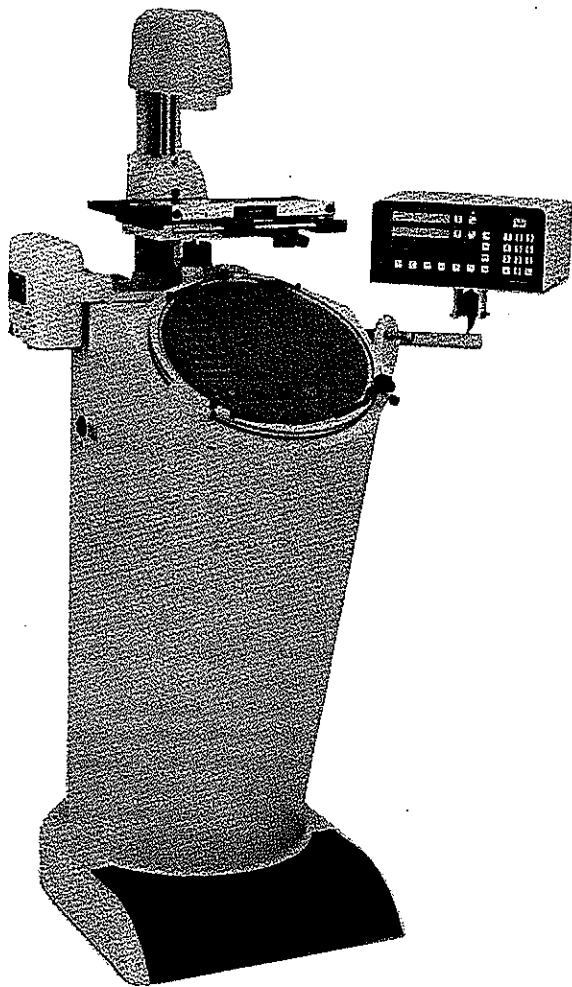


ST INDUSTRIES, INC.

INSTRUCTION MANUAL

20-1500 SERIES 14" VERTICAL BEAM COMPARATOR



20-1500-00 shown
with 2" x 6" stage, surface illumination
and QUADRA-CHEK II display.

The SCHERR-TUMICO 14" Vertical Beam Comparator is the most versatile and universal comparator available.

This rigid floor standing unit offers superior optics with a range of magnification lenses from 5x to 250x and a built-in telecentric condensor lens system. The basic unit is available with a fixed protractor ring and as an option a 1 minute or 5 minute protractor ring is available, along with a variety of 2" x 2" or 2" x 6" stages, surface illumination and a large selection of fixtures and attachments.

Made in U.S.A.

ST INDUSTRIES, INC.

301 Armstrong Boulevard North / St. James, MN 56081-0029
Phone (507) 375-3211 / FAX (507) 375-4503 / Telex 503048

INSTRUCTION MANUAL

INTRODUCTION

This manual contains the instructions for the installation, operation and maintenance of the SCHERR-TUMICO 20-1500 series vertical beam comparator.

Due to the S-T Industries policy of continued improvement of products, the right to change without notice is reserved. The information contained in this manual may vary somewhat from the machine with which it is to be used.

Numerous safety features have been designed and built into this machine. These safety devices should never be altered or removed without first consulting S-T Industries.

To fully utilize the capabilities of this machine, a comprehensive study of this manual is essential.

The 20-1500 series comparator has been designed to provide many years of reliable service.

A wide range of optional, standard staging fixtures are available as described in this manual. Special staging fixtures are available upon request.

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20-1500 Series Nomenclature

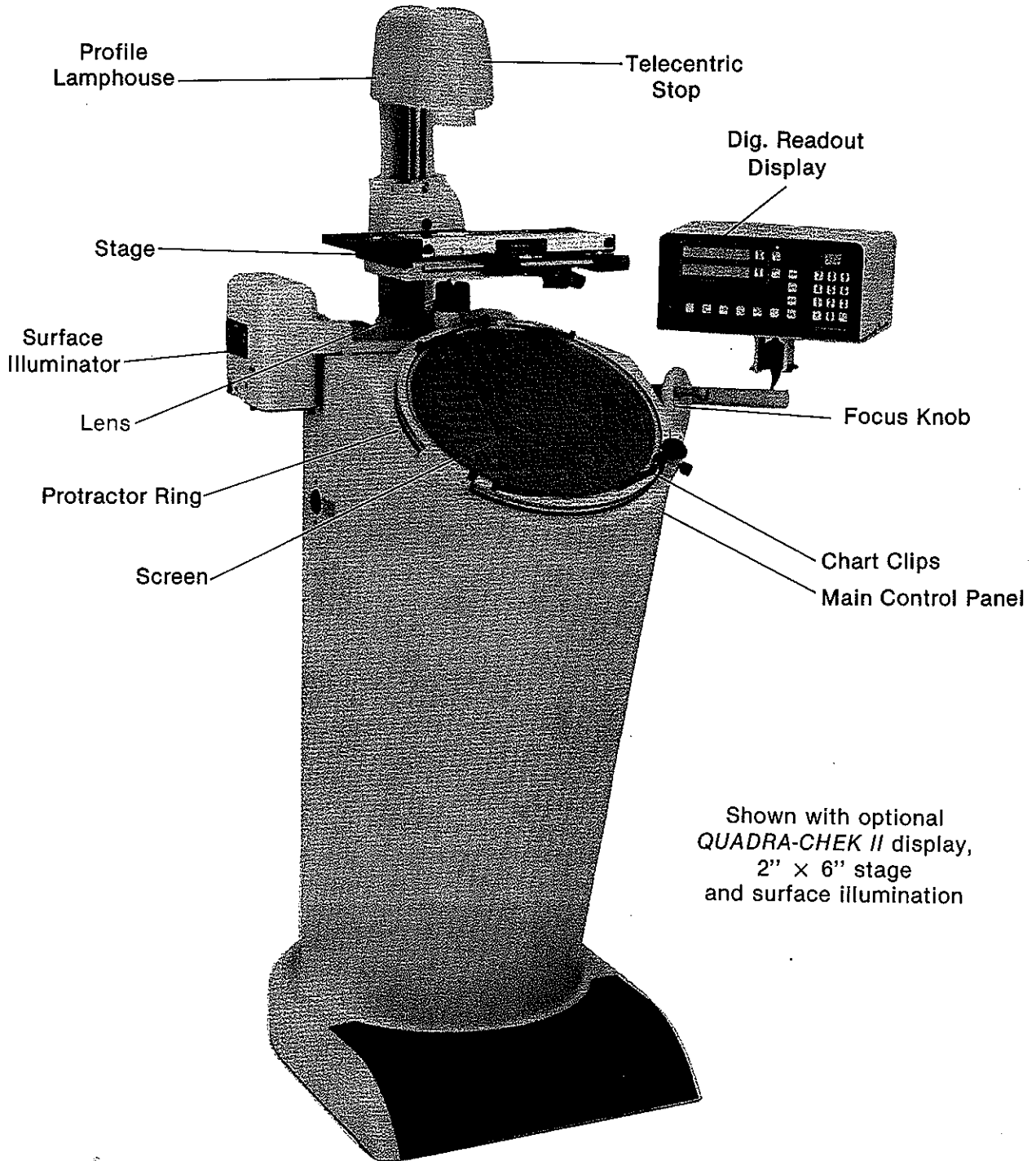


Figure 1

SPECIFICATIONS

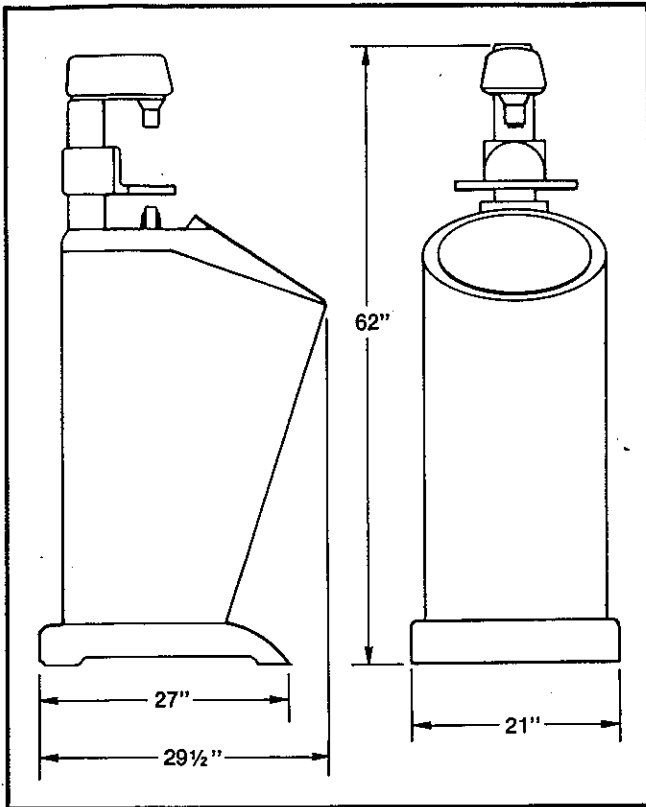


Figure 2 Outline Dimensions
Outline 20-1500

Machine Dimensions

Screen Diameter	14.00"	(355.6 mm)
Comparator Length	29.50"	(749 mm)
Comparator Width	21.00"	(533 mm)
Comparator Height	62.00"	(1575 mm)
Footprint Length	27.00"	(686 mm)
Footprint Width	21.00"	(533 mm)

Work Table

Length	8.75"	(222 mm)
Width	6.75"	(172 mm)
Allowable Workload on Stage	100 lbs.	(45 Kg.)

Measuring Capacity

Cross Slide	2.00"	(51 mm)
Horizontal	6.00"	(153 mm)
Focus	5.00"	(127 mm)
Helix	± 20°	
Angular (1 or 5 min. vernier)	360°	

Magnification Lenses

5x, 10x, 20x, 31¼x, 50x, 62½x, 100x, 250x

	MAGNIFICATION						
	5X	10X	20X	31¼X	50X	62½X	100X
Effective Field	2.8"	1.400"	.700"	.448"	.280"	.224"	1.40"
Focal Clearance	1.9"	2.7"	1.25"	.82"	2.9"	2.5"	1.25"
O.D. of Lens Housing	3.0"	2.0"	1.125"	.84"	.70"	.70"	.70"
Max. Work Diameter—Half Field	3.9"	8.3"	3.3"	2.0"	12.0"	12.0"	4.8"
Max. Work Diameter—Full Field	3.8"	6.0"	1.7"	1.7"	12.0"	12.0"	4.1"

Figure 3-A Lens Specifications

Electrical

Voltage	115 volts, 50 or 60 cycle
Phase	Single
Current	8 amperes
Profile Bulb	150 watts, 20 volts
Surface Illuminator Bulbs	500 watts, 115 volts

Weight

Comparator	250 lbs.	(114 Kg.)
Crated Comparator	310 lbs.	(141 Kg.)

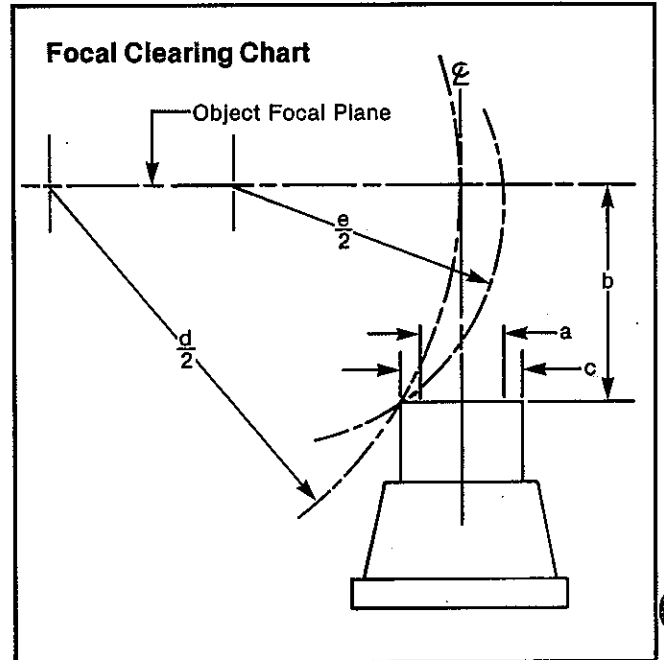


Figure 3-B

INSTALLATION

Introduction

The 20-1500 Series Instruction Manual should be kept at the comparator at all times for reference by operators. Exploded views of various machine components are shown, simplifying parts ordering and maintenance.

All inquiries regarding this machine should include model and serial numbers. This information can be obtained from the main control panel switch plate located on the front, right side of the machine.

Any damage, either to the shipping carton or crate or to the contents, should be documented immediately upon receipt of the machine. An inventory of the contents of the carton or crate should be checked against the packing list and any irregularities noted.

Unpacking

1. Remove plastic protective cover.
2. Place the crate on its back and remove the two bolts securing the base of the comparator to the bottom of the crate.
3. Return the crate to an upright position and remove the accessory packages.
4. Remove the steel band securing the comparator to the back of the crate.
5. The comparator may now be removed from the crate.

Initial Setup and Alignment Procedure

The operator section of the 20-1500 Series Instruction Manual should be read before proceeding with the initial setup. A familiarization of this section will simplify the following instructions. Reference to exploded view drawings and parts lists will also be helpful.

1. Remove cardboard dust cover from screen mounting opening. Carefully, remove paper covering over mirror.
2. Inspect mirror for excessive dust. A small amount of dust is not detrimental. If cleaning is required, refer to the Maintenance section under "Optical Care".
3. Install stage using shoulder bolt in post clamp. If stage uses mic heads, install them into head mounts and secure with one screw. CAUTION: DO NOT overtighten set screw or binding of the micrometer head will result.
4. Install surface illuminator, if available, referring to "Installation of Surface Illuminator" section. Plug cord into socket located on the left side of the machine.
5. Remove dust cover plug from the lens opening and install lens. Refer to Operation section under "Lens Identification and Mounting".
6. Install screen in the protractor ring with frosted side OUT and align referring to the "Screen and Chart Calibration" section.
7. Plug in main power cord.

Installation and Use of Accessories

Protractor Ring—The following instructions apply if the protractor ring is not purchased installed on the machine but must be installed later. Figure 4.

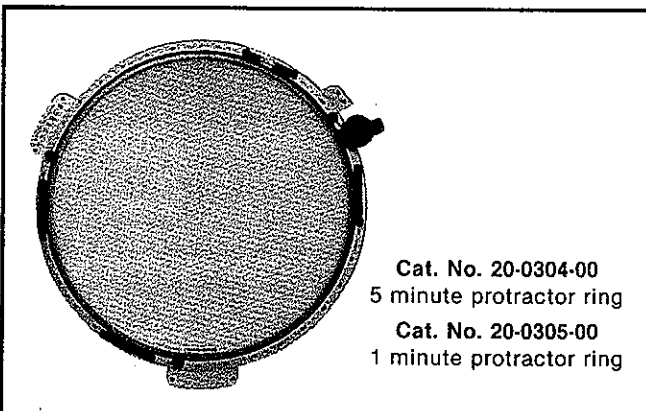


Figure 4

Remove the three flat head screws, clips, and screen mount ring from the comparator. The three drilled and tapped holes remaining in the top casting are used for bolting on the protractor ring roller housings. Install the adjusting knob and roller housing on the lower right hand side of the comparator and tighten the mounting bolt. Then install the upper roller housing which carries the dummy vernier plate on the bottom side of the comparator opening and leave the bolt about one-half turn loose. Then lay the protractor ring in place and install the lower left

hand roller housing which carries the vernier plate and leave about one-half turn loose. The protractor ring may be raised or lowered slightly to clear the casting by swiveling these housings around the bolts before tightening the bolts fully. Finally, adjust the vernier plate and dummy vernier plate up to the protractor ring and tighten the two retaining screws in each one.

2" x 6" Travel Stage With Digital Readout Cat. No. 20-1532-07, 20-1532-08 and 20-1532-09

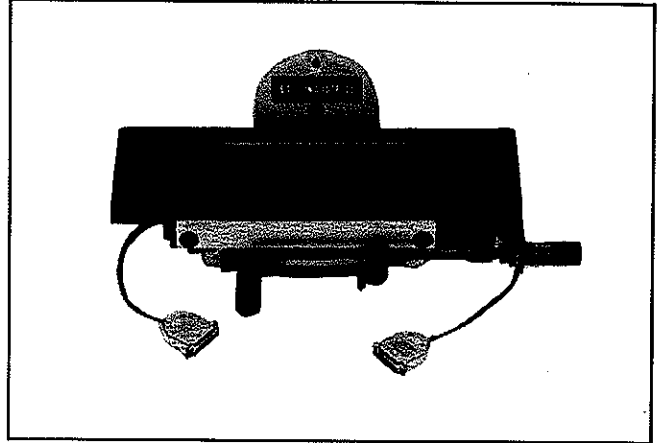


Figure 5-A

The 2" x 6" travel stage has a 6" x 16" top plate with a 4" x 8" glass working area. This stage has precision glass scales for readings to .0001"/.002mm. Stage has manual leadscrews to traverse the full 2" x 6" range. The leadscrew on the 6" axis has a quick release feature that allows fast travel to the approximate point of measurement and fine adjustment.

To use quick release, loosen clamp on leadscrew and slide stage to desired location. Tighten clamp and use fine adjust on right end of leadscrew to precisely position stage.

Display arm is included with stage and is mounted with 4 bolts to the right side of the comparator, near the power switch. The glass screen must be removed so the nuts can be tightened on the inside. Be sure to have the power disconnected when working inside the comparator.

For pre-1967 "1500" series comparators, holes must be drilled to accept the display arm. S-T Industries will provide a template to facilitate drilling the holes. Be sure to disconnect the power before working inside the comparator and carefully cover the mirror with a towel before drilling the holes in the side of the machine.

The stage is supplied with choice of three digital readouts: standard X-Y readout, *QUADRA-CHEK II* or *QUADRA-CHEK III*. See manual for readout for complete operation instructions.

2" x 6" Travel Stage Cat. No. 20-1532-01 and 20-1532-03

The 2" x 6" travel stage has a 6" x 16" top plate with a 4" x 8" glass working area. This stage has a unique built-in gage rod turret for the 6" range and a swing-in gage rod for the 2" range, eliminating the need for end measuring rods. Two types of micrometer heads are available, either 2" diameter forward and reverse reading direct to .0001" or 3" diameter forward and reverse reading direct to .0001" with a zeroing feature and non-rotating spindle.

NOTE:

Stages are available with metric reading mic heads.

20-1532 2" x 6" Travel Stage

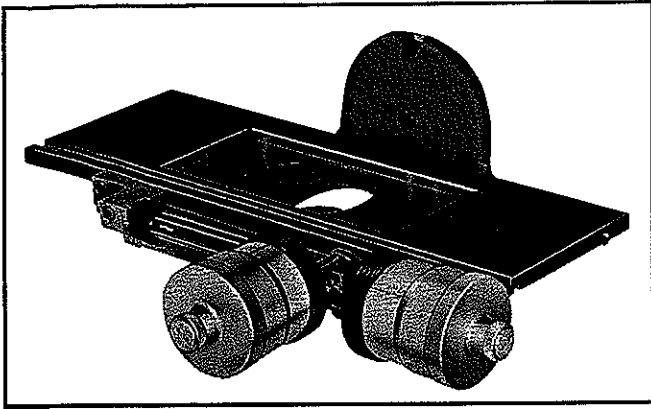


Figure 5-B

See Figure 5-B. The 2" x 6" stage has its own work platform built within. Remove shipping clamp before installing stage.

The stage is bolted to the column slide by a single shoulder socket head screw allowing it to tilt for helix angle, etc. In order to set the pointer on the zero mark for tilt of the stage, a scale or rod may be laid lengthwise on the stage and as the stage is moved back and forth over the 6" range, adjust the tilt of the stage until the object is in sharp focus at both ends of the range. If the stage centers are with the stage, these may be used for this purpose.

A tall square object can be used as well. Example: Place 2" gage block on stage glass. If the shadow on one side is greater than on the other, this would indicate that your stage is not true perpendicular to your lens. Tilt stage until all sides of gage block image are the same sharpness in image.

Stage centers for 2" x 6" stage are mounted on top of stage by means of inserting dovetailed hold down bolts in dovetail of stage.

NOTE:

Right and left hand sides—stage centers serve as vee blocks as well.

When using the stage centers, be sure the bottom mounting surfaces of the stage center blocks and the dovetail groove mounting surfaces of the stage are clean before sliding the blocks onto the stage. The three sets of V-support pads for the center mandrels correspond to 0-2", 2-4", and 4-6" diameter work.

The stage glass is installed with the corner having the largest chamfer at the right hand rear corner of the opening in the stage. If a replacement glass is to be installed, the top of the glass may be brought flush with the top of the table using a depth micrometer for checking and by adjusting the supporting flat head screws under each corner of the glass while the glass is in place. The cone point set screws at the two rearward corners can then be adjusted to remove any shake from the glass. Do not adjust to hold the glass firmly as the glass will have to be removed when using certain powers of projection lens with work on the stage centers.

In using the gage rod turret, the ends of the rods should be kept clean. Be careful not to let the stage bump heavily against the micrometer heads and rods when moving from one

rod to the other. Be sure the gage rod and spacer are seated at both ends before using the micrometer head by rotating the turret slightly.

The spring clips from the screen of the projector may be used in the 4 holes (#8-32NC-2) in the top plate of the stage. The two rearward holes may be used for bolting down the Universal Staging Fixture (Catalog No. 20-0650) if one is used.

2" x 2" Travel Stage Cat. No. 20-1515-01 and 20-1515-03

The 2" x 2" travel stage has a 6" x 6" top plate with a 4" diameter glass working area. Two types of micrometer heads are available, either a 2" diameter forward and reverse reading direct to .0001" or a 3" diameter forward and reverse reading direct to .0001" with a zeroing feature and non-rotating spindle.

NOTE:

Stages are available with metric reading mic heads.

22-1515 2" x 2" Micrometer Measuring Cross Slide

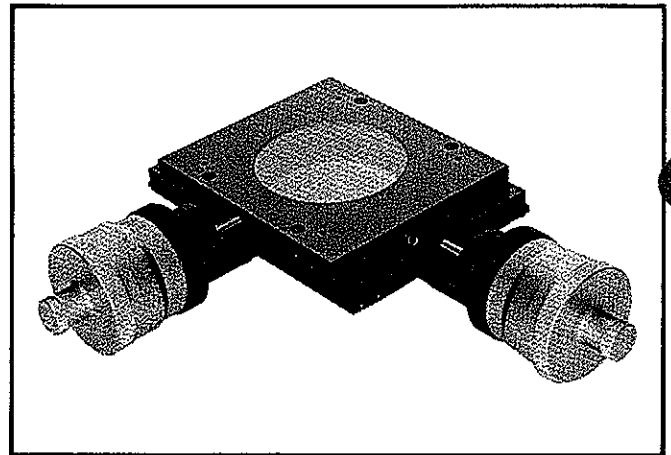


Figure 6

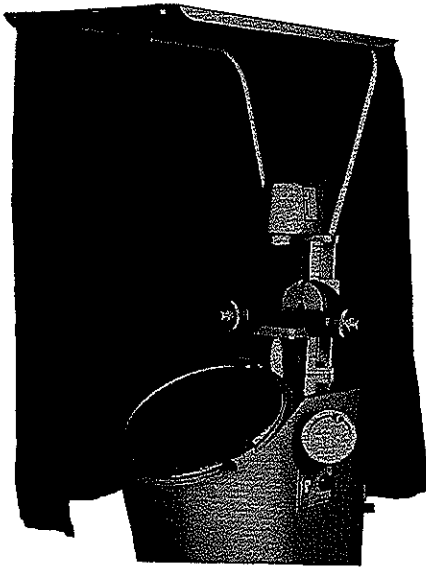
See Figure 5. In unpacking and installing the micrometer cross slide, do not let the slides bump hard against the stops or micrometer heads as this will damage them. Remove the stage glass from the platform of the comparator and bolt down the micrometer cross slide using the two 1/4-20NC cap screws furnished. Align the cross slide to the platform by eye. Then tighten screws.

The top surface of the cross slide contains four Number 10-32 NF tapped holes to facilitate the mounting of holding fixtures and also the Universal Staging fixture (20-0994). The spring clips from the screen may also be used to hold flat work.

For 1" to 2" travel, on 2" x 2" stage, insert a 1" gage block between the micrometer spindle and the cross slide anvil button.

Installation of Curtain Canopy

See figure 7. The curtain canopy is held to the bottom of the lamphouse at the air intake opening by the two bolts and clamp bar furnished. To install, first remove the lamphouse cover and then secure the curtain canopy by running the two bolts up through the air intake opening to the clamp bar. Finally replace the lamphouse cover.



Cat. No. 20-0380-00
Sliding curtain canopy

Figure 7

Installation of Surface Illuminator

To install 20-0338 Surface Illuminator, remove projection lens and knurled thumb screw on right side of the projection lens hold down thumb screw. In use, two beams of light are reflected up along the front and rear sides of the projection lens to a single spot on the object to be illuminated. Since the distance from the focal plane to the top of the comparator varies for the different magnifications, it is necessary to rotate the mirrors of the surface illuminator to form a single spot of light at the correct height when changing projector lens. To do this place a coin on the stage that will cover the complete screen—half dollar for 10x magnification, dime for 20x magnification—and rotate the mirrors as required, to give maximum brightness of image on the screen.

Screen and Chart Calibration

The following procedure is required to insure the exact centering of the screen or chart in the protractor ring. The use of a 10X or 20X lens is preferable in this procedure.

1. Set a pointed object (such as a scribe or edge-finder) on the stage in a holding fixture with the point up.
2. Set the stage helix to zero.
3. Set the protractor ring to 0° and lock in place.
4. Loosen the screen retaining clips.
5. Rotate the screen until the trademark is at the bottom and the horizontal line is nearly horizontal as judged by the eye.
6. Turn on the profile illumination.
7. Focus the point on the screen.
8. Move the point until it touches the horizontal line at one place.
9. Move the point back and forth with the horizontal stage motion and rotate the screen until the point just touches the line all the way across the screen.
10. Lightly tighten the screen clips.
11. Remove the pointer from its holder.
12. Place a square cornered object (such as a 6" rule or machinists' square) in a holding fixture on the stage.
13. Adjust the stage and square until its horizontal edge aligns to the screen horizontal line, and the vertical edge aligns to the screen vertical line.

14. Unlock the protractor ring.
15. Rotate the protractor ring 180°.
16. If the screen vertical line does not align to the square's vertical, use the pusher screws in the protractor ring edge at the 40° and 130° positions to move the line half of the alignment error. (These screws are accessible from the sides when the 40° and 130° marks are opposite the front casting notches at the horizontal position.)
17. If the screen horizontal line does not align to the square's horizontal, use the pusher screws in the protractor ring edge at the 220°-310° positions to move the line half of the alignment error. (These screws are accessible from the sides when the 220°-310° marks are opposite the front casting notches at the horizontal position.)
18. Reset the square to fit the quadrant with the protractor at 180°.
19. Turn the protractor ring back to the 0° position.
20. Note the vertical and horizontal error and use the pusher screws to align half the error in this quadrant.
21. Repeat steps (13) through (20) until the square fits both quadrants; then tighten the screen clips.

CAUTION:

Be careful NOT to overtighten the screen pusher screws or the screen may be damaged.

Lens and Mirror Calibration

Lens and mirror adjustments should be attempted only by qualified, competent service personnel. The following procedure is primarily for reference.

Use of the Magnification Checker

After the projector has been set up and the mechanical movements operate satisfactorily, the screen image magnification should be checked. In set-up of new projectors this is done to check that the mirror in the projection system has not been shifted due to shipping shock. This check should also be made if the projector has been moved to another location in the same plant. After the projector has been in use awhile, this check should be made periodically to make sure that the projection lens magnification has not been changed by dropping the lens or the lens being bumped by the stage or work object. If a new lens is purchased for the projector at a later time, then it is well to check its magnification to make sure it matches the projector perfectly.

If the projector has an adjustable telecentric stop, it is set according to the manufacturer's manual for the lens magnification to be checked. The block with the master balls is then placed on the stage and a ball size selected which will give an image diameter on the screen of approximately 70 percent of the screen diameter. This would be approximately a 9" to 10" image for the 14" screen projectors and a 19" to 20" image for the 30" screen projectors. For a few odd magnifications and screen sizes, a jo-block must be used for an object. For instance the 5X on the 30" projector requires a 4" jo-block. Other sizes are marked on the glass checking scales. If a jo-block is used it must be squared to the optical axis of the light beam or a false image size will result. The ball selected is first focused sharply in the center of the screen. On projectors with an adjustable telecentric stop, the ball may first be focused with the stop wide open and then the stop closed to the normal position. Measure the ball top to bottom and side to side. The glass scale arc-line traceable calibration is measured from the center of arc-line to center of arc-line. Therefore the scale should be used by first placing the center of one arc-line on the O.D. of the image. This first arc-line would show .002" high

cogging effect due to the broken arc-line. The other side of the image should then fall within the .004" line width of the other arc-line. The image would then supposedly be within $\pm .002$ " for screen magnification. Sometimes a low power hand magnifying glass can be used to help see the lines.

After the projector screen image has been brought to size for the 70 percent screen diameter image and the side to side and top and bottom image size is okay, it is well to check the image size at the edge of the screen at 45 degree chordal orientations also; i.e., as of along the sides of an octagon. Be sure the glass scale is always the same distance from the edge of the screen; otherwise if the lens has appreciable distortion, different readings will result, depending on the distance of the scale from the edge of the screen. If a jo-block is used for an object and is turned from vertical to horizontal, etc., and refocused each time, the focusing must be done very carefully; otherwise apparent image size changes will be introduced, depending on the change in distance of the jo-block from the projection lens. This is also true if the ball checker is slid by hand. Also, if one side of the jo-block is closer to the projection lens than the other side, then an apparent keystoneing of the image could be introduced. It is best to check the mirror setting using the ball checker and stage motions, and use a jo-block only to check lens magnification on those lenses where a ball size is not available on the ball checker.

After the 70 percent screen diameter image size checks are completed the distortion of the image may be checked. In general the maximum measurable distortion error will occur between the 50 percent image size and the 100 percent image size in a radial direction. Therefore choose a ball size which will give an image of approximately 25 percent of the screen diameter. This would be $3\frac{1}{2}$ " on the 20-1500. The 5" and 10" diameters on the glass scale could be used. Otherwise jo-blocks and a precision thin machinist scale with hand magnifying glass can be used. Then place the glass scale centerline in a radial direction along the centerline of the screen as if on a spoke of a wheel. First measure the ball image from say $\frac{1}{8}$ " in from the edge of the screen toward the center of the screen. Do this for the left and right side and top and bottom of the screen. Then place the ball image so as to touch the center of the screen and measure radially outward. Do this for the left and right and top and bottom directions. Also place the 25 percent ball image on the center of the screen and measure it. It can also be placed half way from the center to the edge of the screen and measured in a radial direction.

OPERATION

Electrical Controls

The main control panel, located on the right side of the machine, contains three controls.

1. The motor travel switch is used primarily for adjusting of the focus of the displayed image.
2. The profile illumination switch applies power to the profile lamp in the lamphouse. This switch also applies power to the surface illuminator.
3. The brightness control is used to increase or decrease the brightness of the profile lamp. Reducing the amount of illumination required will prolong lamp life. An optional curtain canopy is available to reduce backlighting and allows the profile lamp to be operated at reduced brightness.
4. There is also an ON/OFF switch located on the surface illuminator lens housing.

Lens Identification and Mounting

The standard lens systems available for the 20-1500 Series Comparator are listed in the Specifications section under "Lens Specifications."

The magnification of a lens system is engraved on the outer surface of the lens assembly. A system that is engraved "10X" would indicate that the image projected on the screen would be enlarged 10 times.

Mounting a lens system is achieved by loosening the two lens holding screws located in the lens mounting boss, inserting the lens and rotating 90° and securing the two lens holding screws.

Mounting the 5X lens system requires one additional step.

1. The condenser lens assembly, which is a part of the 5X lens system, must be mounted on the profile lamphouse. This is accomplished by mounting the condenser onto the protruding ring on the profile lamphouse and securing two thumb screws. Illumination of the entire screen cannot be achieved without the condenser assembly.

CAUTION:

Care must be exercised to insure that parts mounted on the stage DO NOT strike the lens.

Profile Illumination

The profile illumination is used to project a shadow of the outline of a part. The profile illumination is a collimated light source emanating from the profile lamphouse. This light is controlled electrically for brightness as explained in the section titled "Profile Illumination Switch and Brightness Control". In addition the light is manipulated mechanically by a telecentric stop.

Profile Illumination Filter

A filter attachment is available for the profile illuminator (Part No. 20-0407). The filter causes the screen to be illuminated with green light. The filter is attached by inserting the small end inside the lamphouse ring. The small tabs on the periphery of the filter should hold it in place. (The tabs may have to be sprung slightly outward when first used.)

Telecentric Stop

The telecentric stop is mounted in the profile lamphouse to further control the performance of the 20-1500 series comparator. The telecentric stop control lever extends through the right side of the profile lamphouse. An escutcheon plate indicates the mode: open, normal or closed. When a sharply defined edge on a part is to be projected on the screen, the telecentric stop lever should be in the "normal" position for 5X through 20X lens systems and in the "open" position for $31\frac{1}{4}$ X through 250X lens systems.

Cylindrically shaped parts and parts with uneven or chamfered edges to be projected on the screen can be focused more sharply by using the following procedure.

1. Open the telecentric stop lever to the "open" position.
2. Adjust the part for the best focus of the image on the screen.

3. Slowly move the telecentric stop lever toward the "closed" position until the image projected on the screen achieves the best definition.

Surface Illumination

As the name implies, surface illumination is required when an opaque surface is to be examined. Figure (5).

Surface illumination is accomplished by using the twin mirrors located on either side of the lens mounting boss. The area lighted by the illuminators can be varied by moving either mirror. See "Installation of Surface Illuminator."

Stage Helix or Protractor Measurements

Helix or angular face measurements can be accomplished by the use of the stage protractor. The stage helix or protractor is located on the rear of the stage, between the stage and profile lamphouse. See Figure 6. Ref. "2" x 6" Stage."

Helix measurements can be taken using the following procedure:

1. Secure the part in the center of the stage.
2. Loosen the protractor by turning the pivot screw counterclockwise.
3. Rotate the stage until the protractor indicates the required angle, OR until the focused screen image shows as required and then read the protractor.

Measuring Screw Threads

One of the most frequent uses of the helix is to measure screw threads. It is because of its common occurrence this special section is included. To project a screw thread the following procedure is used.

Use the front table slot for the centers and place the screw between the centers.

Adjust the table until the profile of the threads is about at the center of the screen. Focus the thread on the screen. Throw the thread image out of focus by moving the table slightly toward the projection lens by means of the focus hand wheel. A bright "out-of-focus" image will appear on the screen, but this will not be symmetrical with the right and left flanks of the thread. Release the stage helix and swing the stage until the "out-of-focus" image is an equal distance in from the right and left flanks of the thread. A thread near the center of the screen should be used. Now refocus the image and the correct normal-to-helix image is obtained.

Protractor Ring Settings for Angular Measurements

The comparator can be used to measure the angles of screen images if equipped with a rotary screen protractor ring. See Figure (7). This ring surrounds the screen, is marked off in half degree intervals and is vernier read.

The image angles, or rotary measurements, are made by using the projected image in relation to a screen reference line. The angular measurement is made by either a differential or an absolute method.

The differential measurement is made using two edges of the images. The procedure is as follows:

1. Secure the part to the stage.
2. Focus the image.

3. Position the image as required.
4. Align the screen reference line to the first edge on the image by rotating the ring and position of the stage. Read the angle of the ring.
5. Move the screen reference line to the second edge using the necessary stage and ring motions. Read this second ring angle.
6. The difference between these two angles is the angle between the surfaces.

The absolute method assumes that a standard angle chart such as a 30°-60°-90° has been installed and aligned (see "Chart Setting" in the Setup section of this manual). In this case the angle is being matched with one of the known chart angles.

1. Secure the part to the stage.
2. Focus the image.
3. Set the part with respect to the chart angle lines by adjusting the part in its fixture.
(NOTE: Prealigned stage fixtures will allow deletion of Step 3.)
4. Rotate the rotary ring to the edge to be measured.
5. Read the angle.
6. The difference between the angle read and the chart angle is the error.
(NOTE: If the 0° [horizontal] line is used the angle can be read directly.)

Measuring Techniques

The optical comparator is capable of making measurements by two methods: by direct optical comparison and by measured optical comparison.

For greater accuracy when using either direct or measured optical comparison the part being examined should be secured to the stage top. A wide range of standard fixtures is available for use on the 20-1500 series comparator. For the special job, specialty fixtures can be supplied by S-T Industries, upon request.

Direct Optical Comparison

Irregular contours, especially those including angles, radii, tapers, etc., and high quantity measurements are best checked by comparison against a master chart. There are four different ways of preparing such charts:

1. The most common practice is to make an enlarged drawing, whose scale should always correspond to the power (magnification) of the lens used. For instance, for the 20X lens, the drawing should be scaled 20:1. The use of a drawing is the only possible method if only blueprints of the part to be made, but no master part itself, is available. Such drawings should be made with the greatest care and accuracy.
2. Should a master part be available, it is both possible and practical to make a chart by tracing the outline of the image on the screen with a finely pointed hard pencil. This tracing method will again depend on the practice and skill of the draftsman, but under favorable conditions an accuracy of .01" can be approached. This method has the advantage that any errors in the optics or their rated magnifications are cancelled out.
3. Still better, results from a master part are obtainable by photographing the image on a photographic plate and using the developed plate as a master chart. This method will eliminate errors inherent to the tracing method.
4. When sufficient quantities of the same part are to be checked S-T Industries can supply from your print or sample part, special comparator charts. These are constructed from over-size master layouts which result in a chart of your part which is, for all practical purposes, without error.

Except for method 2 the contribution from the optical ac-

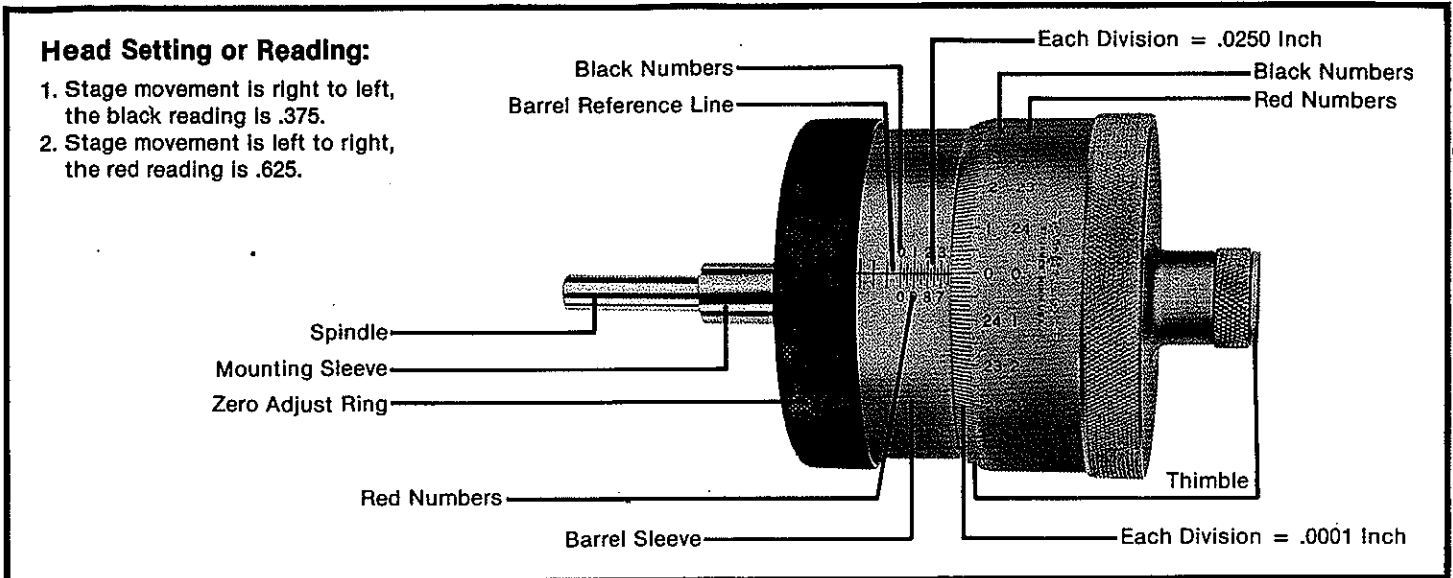


Figure 8

curacy will not be accounted for. However, the optical system is of highest quality and the inaccuracy caused by the optics will be but a fraction of one percent of the dimension checked.

Overlay drawings or charts may be held in place by the four spring paper clips provided around the periphery of the protractor ring. A number of standard charts are available from S-T Industries. A catalog of these charts is available from your S-T Industries representative.

Measured Optical Comparison

Comparators equipped with measuring stages can be used to make dimensional checks. The standard measuring stage has the facility to make three measurements, transverse, horizontal and helix angle. The capacities of the three motions is 0 to 2 inches transverse, 0 to 6 inches horizontal and ± 20 degrees helix angle.

Horizontal Stage Measurements

The six inch horizontal motion is measured using a combination of six indexable standards and a one inch travel micrometer head. Figure (8).

The steps in obtaining a horizontal measurement are as follows:

1. Set up a means to secure the part to the stage.
2. Set the micrometer head on zero reading.
3. Align an edge of the focused screen image to a screen reference line by sliding the part along the stage and securing. The alignment with the screen reference line need only be approximate. The zero adjusting feature of the micrometer head can be utilized to achieve exact alignment, as described under "Reading the 3-Inch Micrometer Head."
4. If the distance to the next edge to be measured is within the travel range of the micrometer head, rotate the thimble until the imaged edge is aligned to the original screen reference line.
5. Read the micrometer head setting.
6. If the distance to the next edge to be measured is greater than the travel range of the micrometer head, push the stage to the right and place in the trough a standard of the approximate length required.
7. Allow the stage to gently retract to the left until the micrometer head and standards are engaged.

8. Seat the standards by rotating slightly.
9. Rotate the thimble until the imaged edge to be measured is aligned to the original screen reference line.
10. Read the micrometer head.

The measured distance is the difference of the start and finish reading of the micrometer head plus the additional length of any standards that may have been required.

Reading the 3-Inch Micrometer Head

The 3" micrometer head is available in either English or Metric divisions. The Metric equivalent will be indicated in parentheses in the following description.

The 3" micrometer head (See Figure 8) directly reads the projection of its non-rotating spindle in .0001 (.002mm) increments. Direct reading denotes the measurement is read without the need of a vernier scale.

The thimble and barrel markings are used to indicate the amount of spindle projection, with respect to the mounting surface, in .0001 (.002mm) increments. The thimble is marked around its periphery with 250 lines. Each line represents .0001 (.002mm) movement of the spindle when the thimble is rotated from one line to the next adjacent line. Every 10th line around the thimble is numbered 0-24-0 (0-49-0). One full revolution of the thimble will change the spindle projection .0250 (.5mm).

The barrel markings are in increments of .0250 (.5mm) corresponding to one revolution of the thimble. The barrel reference lines are numbered every fourth line or in increments of .1000 (5.000mm).

The forward or reverse reading feature of the 3" micrometer head is color coded red and black to eliminate any possible reading errors. The black numbers are read when the stage movement is from right to left. The red numbers are read when the stage movement is from left to right.

The zero adjusting ring allows approximately .400 adjustment of the stage without affecting the thimble setting. This adjustment capability simplifies the initial alignment of the focused edge and screen reference line. The advantage of this feature was mentioned under "Horizontal Stage Measurements."

The zero adjusting ring would normally be centered over the second un-numbered division, away from the zero division. This

setting allows approximately .200 (5mm) adjustment of the stage, in either direction, without affecting the thimble setting.

MAINTENANCE

Lubrication

Stage "V" ways and balls should be lubricated occasionally with a few drops of light oil, as a corrosion preventative.

The top plate of the stage should be cleaned and a coating of light oil applied to prevent rusting and corrosion.

Environmental conditions will determine the frequency of corrosion preventative, lubrication applications.

The stage horizontal and vertical adjusting screws may occasionally require a few drops of light oil to prevent binding.

Care and Cleaning of the Optical System

Lens

Lens systems should always be stored in a case when not in use. Dropping or a severe jolting of the lens may not crack the glass but may cause the lens to shift in its mount, resulting in a change of the image size. If a lens is suspected of being out of size, image a ball of known size on the screen and using a precision scale, check the exact size of the image. Precision glass or plastic scales are available from S-T Industries.

CAUTION:

DO NOT disassemble optical lens system to adjust or clean interior glass surfaces. The assembly and calibration of these systems require special aligning equipment and procedures.

Notify S-T Industries if a lens problem becomes obvious.

Cleaning of the external surfaces of the lens system should be done in two steps.

1. To avoid abrasive action, remove all dust from the exposed glass surfaces with a soft brush or clean cotton. Brush or wipe gently.
2. After all dust is removed, use a pure grade of anhydrous alcohol and clean absorbent cotton to clean the lens surfaces. Rub gently.

CAUTION:

Never immerse a lens system in any cleaning solution. Apply alcohol to cotton to moisten only.

Removing dust from the mirror, with a brush, is generally adequate. If additional cleaning is necessary, use clean cotton and alcohol. Wipe in straight lines across the mirror, turning the cotton each time. Mirror cleaning should be done as infrequently as practical due to the delicate nature of the mirror coating.

The projection screen can be cleaned with a nonabrasive, nondetergent soap and water, and soft cloth. DO NOT use paper towels.

Lamp Replacement, Surface Illuminator and Profile

Should a lamp fail while the comparator is in operation, the cooling fans should be allowed to run for approximately five minutes.

1. Turn all switches to the "Off" position and disconnect main power line.
2. Remove access panel, located on the front of the profile lamphouse, for access to the profile lamp. Remove side panels containing the filters, for access to the surface illuminator lamps.
3. Grasp the lamp with gloves or cloth, for protection in case of breakage, and remove.
4. Install new lamp in a similar manner, making sure it is clean and free of fingerprints.
5. Replace covers and reconnect main power line.

Cleaning of Cooling Fans

Cooling fans and filters should be checked periodically for excessive dirt and grease accumulations. Routine maintenance will help to avoid premature failure of lamps and fan motors.

Fuse Protection

A 2 amp and a 5 amp fuse protect all electrical circuits in the 20-1500 series comparators. The illuminated fuse posts are located at the rear of the machine beside the main power cord receptacle. Access to a fuse is gained by unscrewing the fuse cap and replacing the fuse and cap. The fuse cap is illuminated only when the fuse has failed. The 2 amp fuse is for the profile illuminator and the 5 amp fuse is for the optional surface illuminator. An additional 5 amp fuse is provided with the power stage option.

NOTE:

Before replacing a fuse, correct the condition which caused the fuse to burn out.

WARRANTY

Within one year from the date of purchase, any repairs necessary due to defects in material or workmanship will be made without charge by S-T INDUSTRIES, INC. Normal wear and tear is not covered by this warranty. This warranty applies to the original purchaser and is not transferable. No other warranty, either expressed or implied, shall be applicable to this equipment. S-T INDUSTRIES, INC. liability does not extend beyond the repair or replacement.

PARTS ORDERING INFORMATION

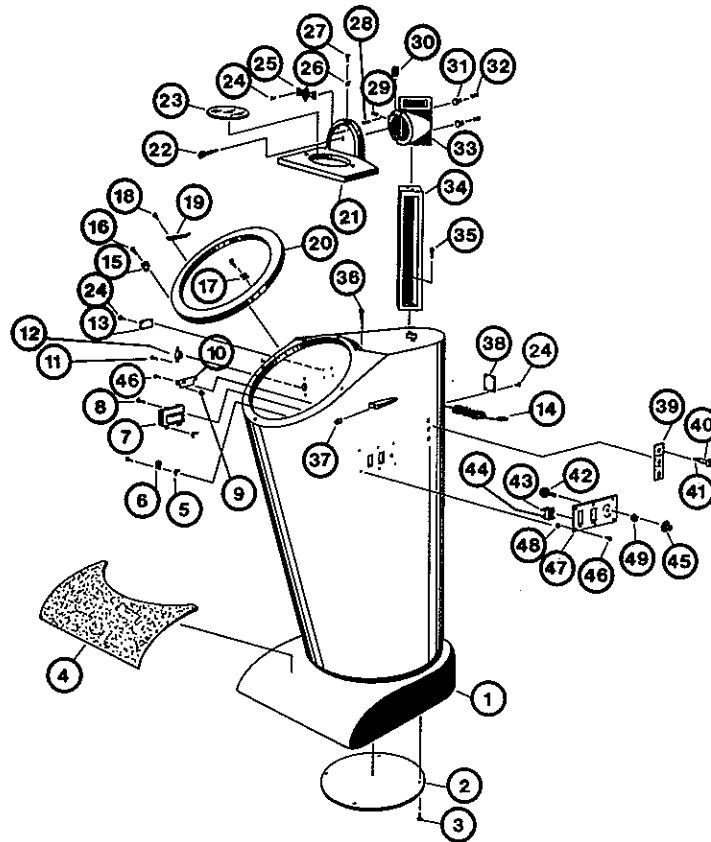
1. State the machine model and serial number.
2. State part number, description and quantity of each part required.
3. State shipping instructions.

PART IDENTIFICATION

The remainder of this manual is devoted to exploded-view drawings illustrating the relative location of the various machine components.

Key numbers relate the exploded-view drawings to the parts list, which includes part number, description and quantity required.

Body Assembly Manual and Power Stages



Ref.	Part No.	Description	Qty.	Ref.	Part No.	Description	Qty.
1	22 0853	Body Assembly, Manual Stage	1	30	22 0551	Bushing	1
	22 0880	Body Assembly, Power Stage	1	31	22 0888	Clamp Pad	4
2	22 0874	Bottom	1	32	48 6619	Set Screw $\frac{3}{8}$ -24 \times $\frac{3}{8}$	4
3	48 6779	Drive Rivet	4	33	22 0886	Clamp	1
4	22 0924	Mat	1	34	22 0872	Post	1
5	48 5788	Wing Nut, 8-32	5	35	48 5114	Cap Screw $\frac{1}{2}$ -13 \times 4"	2
6	48 5637	Nylon Wire Clamp	2	36	22 0326	Lens Mount Screw	2
7	22 1430	Transformer	1	37	48 5122	Bearing	1
8	48 5126	Button Head Screw 8-32 \times $\frac{1}{2}$	5	38	22 0752	Name Plate, Manual Stage	1
9	48 5605	Nut, Power Stage 6-32	2		22 0753	Name Plate, Power Stage	1
10	48 5714-2	Relay, Power Stage	1	39	22 1570	Fuse Plate	1
11	48 5137	Button Head Screw 6-32 \times $\frac{1}{4}$	2	40	22 1563	Fuse Post, Manual Stage	2
12	48 5383	Electrical Outlet	1		22 1563	Fuse Post, Power Stage	3
13	22 0633	Outlet Cover Plate	1	41	48 6223	Fuse, 2 Amp	1
14	22 0864	Power Cord	1		48 6215	Fuse, 5 Amp, Manual Stage	1
15	22 0129	Screen Mount Clips	3		48 6215	Fuse, 5 Amp, Power Stage	2
16	48 5127	Flat Head Screw $\frac{1}{4}$ -20 \times $1\frac{1}{4}$	3	42	22 1562	Rheostat Assembly	1
17	22 0127	Clip	3	43	48 5577	Power Switch	1
18	22 0087	Lock Screw	7	44	48 6214	Power Stage Switch	1
19	22 0130	Clip	4	45	48 5446	Control Knob	1
20	22 0905	Screen Mount Ring	REF	46	48 5138	Button Head Screw, Manual, 6-32 \times $\frac{1}{2}$	4
21	22 0891	Platform	1		48 5138	Button Head Screw, Power, 6-32 \times $\frac{1}{2}$	8
22	48 5128	Shoulder Screw $\frac{3}{8}$ Did. \times $\frac{3}{8}$	REF	47	22 1278	Switch Plate, Manual Stage	1
23	48 5130	Glass	REF		22 0881	Switch Plate, Power Stage	1
24	48 5188	Drive Screw	REF	48	48 6121	Nut, Manual Stage 6-32	4
25	22 0238	Name Plate	REF		48 6121	Nut, Power Stage 6-32	6
26	22 2322	Pointer	REF	49	48 6080	Nut $\frac{3}{8}$ -32	1
27	48 5365	Machine Screw 2-56 \times $\frac{1}{8}$	1				
28	48 5486	Spring Pin	1				
29	48 5054	Set Screw $\frac{1}{4}$ -28 \times $\frac{1}{4}$	1				

Figure 9

Profile Lamphouse

Ref.	Part No.	Description	Qty.
1	22 0198	Mirror	1
2	22 0918	Lens Tube	1
3	22 0099	Lens	1
4	22 0098	Retaining Ring	1
5	48 5004	Set Screw 8-32 x 3/16	1
6	22 2229	Base	1
7	48 5126	Button Head Screw 8-32 x 1/2	3
8	22 0719	Telecentric Stop	1
9	22 2230	Stop and Lens Mount Assembly	1
10	48 5438	Button Head Screw 8-32 x 3/8	2
11	22 0921	Contour Lens	1
12	22 2239	Lens Block	1
13	22 0922	Heat Absorbing Lens	1
14	48 5185	Button Head Screw 8-32 x 3/4	1
15	48 5442	Bulb	1
16	48 5339	Button Head Screw 4-40 x 1/4	2
17	22 1273	Socket and Wire Assembly	1
18	48 6826	Round Head Screw 10-32 x 3 1/2"	1
19	22 0909	Cover	1
20	48 5137	Button Head Screw 6-32 x 1/4	2
21	22 0923	Control Plate	1
22	48 5068	Set Screw 10-32 x 1/4	2
23	22 0895	Mounting Screw	2
24	22 2241	Retaining Ring	1
25	22 2242	Retaining Ring	1

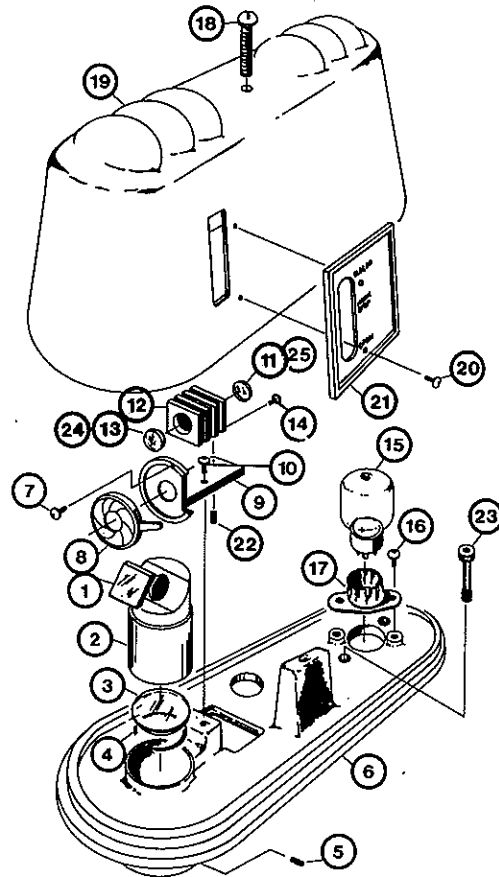


Figure 10

Surface Illuminator

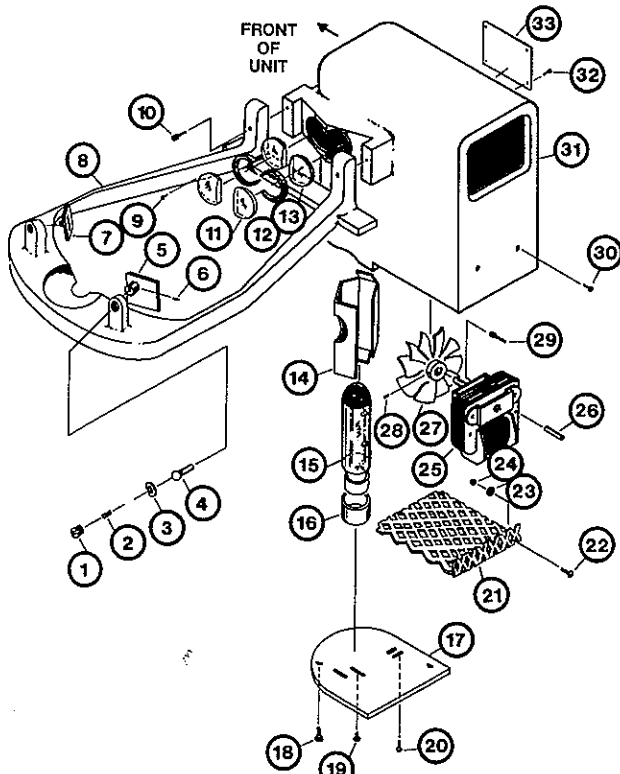


Figure 11

Ref.	Part No.	Description	Qty.
1	22 0354	Pressure Pad	2
2	22 0341	Spring	2
3	22 0340	Wave Spring	2
4	22 0352	Ball and Rod Assembly	2
5	22 0358	Relay Lens Assembly—Rear	1
6	48 5004	Set Screw 8-32 x 3/16	2
7	22 0355	Relay Lens Assembly—Front	1
8	22 0342	Base Frame	1
9	48 5020	Machine Screw 5-40 x 3/16	4
10	48 5057	Cap Screw 1/4-20 x 3/4	2
11	22 0349	Condensor Lens	2
12	22 0347	Spacer	2
13	22 0350	Condensor Lens	2
14	22 0351	Shroud	1
15	48 5279	Bulb	1
16	48 6288	Socket	1
17	22 0346	Bottom Plate	1
18	22 0087	Lock Screw	2
19	48 5277	Machine Screw 4-36 x 1/2	2
20	48 5137	Button Head Screw 6-32 x 1/4	4
21	22 1579	Wire Guard	1
22	48 6479	Button Head Screw 10-32 x 1/2	2
23	48 6083	Washer	2
24	48 5036	Nut 10-32	2
25	48 5304	Fan Motor	1
26	22 0348	Spacer	2
27	48 5305	Fan	1
28	48 5013	Set Screw 8-32 x 1/4	1
29	48 5296	Cap Screw 6-32 x 1"	2
30	48 5275	Button Head Screw 10-32 x 3/4	2
31	22 0344	Lens Housing	1
32	48 5188	Drive Screw	4
33	22 1212	Name Tag	1

Ref.	Part No.	Description	Qty.
1	22 0869	Mirror Hanger	1
2	48 6425	Cap Screw $\frac{1}{4}$ -20 \times $\frac{1}{2}$	1
3	48 5750	Set Screw $\frac{5}{16}$ -18 \times $\frac{3}{8}$	1
4	48 5378	Collar	1
5	48 5478	Bearing	2
6	22 0871	Adjusting Nut	1
7	22 0124	Mirror	1
8	48 5121	Spring Pin	1
9	22 1933	Bevel Gear	1
10	22 0867	Adjusting Screw	1
11	48 5476	Set Screw $\frac{5}{16}$ -18 \times $\frac{1}{4}$	2
12	48 5124	Spring Pin	1
13	48 5316	Bevel Gear	1
14	22 0878	Gimbal Bushing	1
15	48 5125	Collar	1
16	22 0877	Rod	1
17	22 0817	Adjusting Wheel	1
18	22 0846	Stud	1
19	22 0847	Handle	1
20	48 5185	Button Head Screw	3
21	22 0127	Clip	3
22	22 0897	Spacer	3
23	22 0126	Felt Pad	3
24	22 0283	Mirror Mount	1
25	48 5140	Lock Washer	1
26	48 5931	Cap Screw $\frac{5}{8}$ -16 \times $1\frac{1}{2}$	1
27	22 0899	Post	1
28	48 5110	Cap Screw $\frac{3}{8}$ -24 \times 1"	1
29	48 5527	Washer	1
30	48 5528	Nut $\frac{5}{8}$ -16	1

Mirror Hanger Assembly Manual Stage

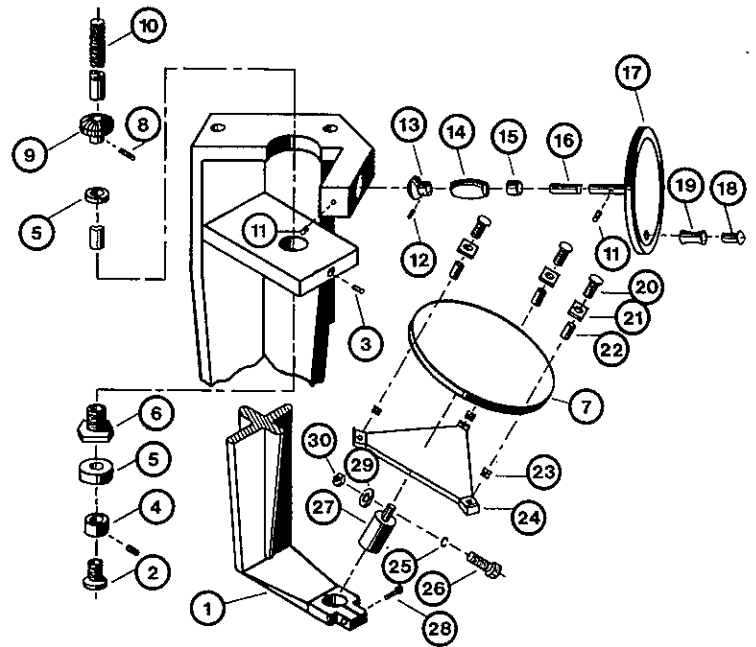


Figure 12-A

Mirror Hanger Assembly Power Stage

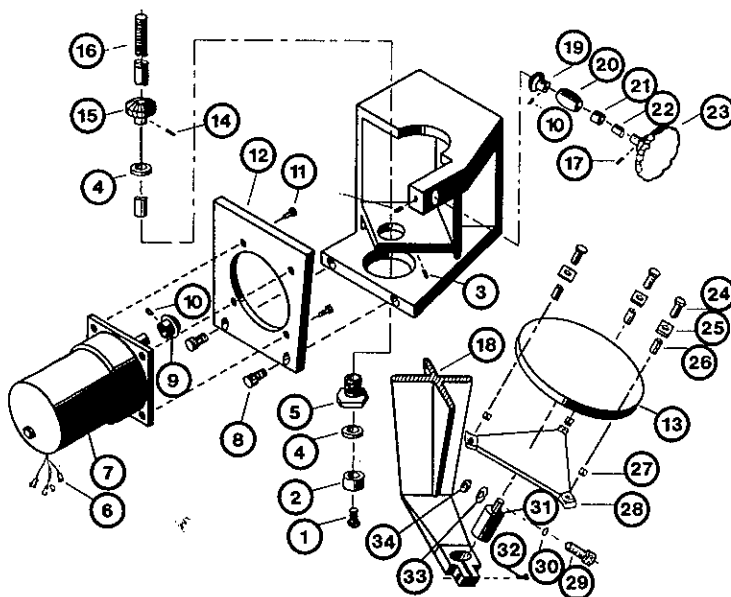
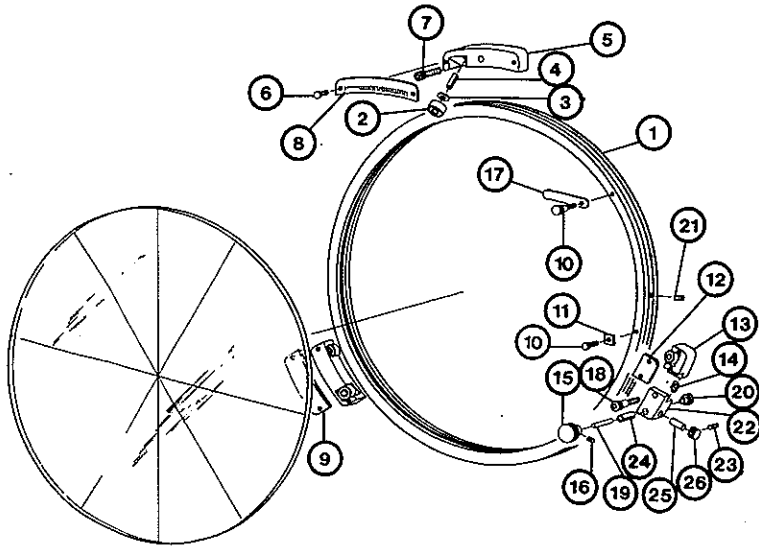


Figure 12-B

Ref.	Part No.	Description	Qty.
1	48 6425	Button Head Screw	1
2	48 5378	Collar	1
3	48 5750	Set Screw $\frac{5}{16}$ -18 \times $\frac{3}{8}$	1
4	48 5478	Bearing	2
5	22 0871	Adjusting Nut	1
6	48 6189	Terminal	4
7	22 0932	Motor Assembly	1
8	48 5047	Cap Screw $\frac{5}{8}$ -16 \times $1\frac{1}{4}$	2
9	22 0930	Bevel Gear	1
10	48 5124	Spring Pin	2
11	48 5057	Cap Screw $\frac{1}{4}$ -20 \times $\frac{3}{4}$	4
12	22 0931	Motor Upright	1
13	22 0124	Mirror	1
14	48 5121	Spring Pin	1
15	22 1933	Bevel Gear	1
16	22 0867	Adjusting Screw	1
17	48 5476	Set Screw $\frac{5}{16}$ -18 \times $\frac{1}{4}$	2
18	22 1712	Mirror Hanger	1
19	48 5316	Bevel Gear	1
20	22 0878	Gimbal Bushing	1
21	48 5125	Collar	1
22	22 0877	Rod	1
23	22 0933	Knob	1
24	48 5185	Button Head Screw 8-32 \times $\frac{3}{4}$	3
25	22 0127	Clip	3
26	22 0897	Spacer	3
27	22 0126	Felt Pad	3
28	22 0283	Mirror Mount	1
29	48 5931	Cap Screw $\frac{5}{8}$ -16 \times $1\frac{1}{2}$	1
30	48 5140	Lock Washer	1
31	22 0899	Post	1
32	48 5110	Cap Screw $\frac{3}{8}$ -24 \times 1"	1
33	48 5527	Washer	1
34	48 5528	Nut $\frac{5}{8}$ -16	1

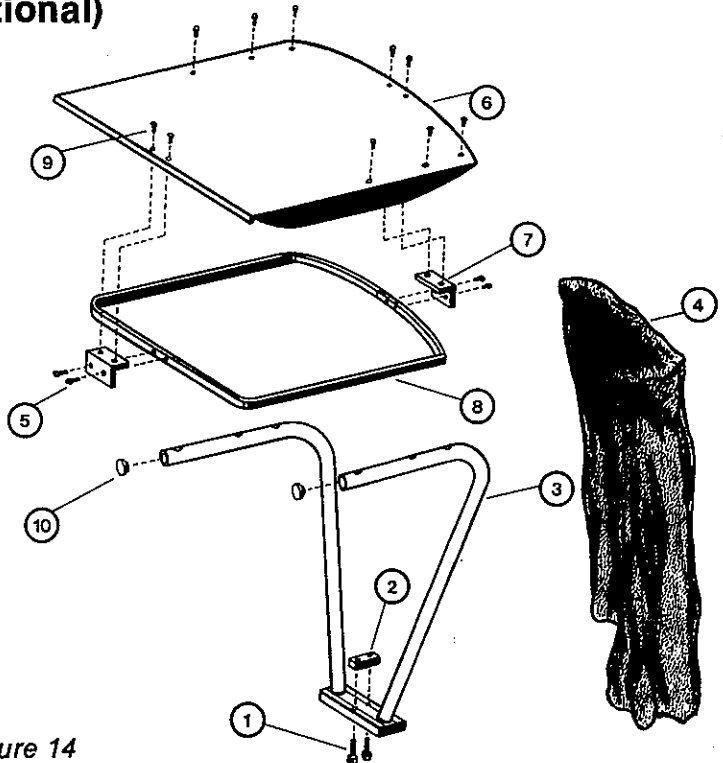
Rotary Protractor Ring



Ref.	Part No.	Description	Qty.
1	22 1464	Protractor Ring—5 Minute	1
	22 1463	Protractor Ring—1 Minute	
2	48 5183	Bearing	6
3	22 0143	Washer	6
4	48 5132	Spring Pin	6
5	22 0133	Roller Housing	2
6	48 5158	Machine Screw 2-56 x 1/8	6
7	48 5057	Cap Screw 1/4-20 x 3/4	2
8	22 1638	Vernier Plate—5 Minute	1
	22 1637	Vernier Plate—1 Minute	
9	22 0145	Cover	1
10	22 0087	Thumb Screw	7
11	22 0127	Clip Assembly	3
12	22 0144	Cover	1
13	22 0134	Drive Roller Housing	1
14	22 0141	Spring	2
15	22 0140	Knob	1
16	48 5065	Set Screw 5-40 x 1/8	1
17	22 0130	Clip	4
18	22 0142	Screw	1
19	22 0137	Shaft	1
20	22 0136	Gear	1
21	48 6063	Set Screw, Nylon Tip 6-32 x 3/16	4
22	22 0135	Roller Housing	1
23	48 5065	Set Screw 5-40 x 1/8	1
24	22 0139	Bushing	1
25	48 5273	Swivel Pad	1
26	48 6711	Knob	1
	22 0148	Roller-Assembly	2
	22 0149	Drive Roller-Assembly	1

Figure 13

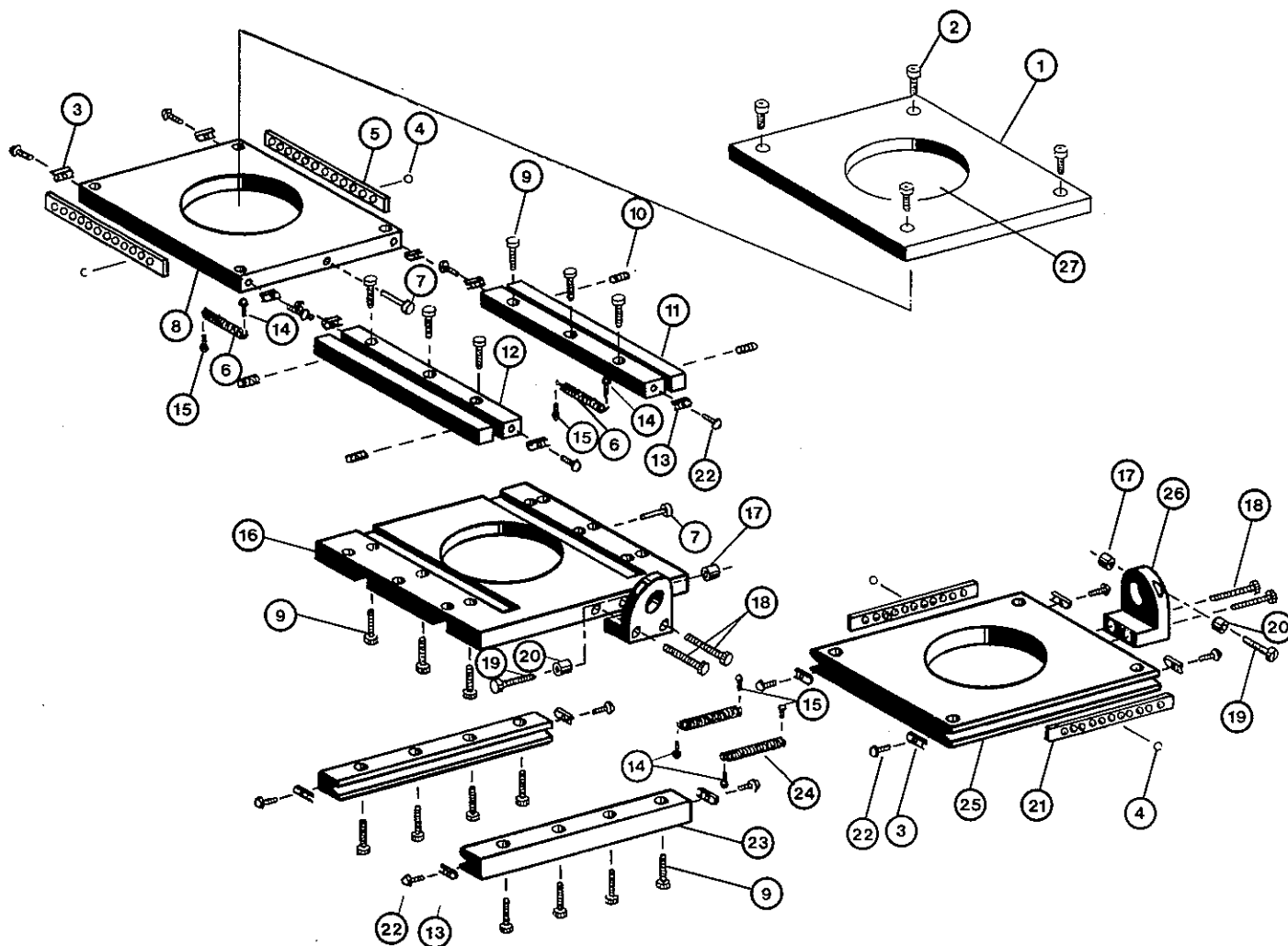
Curtain Canopy (Optional)



Ref.	Part No.	Description	Qty.
1	48 5262	Cap Screw 1/4-20 x 1 1/4	2
2	22 0378	Mounting Plate	1
3	22 0372	Support Rod	1
4	22 0379	Curtain	1
5	48 5138	Button Head Screw 6-32 x 1/2	2
6	22 0373	Top	1
7	22 0376	Curtain Rod Mount	2
8	22 0374	Curtain Rod	1
9	48 5137	Button Head Screw 6-32 x 1/4	12
10	48 5269	Plug	2

Figure 14

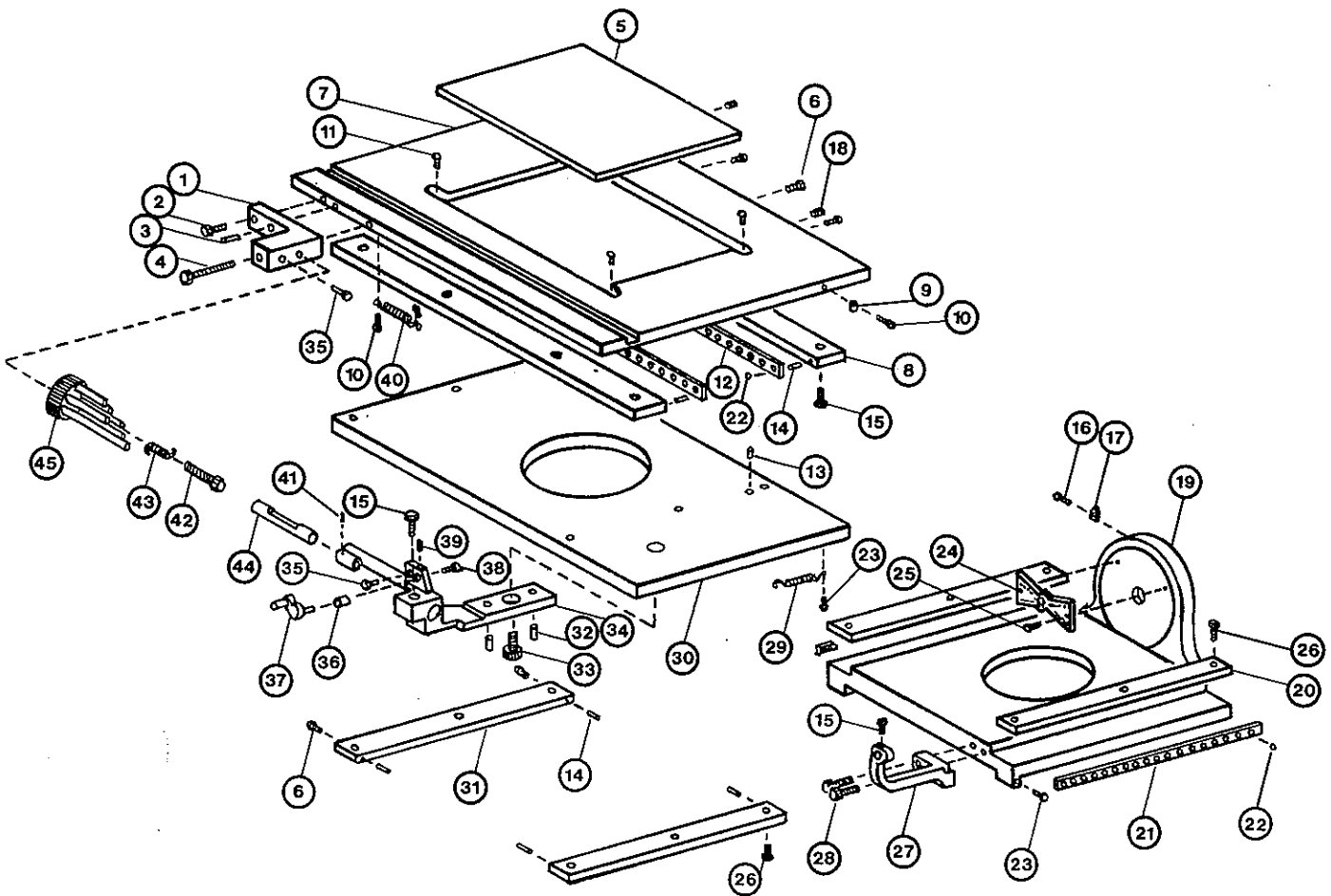
2" x 2" Stage Assembly



Ref.	Part No.	Description	Qty.	Ref.	Part No.	Description	Qty.
1	22 0436	Top Plate	1	14	48 6390	Flat Head Screw 4-40 x 1/4	4
2	48 5438	Button Head Screw 8-32 x 3/8	4	15	48 6717	Round Head Screw 4-40 x 1/8	4
3	22 2077	Ball Retainer Stop	8	16	22 0422	Lower Slide	1
4	48 5152	Ball	46	17	22 0435	Lock Nut	2
5	22 0241	Ball Retainer	2	18	48 6850	Cap Screw 8-32 x 2"	4
6	22 0428	Spring	2	19	48 6733	Screw 12-24 x 1/2	2
7	22 0430	Button	2	20	22 0433	Lock Bushing	2
8	22 0437	Cross Slide	1	21	22 0429	Ball Retainer	2
9	48 5161	Socket Head Cap Screw 8-32 x 3/8	24	22	48 5339	Cap Screw 4-40 x 1/4	16
10	48 5083	Set Screw 8-32 x 3/8	8	23	22 0425	Gib, Paired	1
11	22 0423	Back Up Bar	2	24	22 0431	Spring	2
12	22 0424	Gib	2	25	22 0438	Lower Plate	1
13	22 2077	Ball Retainer Stop	8	26	22 0439	Micrometer Head Mount	2
				27	48 5130	Glass Plate	1

Figure 15

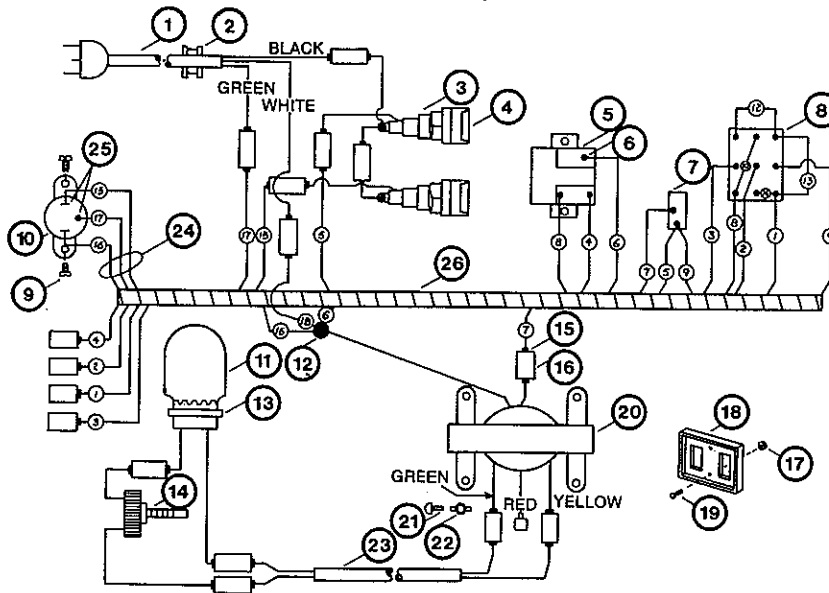
2" x 6" Stage Assembly



Ref.	Part No.	Description	Qty.	Ref.	Part No.	Description	Qty.
1	22 1703	Anvil Block	1	27	22 0247	Micrometer Head Mount	1
2	48 5320	Cap Screw $\frac{1}{4}$ -20 x $\frac{3}{8}$	1	28	48 5057	Cap Screw $\frac{1}{4}$ -20 x $\frac{3}{8}$	2
3	48 5317	Dowel Pin	1	29	22 0230	Spring	1
4	48 5401	Cap Screw $\frac{1}{4}$ -20 x $1\frac{1}{2}$	1	30	22 0208	Slide Plate	1
5	22 0232	Stage Glass	1	31	22 0212	Gib, Paired	1
6	48 6312	Button Head Screw 10-32 x $\frac{3}{8}$	5	32	22 0254	Dowel Pin	2
7	22 0239	Top Plate	1	33	48 5322	Cap Screw $\frac{1}{2}$ -20 x 1"	2
8	22 0257	Gib, Paired	1	34	22 1690	Micrometer Head Mount	1
9	22 0231	Ball Retainer Stop	1	35	22 0242	Anvil	2
10	48 5158	Machine Screw 2-56 x $\frac{1}{8}$	3	36	22 0252	Gimbel	1
11	48 5333	Flat Head Screw 6-32 x $\frac{1}{4}$	4	37	22 0215	Holder and Standard Assembly (English)	1
12	22 0240	Ball Guide	2		22 0228	Holder and Standard Assembly (Metric)	
13	48 5943	Dowel Pin	1	38	48 5090	Machine Screw 5-40 x $\frac{3}{16}$	1
14	58 5096	Spring Pin	8	39	48 5011	Set Screw 8-32 x $\frac{1}{8}$	1
15	48 5061	Cap Screw 8-32 x $\frac{1}{2}$	10	40	22 0243	Spring	1
16	48 5365	Screw 2-56 x $\frac{1}{8}$	1	41	48 5081	Spring Pin	1
17	22 2322	Pointer	1	42	48 5376	Shoulder Screw $\frac{3}{16}$ x $1\frac{1}{4}$	1
18	22 0244	Set Screw	2	43	22 0255	Spring	1
19	22 0297	Platform	1	44	22 0251	Spacer Rod	1
20	22 0210	Gib	2	45	22 0219	Turret and Standard Assembly (English)	1
21	22 0241	Ball Guide	2		22 0229	Turret and Standard Assembly (Metric)	1
22	48 5152	Ball—.187"	52				
23	48 5154	Machine Screw 4-48 x $\frac{1}{8}$	2				
24	22 0875	Name Plate	1				
25	48 5188	Drive Screw	2				
26	48 5161	Cap Screw 8-32 x $\frac{3}{8}$	12				

Figure 16

20-1500 Series Wiring Diagram



Ref. Part No.	Description	Qty.	Ref. Part No.	Description	Qty.
1 22 0864	Power Cord	1	14 22 1562	Rheostat Assembly	1
2 48 5615	Strain Relief Bushing	1	15 48 5809	Plug	33
3 22 1563	Fuse Post, Manual Stage	2	16 48 5810	Receptacle	16
22 1563	Fuse Post, Power Stage	3	17 48 5605	Nut 6-32	2
4 48 6215	Fuse, 5 Amp	2	18 22 0881	Switch Plate, Power Stage	1
48 6223	Fuse, 2 Amp	1	22 1278	Switch Plate, Manual Stage	
5 48 6214	Switch, Power Stage	1	19 48 5137	Button Head Screw 6-32 x 1/4	2
6 48 5581	Terminal	15	20 22 1430	Transformer	1
7 48 5714-2	Relay, Power Stage	1	21 48 5126	Button Head Screw 8-32 x 1/2	4
8 48 5577	Switch, Profile Lamp	1	22 48 5788	Wing Nut 8-32	4
9 48 5111	Button Head Screw 8-32 x 1/4	2	23 48 5612	Cord	1
10 48 5383	Electrical Outlet	1	24 48 5614	Cord	1
11 48 5442	Profile Bulb	1	25 48 5581	Terminal	3
12 48 5386	Splice Cap	1	26 48 6202	Spiral Wrap	31"
13 22 1273	Socket and Wire Assembly	1			

Figure 17

Surface Illuminator Wiring Diagram

Ref. Part No.	Description	Qty.
1 48 5584	Grommet	1
2 22 1635	Power Cord	1
3 48 5585	Switch Plate	1
4 48 5580	Power Switch	1
5 48 6421	Button Head Screw 6-32 x 3/8	2
6 48 5605	Nut 6-32	2
7 48 5791	Clamp	1
8 22 1581	Socket and Mount Assembly	1
9 48 5137	Button Head Screw 6-32 x 1/4	2
10 22 1583	Plug and Mount Assembly	1

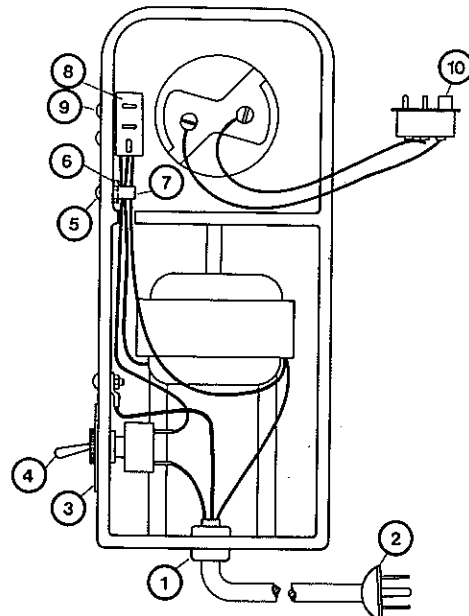
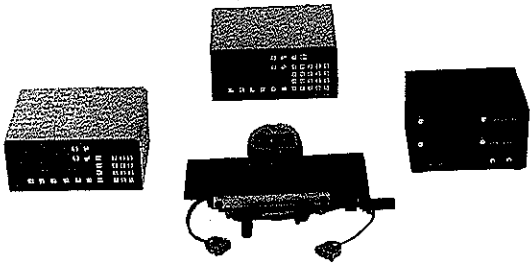


Figure 18

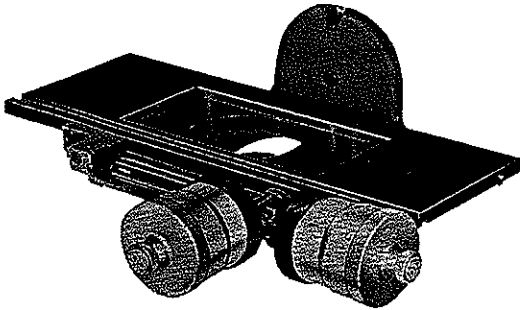
ACCESSORIES



2" x 6" TRAVEL STAGE WITH DIGITAL Cat. No. 20-1532-07 thru 20-1532-09

2" x 6" travel, electronic digital readout stage, readings via precision glass scales to .0001"/.002mm. Stage has a 6" x 16" top plate with a 4" x 8" stage glass and manual lead screws to traverse the full 2" x 6" range. Quick release for fast travel on 6" axis.

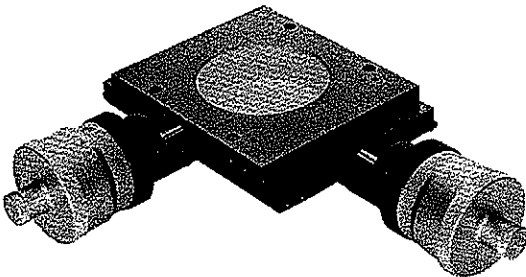
The stage is supplied with choice of three digital readouts: standard X-Y readout, *QUADRA-CHECK II* or *QUADRA-CHEK III*.



2" x 6" TRAVEL STAGE Cat. No. 20-1532-01 and 20-1532-03

The 2" x 6" travel stage has a 6" x 16" top plate with a 4" x 8" glass working area. This stage has a unique built-in gage rod turret for the 6" range and a swing-in gage rod for the 2" range, eliminating the need for end measuring rods. Two types of micrometer heads are available, either 2" diameter forward and reverse reading direct to .0001" or 3" diameter forward and reverse reading direct to .0001" with a zeroing feature and non-rotating spindle.

Note: All stages are also available with metric reading mic heads.



2" x 2" TRAVEL STAGE Cat. No. 20-1515-01 and 20-1515-03

The 2" x 2" travel stage has a 6" x 6" top plate with a 4" diameter glass working area. Two types of micrometer heads are available—either a 2" diameter forward and reverse reading direct to .0001" or a 3" diameter forward and reverse reading direct to .0001" with a zeroing feature and non-rotating spindle.

Note: All stages are available with metric reading mic heads.



Cat. No. 20-0304-00
5 minute protractor ring

Cat. No. 20-0305-00
1 minute protractor ring

 <p>Cat. No. 20-0389-01 Right angle backing plate for 2" x 6" stage</p> <p>Cat. No. 20-0393-00 Right angle backing plate for 2" x 2" stage (not shown)</p>	 <p>Cat. No. 20-0222-00 Rotary top plate for 2" x 2" or 2" x 6" stages</p>	 <p>Cat. No. 20-0394-00 Surface illumination intensifier, 50x through 100x</p>	 <p>Cat. No. 20-0405-00 Dovetail form tool holder</p>
 <p>Cat. No. 20-0380-00 Sliding curtain canopy</p>	 <p>Cat. No. 20-0410-00 Center support for 2" x 6" stage</p>  <p>Cat. No. 20-0363-00 Center support for 2" x 2" stage</p>	 <p>Cat. No. 20-0414-00 Crossway center support for 2" x 6" stage</p>	 <p>Cat. No. 20-0650-00 Universal staging fixture for 2" x 2" or 2" x 6" stage</p>

Cat. No. 20-1500-00 — The SCHERR-TUMICO 14" Vertical Beam Comparator is a self contained floor model with a rigid vertical column. The basic unit includes a tilting platform, telecentric condenser lens system, and plastic cover. The basic unit does not include a lens, graduated protractor ring, surface illuminator, measuring stage or glass screen.

Cat. No. 20-1500-01 — Same as 20-1500-00 above, except includes power elevation of platform.

NOTE:

A complete range of measuring stages, digital readouts, fixtures and convenience accessories are available as shown below.

14" Vertical Beam Comparator Accessories

Cat. No. 20-0904-00 — Plain protractor ring (no graduations). Does not rotate.

Cat. No. 20-0304-00 — Rotary protractor ring with graduations and 5 minute vernier scale. Does not include screen.

Cat. No. 20-0305-00 — Rotary protractor ring with graduations and 1 minute vernier scale. Does not include screen.

Cat. No. 20-0338-00 — Surface illuminator, for use with all projection lens powers and for 110 volts, 60 cycle, A.C.

Cat. No. 20-0394-00 — Surface illumination intensifier for 50x through 100x.

Cat. No. 20-0380-00 — Curtain canopy to shade screen for better contrast in extra bright surroundings.

Cat. No. 99-0174-00 — Accessories chest. Will hold set of projection lenses, four screens, center support, etc.

Note: If a graduated protractor ring is not required 20-0904-00 plain protractor ring must be ordered.

Lenses

Cat. No. 20-0320-00 — Standard 5x projections lens with matching condenser lens.

Cat. No. 20-0310-00 — Standard 10x coated projection lens.

Cat. No. 20-0313-00 — Standard 20x coated projection lens.

Cat. No. 20-0314-00 — Standard 31 1/4x coated projection lens.

Cat. No. 20-0318-00 — Standard 50x coated projection lens.

Cat. No. 20-0319-00 — Standard 62 1/2x coated projection lens.

Cat. No. 20-0321-00 — Standard 100x coated projection lens.

Cat. No. 20-0322-00 — Standard 250x projection lens. Uses standard 48-5170-00 condenser lens for models before 1966.

Cat. No. 20-0407-00 — Green filter for use on regular or telecentric lens system.

Stages

Cat. No. 20-1515-01 — 2" x 2" stage with 2" diameter forward and reverse reading micrometer heads. Direct reading to .0001".

Cat. No. 20-1515-03 — 2" x 2" stage with 3" diameter zeroing forward and reverse, .0001" reading, non-rotating spindle micrometer heads.

Cat. No. 48-5130-00 — 4" diameter stage and platform glass.

Cat. No. 20-1532-01 — 2" x 6" stage with 2" forward and reverse reading .0001" micrometer heads.

Cat. No. 20-1532-03 — 2" x 6" stage with 3" diameter zeroing forward and reverse .0001" reading, non-rotating spindle micrometer heads.

Cat. No. 20-1532-07 — 2" x 6" stage with standard X-Y display.

Cat. No. 20-1532-08 — 2" x 6" stage with QUADRA-CHEK II.

Cat. No. 20-1532-09 — 2" x 6" stage with QUADRA-CHEK III.

Cat. No. 20-0222-00 — Rotary stage plate for 2" x 2" or 2" x 6" stage.

Cat. No. 20-0232-00 — Stage glass for 2" x 6" stage.

NOTE:

Stages available with metric reading mic heads at no additional charge.

Staging Fixtures

- Cat. No. 20-0363-00** — Center support. Capacity 3" diameter x 7", with male and female centers for 2" x 2" stage.
- Cat. No. 20-0393-00** — Right angle backing plates for 2" x 2" stage.
- Cat. No. 20-0650-00** — Staging fixture for 2" x 2" or 2" x 6" stage.
- Cat. No. 20-0410-00** — Stage center. Capacity 6" diameter by 12" length, with male and female centers for 2" x 6" stage.
- Cat. No. 20-0414-00** — Crossway center support for 2" x 6" stage.
- Cat. No. 20-0389-01** — Right angle backing plate for 2" x 6" stage.
- Cat. No. 20-0405-00** — Dovetail form tool holder.

Spare Bulbs

- Cat. No. 48-5279-00** — Surface illuminator bulb, 500 watt.
- Cat. No. 48-5162-00** — Projection bulb for models 1966 and before.

Cat. No. 48-5442-00 — Projection bulb for high-intensity light. Built-in reflector for telecentric lens system after 1965.

Cat. No. 48-5172-00 — Replacement heavy-duty clear plastic dust cover.

Screens

Cat. No. 74-0175-00 — Frosted glass screen with 90° and 30° crosslines.

See catalog for complete list of screens and charts.

Spare Bulbs

- Cat. No. 48-5279-00** — Surface illuminator bulb, 500 watt.
- Cat. No. 48-5162-00** — Projection bulb for models 1966 and before.
- Cat. No. 48-5442-00** — Projection bulb for high-intensity light. Built-in reflector for telecentric lens system after 1965.
- Cat. No. 48-5172-00** — Replacement heavy-duty clear plastic dust cover.

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