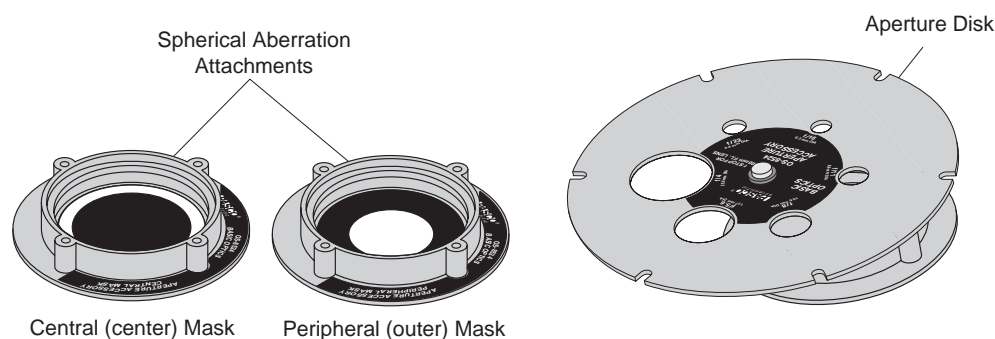


**Instruction Sheet
for the PASCO
Model OS-8524**

APERTURE ACCESSORIES



Introduction

The Pasco OS-8524 Aperture Accessories are designed to be used with the PASCO OS-8515 Basic Optics System.

The Aperture Disk provides 6 holes, corresponding to $f/4$, 5.6, 8, 11, 16, and 22 apertures for a 100 mm lens (included with the PASCO OS-8515 Basic Optics System).

The Spherical Aberration Attachments enables the user to investigate how the center and outside parts of a lens focus light in different planes.

Equipment

This set includes two different accessories to the Basic Optics System (OS-8515):

- An Aperture Disk for demonstrating the f -stops used in cameras.
- Spherical Aberration Attachments for masking the center and outer areas of a lens to show spherical aberration.

Assembly

Simply snap the Aperture Disk, Central Mask, or Peripheral Mask onto a lens from the Basic Optics System. See Figure 1.

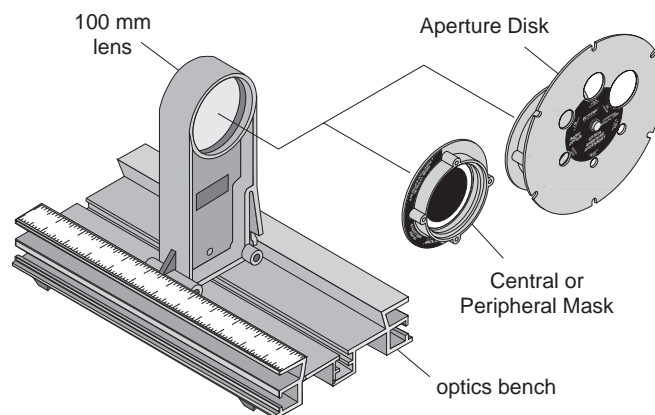


Figure 1: Aperture Accessories Assembly

Aperture Disk

When the aperture size is reduced by one setting, the intensity of the light transmitted through the smaller aperture is half the intensity through the next larger aperture. The 6 apertures on this disk correspond to 6 f -stops as defined in photography. The f -stop is defined as follows:

$$f \text{ value} = \frac{\text{focal length of the lens}}{\text{diameter of the aperture}}$$

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Table 1: Aperture Disk Specifications

f -stop	f -stop calculation	aperture diameter $= \frac{100 \text{ mm}}{f\text{-stop}}$
f -4	$(\sqrt{2})^4 = 4.00$	25.0 mm
f -5.6	$(\sqrt{2})^5 = 5.66$	17.7 mm
f -8	$(\sqrt{2})^6 = 8.00$	12.5 mm
f -11	$(\sqrt{2})^7 = 11.31$	8.8 mm
f -16	$(\sqrt{2})^8 = 16.00$	6.3 mm
f -22	$(\sqrt{2})^9 = 22.63$	4.4 mm

The f values are chosen to be powers of the square root of 2. This disk is designed to be used with a lens of focal length 100 mm (10 cm). See Table 1 for the corresponding f -stops and diameters.

Using the Aperture Disk

To mount the aperture disk to the optics bench (OS-8515), press the mounting ring into the lens holder that contains the 100 mm focal length lens (see Figure 1). To select different apertures, the disk is rotated until it clicks into place with the desired aperture positioned at the center of the lens.

Suggested Experiments for the Aperture Disk:

Show that the intensity of an image is halved with each incremental decrease in aperture size

- Using the 100 mm lens with the aperture disk set on its largest aperture (f -4), focus the image of the lighted object on the screen.
- Use a digital photometer (such as SE-9087) at the position of the screen to determine the intensity of the image. Or use a comparative photometer (such as OS-8520) at the position of the screen (with the screen removed) and find the intensity relative to a second light source.
- Select the next smaller aperture (f -5.6) and measure the new light intensity to show that the light intensity is half of the previous value. Repeat this for all the apertures.

Show how the aperture size affects the depth of field

- Put the screen 50 cm from the light source. Use the 100 mm lens with the f -4 aperture to focus the object on the screen. Check how far the screen can be moved without noticeably changing the sharpness of the image.

- Repeat this procedure using a smaller aperture to show that “stopping down” gives a greater depth of field (i.e., the image will stay in focus over a larger range of screen positions).

Spherical Aberration Attachments

The spherical aberration attachments press into any lens holder in the Basic Optics System (OS-8515).

Suggested Experiments:

Show spherical aberration of a lens

- Use the 100 mm lens to focus the image of the lighted object on the screen.
- Put the outer-mask spherical aberration attachment on the lens and refocus the image by moving the screen. Note which way the screen must be moved to bring the image into focus.
- Put the center-mask spherical aberration attachment on the lens and refocus the image by moving the screen. Note which way the screen must be moved to bring the image into focus. Are the rays that pass through the outer edge of the lens bent more or less than those that pass through the center portion of the lens?

Show color aberration

- Use the 100 mm lens with the center-mask to focus the image of the lighted object on the screen.
- Move the screen away from the lens until the image is blurred. What color does the image appear to be?
- Move the screen toward the lens passing through the focused point until the image is blurred again. Now what color does the image appear to be? Which color (red or blue) is bent more as it passes through the outer part of the lens?

Limited Warranty

PASCO scientific warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. PASCO will repair or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. This warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment, after repair, will be paid by PASCO scientific.

To Reach PASCO

For Technical Support call us at 1-800-772-8700 (toll-free within the U.S.) or (916) 786-3800.

email: techsupp@PASCO.com

Tech support fax: (916) 786-3292

Equipment Return

Should this product have to be returned to PASCO scientific, for whatever reason, notify PASCO scientific by letter or phone BEFORE returning the product. Upon notification, the return authorization and shipping instructions will be promptly issued.

► **NOTE: NO EQUIPMENT WILL BE ACCEPTED FOR RETURN WITHOUT AN AUTHORIZATION.**

When returning equipment for repair, the units must be packed properly. Carriers will not accept responsibility for damage caused by improper packing. To be certain the unit will not be damaged in shipment, observe the following rules:

- ① The carton must be strong enough for the item shipped.
- ② Make certain there is at least two inches of packing material between any point on the apparatus and the inside walls of the carton.
- ③ Make certain that the packing material can not shift in the box, or become compressed, thus letting the instrument come in contact with the edge of the box.

Notes: