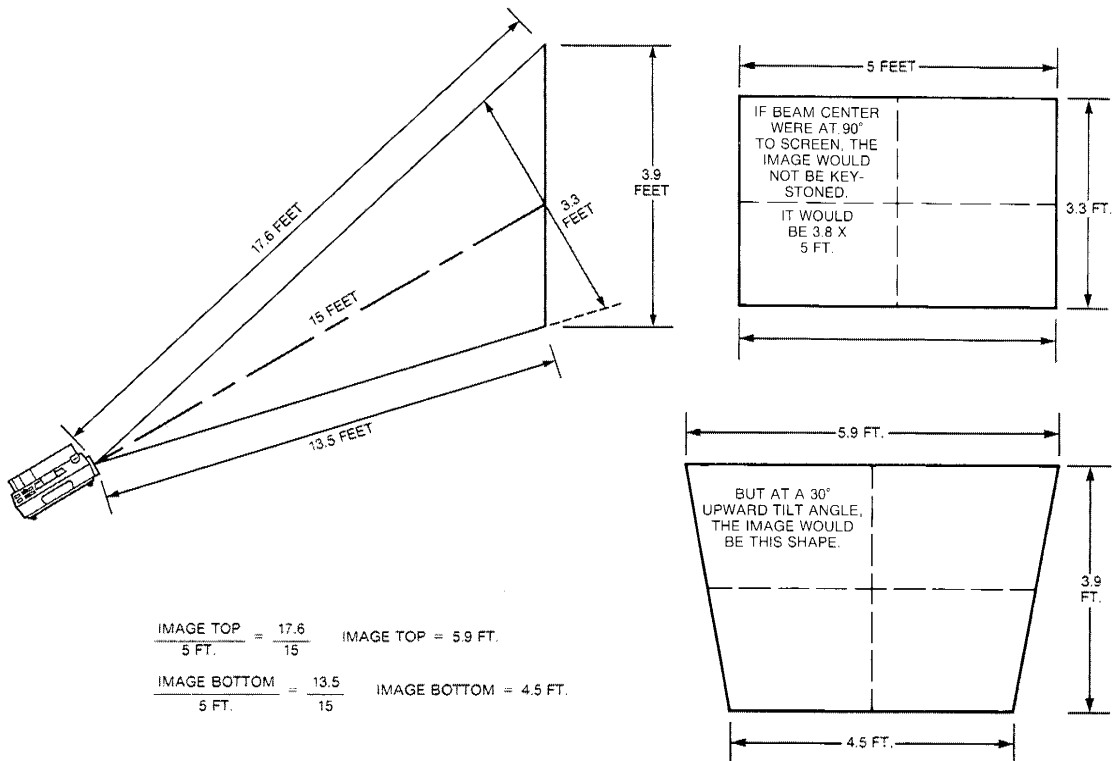
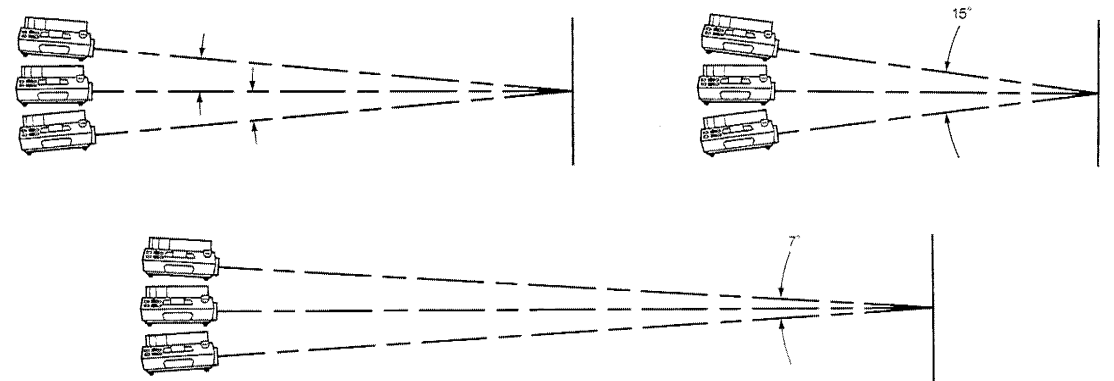
(CONTINUED)

If, as before, the projector is tilted downward, the distance from the lens to the bottom of the screen will be greater than the distance to the top, so the bottom of the image will be magnified more, just as if the projector were moved farther from the screen. If the projector is tilted up, the top of the image will be magnified or enlarged more, and so on. So long as the angular difference between the screen surface and beam center is close to 90°, the differences will not be great.

With three stacked projectors, there will be minimum keystoneing if the center projector is at 90° to the screen as shown here, and the other two projectors are located as close above and below it as possible, to keep the angles of all three beam centers as close together as possible.

*The greater the projection distance, the less beam angle variance, and the less keystoneing will take place.*

The amount of keystoneing can be calculated by laying out the projection distance and angles as shown here. This is a projector with a 135-size slide, 4-inch lens, and 14-foot projector-to-screen distance.



$$\frac{\text{IMAGE TOP}}{5 \text{ FT.}} = \frac{17.6}{15} \quad \text{IMAGE TOP} = 5.9 \text{ FT.}$$

$$\frac{\text{IMAGE BOTTOM}}{5 \text{ FT.}} = \frac{13.5}{15} \quad \text{IMAGE BOTTOM} = 4.5 \text{ FT.}$$