

20-1600 SERIES
16" OPTICAL COMPARATOR
INSTRUCTION MANUAL

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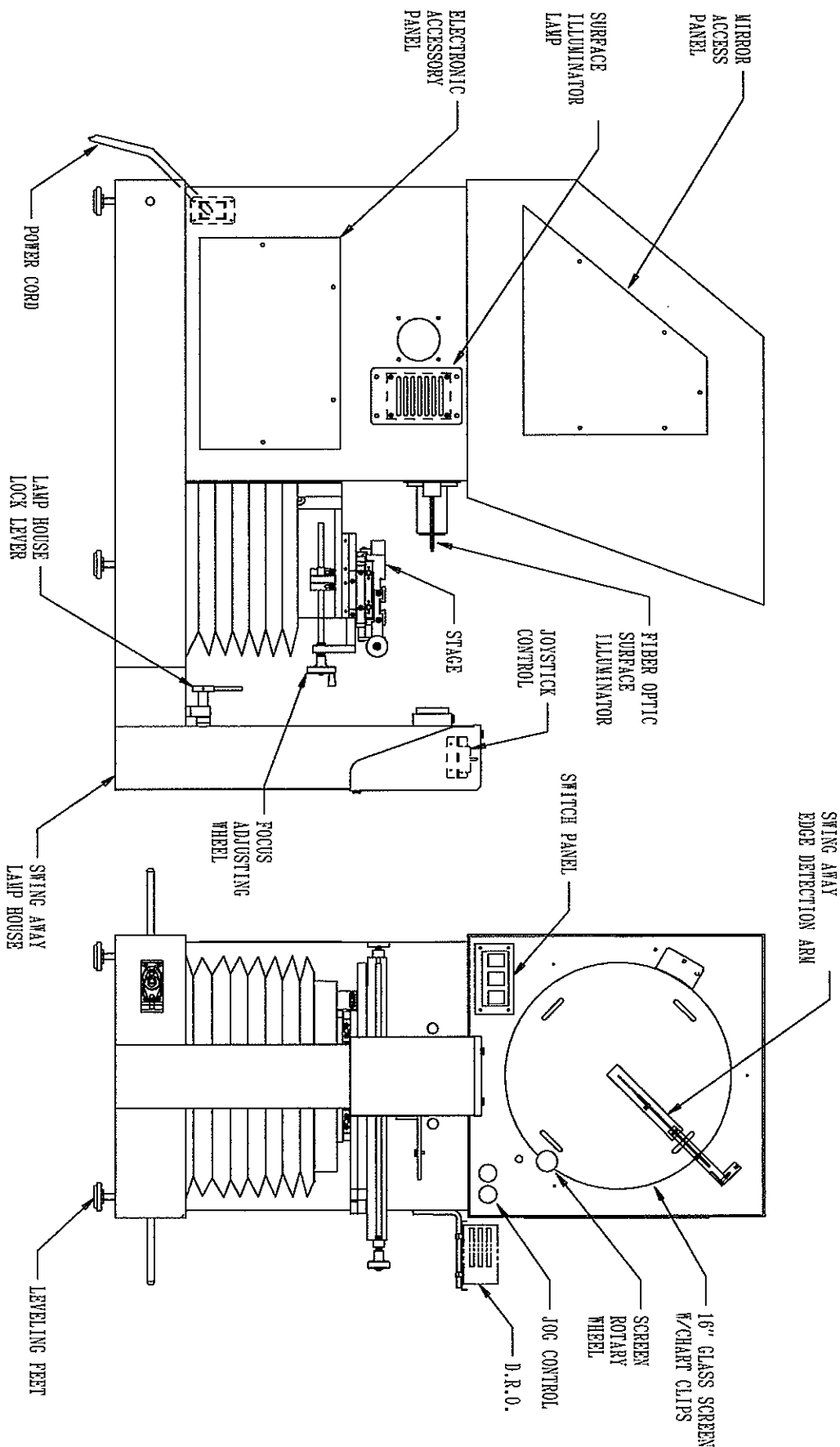
INTRODUCTION

This manual contains the instructions for the installation, operation and maintenance of the SCHERR-TUMICO 20-1600 Series horizontal beam optical comparator.

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20 1600 SERIES NOMENCLATURE



SPECIFICATIONS

Machine Dimensions

Length..... 43.5" (1100 mm)
 Width..... 20" (500 mm)
 Height..... 47.5" (1200 mm)
 Height to Screen Center.... 37" (940 mm)

Work Table

Length..... 20" (500 mm)
 Width..... 5" (125 mm)

Clamping Slots..... 2
 Allowable Workload..... 150 lb. (67 Kg)

Measuring Capacity

X-axis..... 12" (300 mm)
 Y-axis..... 7" (175 mm)
 Focus..... 3" (75 mm)
 Scale Resolution..... 0.0005" (.001mm)

Screen Size..... 16" (400 mm)

Digital Protractor 1 min./0.01 deg.

Magnification Lenses

5X, 10X, 20X, 25X, 50X, 100X

Electrical

Voltage..... 100-240v, 50 or 60 Hz

Current..... 3 amps

Lamps (Tungsten-Halogen)

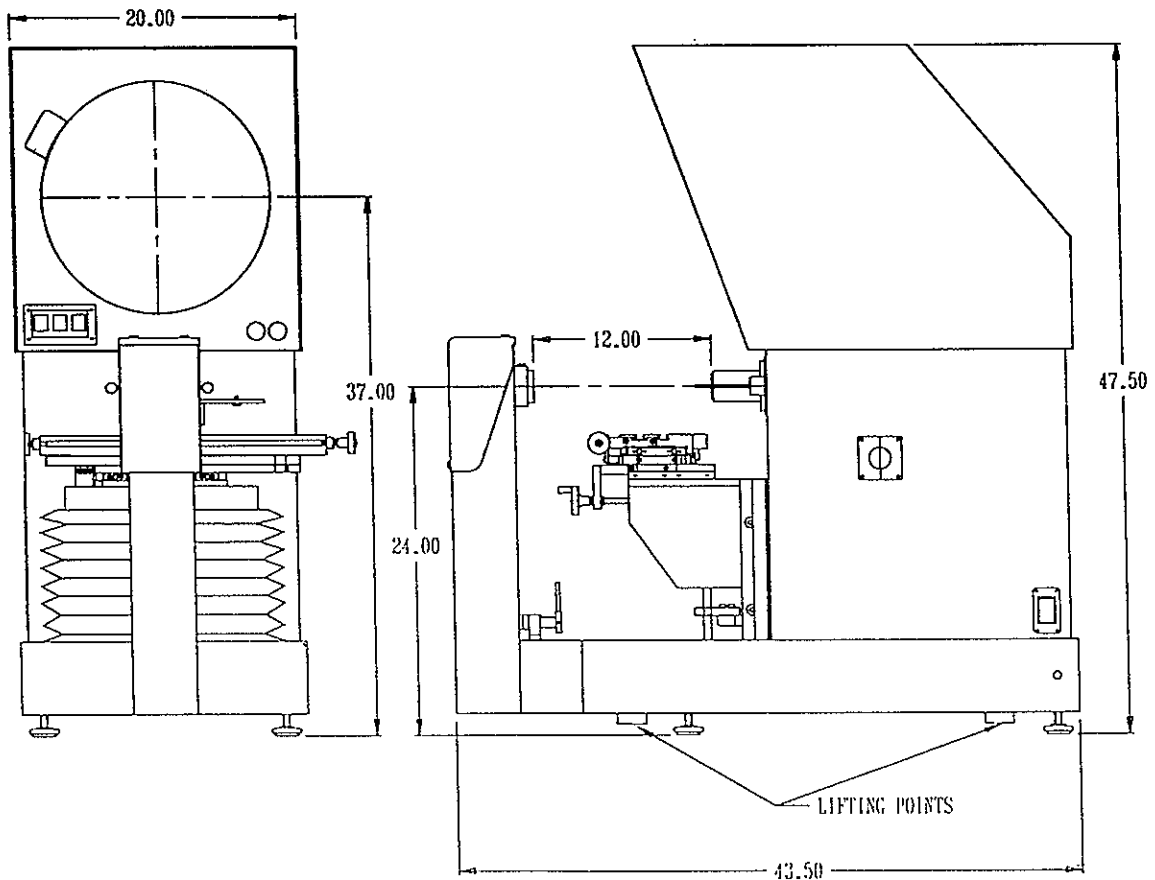
Profile Illum..... 150 watt, 24 volt

Surface Illum..... 100 watt, 12 volt

Weight

Comparator..... 500 lb. (455 Kg)

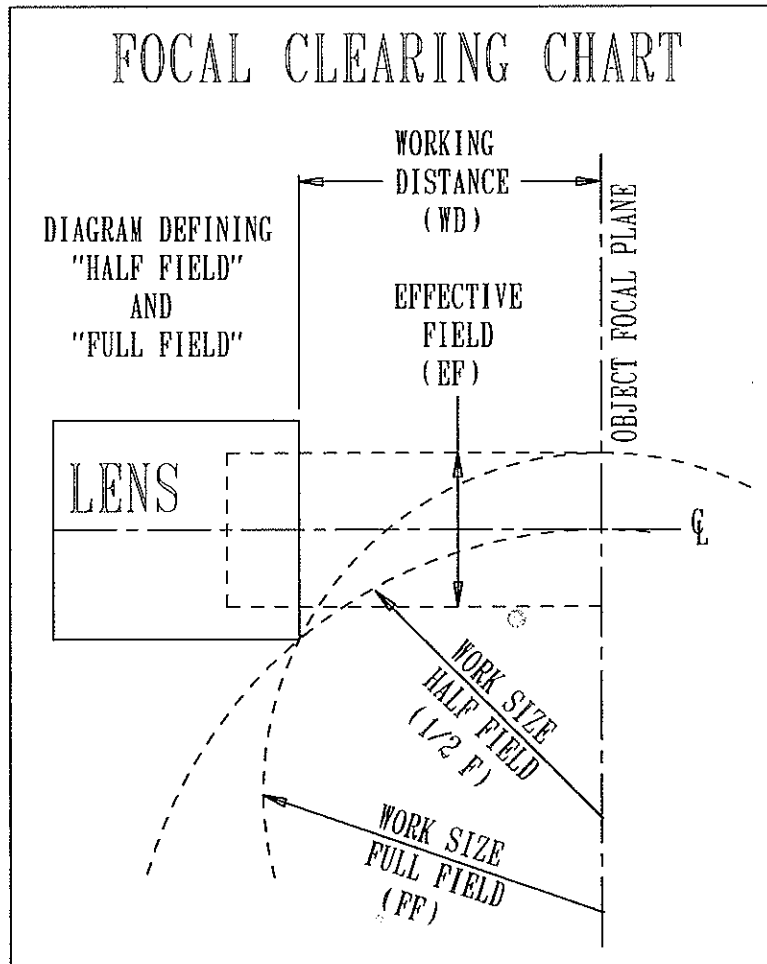
Crated Comparator..... 750 lb. (568 Kg)



FOCAL CLEARING CHART

16" OPTICAL COMPARATORS

| MAG. | WD | EF | DIA 1/2F | DIA FF |
|------|--------------|-------------|---------------|--------------|
| 10X | 3.15" (80mm) | 1.6" (41mm) | 9.7" (246mm) | 7.0" (178mm) |
| 20X | 3.23" (82mm) | .8" (20mm) | 14.0" (356mm) | 9.9" (251mm) |
| 25X | 2.76" (70mm) | .64" (16mm) | 10.4" (264mm) | 7.9" (201mm) |
| 50X | 2.09" (53mm) | .32" (8mm) | 7.9" (201mm) | 6.5" (165mm) |
| 100X | 1.69" (43mm) | .16" (4mm) | 5.4" (137mm) | 4.9" (124mm) |



INSTALLATION SITE

The SCHERR-TUMICO 1600 is a precision optical instrument and should be installed in a clean, vibration free location. Dust, oil and other contaminants may coat the lenses and mirrors and cause distortion or otherwise reduce image quality. Extremes in temperature may cause excessive expansion or contraction of the comparator and parts to be measured resulting in inaccuracy of part measurement. High humidity may result in condensation and fogging of the mirror, lenses and screen. It is recommended to install the comparator in an air-conditioned room with a lower than normal light level.

SETUP

The SCHERR-TUMICO 1600 requires only minimal setup upon receipt. Avoid rough handling, which could cause misalignment and inaccuracy of measurement.

UNPACKING

IMPORTANT...If you have any questions about unpacking or setup, contact S-T Industries or local S-T distributor.

1. Remove sides from pallet. Remove plastic bag covering optical comparator. Unbolt brackets holding comparator on pallet.
2. Pick up comparator with a fork lift. **Be sure to lift at marked positions.** While still being held by the forklift, remove wood beams from under comparator and install leveling feet (4) under base of comparator. Place in position for operation and remove forklift.
3. Adjusting leveling feet until comparator is level and stable. Remove any additional packaging material optical comparator.
4. Check for shipping damages. Document shortages and damages and report to S-T Industries including the Model number and Serial number.
5. Wipe down the comparator with clean dust rags. **CAUTION:** Do not use shop air hoses to blow dirt from the comparator. Flying particles can damage mirror surfaces or optics.

Do not connect power to the comparator until setup is complete

INSTALLATION

DRO INSTALLATION

1. Locate arm and tray or mounting bracket for digital readout on right side of comparator. Loosen clamps and rotate tray and arm until in desired position to support DRO. Tighten clamps to hold in position. **Do not over tighten.**
2. Locate Digital Readout. Place on tray. (If using DRO mounting bracket, follow instructions included with digital readout.) Unwrap cords on side of comparator and plug into digital readout. Plug cables marked X axis and Y axis into the X axis and Y axis connectors on the back of the digital readout. Plug the unmarked cable into the 'Q' axis connector on the back of the digital readout. Plug in power cord to DRO. **CAUTION:** If you have the edge detection option, be careful not to over bend small fiber optic bundles.) Secure cables to arm with wire ties if necessary.

Note: If the comparator is configured with the QC 4215 DRO, there will be a different setup for the DRO tray. See section on CNC option.

STAGE SETUP

1. Remove shipping brackets from stage. Replace any screws and washers, which are, end stops for ballways.
2. If this unit has a motor drive or CNC option, locate joystick and install on joystick mount. Plug in joystick cable.

LENS INSTALLATION

1. Locate lens and remove and packaging and covers. Make sure both ends are clean. Do not blow or use shop air to clean lenses or remove dust. Use an air canister or lens cleaning cloth to clean lens surfaces of necessary.
2. Remove any cover from lens mounting hole. Insert flange of lens in mounting hole by aligning half-round cutouts to the hold-down cams. When the lens is fully seated in the mounting hole, rotate 90 degrees to lock in place with hold-down cams.

POWER UP

IMPORTANT- be sure power entry module voltage is set appropriately. Insert main power cord into power entry module in the side of the comparator and plug into outlet. Turn on main power. Check fan and DRO operation. Turn on profile and surface illumination and check operation.

POWER SWITCHES

There are 3 switches located on the left side of the comparator.

1. The main power switch controls all power to the lamps, fans and accessory cable.
2. The Profile Illumination switch controls power to the profile lamp.
3. The Surface Illumination switch controls power to the surface illumination lamps.

Note: The fans will operate when the main power switch is turned on.

PROFILE AND SURFACE ILLUMINATION

Profile and surface illumination each have their own light sources and respective ON-OFF switches.

The profile illuminator projects a light beam past a part on the stage into a lens, creating an accurately magnified image of the part profile on the screen when properly focused. This allows precise measurements of the features of a part either by comparison to a chart or by positional measurement using a digital readout.

The surface illuminator projects light through two fiber optic bundles onto the front surface of a part. The reflection can be seen on the screen and the image can be measured using the comparison or positional method. To adjust each fiber optic bundle, loosen the respective thumbscrews and position the bundle to obtain desired illumination and retighten thumbscrews. **CAUTION:** Do not over tighten thumbscrews.

MAGNIFICATION LENSES

There are several optional lens magnifications available with the ST 1600 optical comparator.

| | | | |
|------------|-------------------|------------|--------------------|
| 20-1620-00 | 5X Magnification | 20-1610-00 | 10X Magnification |
| 20-1613-00 | 20X Magnification | 20-1615-00 | 25X Magnification |
| 20-1618-00 | 50X Magnification | 20-1621-00 | 100X Magnification |

The lenses that are ordered with the optical comparator will be installed and preset at the factory.

STAGE OPERATION

The horizontal axis (X) is controlled by a hand crank at the right of the top plate and a quick-release mechanism in front of the stage. Rotate the quick-release knob clockwise to release, which will allow free movement of the top plate. Rotate the knob counter-clockwise to tighten the quick-release and then use the hand crank for fine adjust. A small knob on the left side of the stage also provides fine adjustment.

The vertical axis (Y) is controlled by a hand crank located to the left of the lamphouse. Rotate clockwise to raise the stage and rotate counter-clockwise to lower the stage.

The focus axis is controlled by a knob located to the lower left of the stage.

HELIX STAGE

The horizontal axis can be pivoted $\pm 15^\circ$ to measure along the helix of threads. By rotating the stage, the part stays parallel to the top plate and accurate linear measurements can be made. To pivot the stage, first move the top plate to the far left to expose the protractor scale on the right end of the X-axis bearing way. Loosen the clamp screw under the bearing way to release the horizontal axis. Rotate the stage to the desired angle and retighten the clamp screw. Return the top plate to the desired position for measuring.

SWING-AWAY LAMPHOUSE

To accommodate long parts which must be measured straight on rather than along their length, the 1600 is equipped with a swing-away lamphouse. Loosen the large clamp screw located at the bottom of the lamphouse and gently swing the lamphouse to the right. Remove the joystick if necessary. It will be necessary to clamp the part firmly in a vise, V-block or other suitable fixture and to use surface illumination in order to make accurate measurements. To return the lamphouse to its normal position, swing the lamphouse gently back into the stop bracket and tighten the clamp screw.

OPTIONS

Fiber Optic Edge Detection Option

This option provides a fast, accurate means of measuring by sensing the edge of an image when it passes by a fiber optic probe on the optical comparator screen. In this way, X-Y coordinates can be automatically entered into geometric functions (Points, Circles, Lines, etc.). This is available with the QuadraChek 200 and 4000 series digital readouts. See catalog of price list for ordering information.

This option includes a swing-away arm, which holds the fiber optic sensor on the screen. It can be moved out of the way when not in use.

MOTORIZED OPTION

Joystick Control

The X and Y axes are driven by stepper motors and controlled with a 2-axis joystick. (See Nomenclature Figure) The joystick is mounted to the right side of the base. It can be easily removed and handheld if desired. To move the screen image, deflect the joystick in the desired direction. The more the joystick is deflected, the faster the image will move. Pressing and releasing the top button of the joystick will switch the speed switched to slow speed. Press again to return to normal speed. (The left button on the joystick base has the same function as the button on top of the joystick. The forward button on the joystick base has no function.)

Note: The buttons on the joystick may have different functions with the CNC option.

Jog Wheels

In addition to the joystick, there are individual jog wheels for precise control of the X and Y axis. These are located just to the lower right of the screen. By rotating these wheels, the stage can be very accurately positioned. The joystick will override the jog wheels if you attempt to use the jog wheels and the joystick at the same time.

IMPORTANT - The operation of the joystick and jog wheels has been programmed into the stepper amplifier control at the factory. The software and interface cable has been included for your use, should it ever be necessary to update or change these settings. Consult the factory before doing this.

CNC Control Option

The CNC control option provides automatic measurement by driving the part to be measured to preprogrammed positions and taking points either by fiber optic edge detection or by manually targeting the edge of the part with the crosshair. The CNC control option is available with the QuadraChek 4000 series digital readout. Consult your QuadraChek manual or contact your S-T representative for more information. See catalog of price list for ordering information. If this comparator is configured with the QC4215 PC digital readout (CNC or non-CNC), there will be a large, monitor and keyboard tray, which will be installed on the right side of the comparator. In addition, there is a CPU bay, which will hang on the lower right of the comparator, which will house the CPU section of the computer.

PROTRACTOR SCREEN OPERATION

The screen is rotated by turning the screen control knob located at the lower right of the screen. The screen can be locked in place using the screen lock located just above the screen control knob. Angle readings are viewed on the digital readout. Consult DRO manual for operation.

Absolute Zero Setting

The following procedure may be necessary if the glass screen is replaced:

1. Rotate the screen so the horizontal line is approximately level.
2. Focus a pointer on the screen with its tip on the left end of the horizontal screen line.
3. Move the stage so the image of the point is on the right end of the screen.
4. Observe the space between the tip of the pointer and the horizontal screen line.
5. Move the stage so the tip moves closer to the line by one half of the observed space.
6. Rotate the screen so the horizontal line is on the tip of the pointer.
7. Move the stage so the image of the point is on the left edge of the screen.
8. Repeat steps 4-7, alternating sides, until the tip remains on the horizontal line.
9. Loosen the reference marker on the right side of the screen and align with horizontal line.
Consult digital readout manual for establishing Zero set point.

ANGULAR MEASUREMENTS (WITH DIGITAL SCREEN PROTRACTOR)

Consult Digital Readout manual for information on Digital Protractor operation

Incremental Method

1. Secure part to stage.
2. Focus image and position as required.
3. Align a screen reference line with an edge or feature, which is a datum. Zero the incremental 'Q' or ANGLE axis display on DRO.
4. Rotate screen reference line to feature to be measured, align by moving stage if necessary and read angle on incremental 'Q' axis display.

Absolute Method

1. Focus image and position as required.
2. Align datum on part with reference line on screen. Secure part to stage.
3. Rotate screen reference line to feature to be measured, align by moving stage if necessary and read angle on absolute 'Q' axis display.

MEASURING TECHNIQUES

The optical comparator has 2 basic measuring means. Direct Optical Comparison and Measured Linear Displacement.

If necessary, secure parts to stage top. Do not attempt to get accurate measurements unless parts are stable. S-T Industries offers several standard stage fixtures and builds special fixtures for unusual parts according to customer specifications. Contact S-T Industries sales department for information.

Direct Optical Comparison

Precise measurements can be made by comparing accurately magnified images to scaled drawings or shapes superimposed or overlaid on the image. Irregular contours, angles, radii, tapers, etc., together with high quantity measurements get compared best by use with master charts.

Three ways of chart preparation

1. To-scale part or feature drawings. Hand or CAD produced drawings on Mylar to a scale matching the lens magnification. Be sure lines are thin; .005"-.010" for best comparison accuracy.
2. Hand traced master. Focus a part or feature on the screen at the desired magnification. Use the chart clips or tape to secure a sheet of Mylar or drafting film to the surface of the screen. Using a fine point lead pencil, trace the profile. Care must be taken not to rotate the screen or move the part while tracing. Protect pencil lines by spraying a thin coat of a clear fixative.
3. Custom and standard overlay charts. S-T Industries, Inc. can supply precision overlay charts made to order as well as a full line of standard charts.

Charts can be held in place using the chart clips attached to the glass screen.

Measured Linear Displacement

The standard measuring stage allows accurate linear measurements in 2 axes, X and Y. The X-axis travel is 12" (300 mm) and the Y-axis travel is 7" (175 mm). The stage is equipped with .00005"/.001mm resolution glass scale encoders and one of several available digital readouts.

Procedure

1. Secure the part to the stage and focus area to be measured.
2. Be sure that screen is set at 0° and align first edge to be measured with either the vertical or horizontal screen line.
3. Zero the appropriate axis on the digital readout.
4. Move the stage until the second edge to be measured aligns with the same screen line.
5. Read the linear measurement in the digital readout.

This method can be greatly enhanced with the use of QuadraChek Geometric Digital Readouts.

The X and Y display value or coordinate is used to directly calculate geometric features such as points, lines, circles, distances and angles. Also, fiber optic edge detection and CNC control add speed, accuracy and reliability to these measurements.

DIGITAL READOUT SYSTEMS

The 1600 series 16" optical comparator comes with several optional digital readout systems:

#20-1600-01 16" optical comparator with standard digital readout system. S-T's model 20-7000 DRO features X, Y and angle axis. Also includes INCH/MM, INC/ABS and PRINT features.

#20-1600-02 16" optical comparator with QuadraChek 221 geometric digital readout system. DRO has all standard features plus geometric calculations including point, line, circle, distance, angle and skew and programmability.

#20-1600-03 16" optical comparator with QuadraChek 221E geometric digital readout system. DRO has all features of above system plus fiber optic edge detection.

#20-1600-05 16" optical comparator with QuadraChek 4215 computerized geometric digital readout system. DRO has all features of above system and includes PC computer with latest WINDOWS^R based QC 4215 software. Includes graphic representation of part features, mouse controlled commands, CAD-like graphical user interface and unlimited programmability.

CALIBRATION

Magnification

The screen magnification can be calibrated by using S-T Industries' 74-0413-10 Master Ball Checker and 74-0321-10 10" magnification scale.

1. Locate appropriate ball for lens to be checked. (Scale is marked with diameters and magnifications)
2. Focus ball in center of screen.
3. Using magnification scale, check size of image left to right.
4. Repeat check top to bottom.
5. Edge of image should ideally split lines on checking scale. This may vary from the inside of both lines to the outside of both lines.
6. Record the results and move the image to the upper right corner of the screen. Repeat the check.
7. Move to the remaining three corners of the screen and repeat check for all. If the magnification is incorrect, the mirror may need adjustment.

NOTE: It may be determined that the mirror is correct and that a lens needs adjustment.

For assistance in these procedures, contact S-T Industries, Inc. or your local S-T distributor.

CAUTION

Do not disassemble a lens system to adjust or clean internal glass surfaces. Assembly and calibration of these systems requires special alignment equipment and procedures. Notify your S-T representative if you have a lens problem.

Measuring Stage

The measuring stage linear accuracy can be calibrated by using S-T Industries' 74-0500-00 calibration plate.

1. Place the calibration plate on the stage so the longer side is parallel with the X-axis.
2. Focus on the 6" or 150mm scale.
3. Be sure that the screen is set to 0°.
4. Move the stage back and forth to see that the scale line stays on the crosshair. Adjust the calibration plate if necessary.
5. Align the '0' end of the calibration scale with the screen crosshair.
6. Zero the X-axis display on the DRO and move the stage until the other end of the scale aligns with the crosshair.
7. The X-axis display should read the same as the scale length; 6.00000" or 150.000mm. If it does not, consult your DRO manual and adjust LEC (Linear Error Correction) until the reading is correct.
8. Return to the '0' end of the scale, zero the X-axis display, if necessary, and move to the next increment on the scale (1.0" or 10mm). Record the value and repeat for each increment. Without moving the stage, carefully slide the calibration plate until the '0' line is aligned with the vertical screen line. Continue measuring to end of travel (X axis only).
9. For Y-axis, move top plate to center position. Stand stage calibration plate on end. Follow steps 4-8 using the Y-axis.

The measuring stage squareness can be calibrated by using S-T Industries' 74-0500-00 calibration plate.

1. Place the calibration plate on the stage so the longer side is parallel with the X-axis.
2. Focus on the 6" or 150mm scale.
3. Be sure that the screen is set to 0°.
4. Move the stage back and forth to see that the scale line stays on the crosshair. Adjust the calibration plate if necessary.
5. Move the stage until the end of the vertical axis of the calibration plate is aligned with the screen crosshair.
6. Zero the X and Y-axis displays on the DRO.
7. Move the stage in the Y direction only until you reach the end of the scale or the end of stage travel. If the line has moved away from the crosshair in the X direction, move the stage until it lines up again.
8. The squareness is the deviation of the X-axis divided by the length of travel along the Y-axis.

For assistance in this procedure contact S-T Industries, Inc. or your local S-T distributor.

MAINTENANCE

Care and cleaning of the Optical System

External Lens Cleaning

1. Remove all dust from external glass surfaces. Use a clean, soft brush (preferably a lens brush sold in camera stores) or clean cotton to avoid scratching. Turn the cotton each stroke to keep wiped dust particles from the lens.
2. With the dust removed use mild glass cleaner and clean absorbent cotton to clean the lens surface.

CAUTION

Never immerse a lens system in any cleaning solution. Moisten the cotton with the glass cleaner slightly; not soaking wet.

Mirror Cleaning

Remove top side panel to access mirrors.

Remove dust from mirror with a brush, described previously. If necessary, use a clean cotton cloth and a mild glass cleaner for more thorough cleaning. Wipe gently in straight-line motion across the mirror surface, turning the cotton with each pass across the mirror. Due to the delicate nature of the mirror coating, try to keep mirror cleaning to a minimum.

Projection Screen

Clean the projection screen with a mild glass cleaner. Use a clean, soft cloth. Do not use paper towels as they may contain abrasives.

Fuse Protection

A 3-amp fuse (2 amp for 220-240 volt) protects all electric circuits in the 20-1600 optical comparator. The fuse is located in the power input module located at the rear of the comparator. To change, remove the power cord from the power entry module and, using your finger, unsnap the fuse drawer and pull out. Change fuse and replace fuse drawer.

Lamp Replacement

When a lamp fails, wait 5 minutes before replacing to allow fans to cool off lamp area. After this time turn off main power and disconnect main power cord.

Profile Lamp (Part No. 48-7271-00)

1. Remove cover of profile lamphouse.
2. Slide burned lamp from the socket. Be careful, the lamp may still be hot.
3. Install a new lamp into the socket using a clean cloth or gloves to keep from touching the lamp. Rock slightly to seat in the socket and center the filament to the optics as close as possible.
4. Check cooling fan on left side of lamphouse and clean if necessary.
5. Replace cover panel.
6. Reconnect power cord and check lamp operation.

Surface Illumination Lamp (Part No. 48-7747-00)

1. To access the lamp, remove left panel.
2. To remove lamp, pull on ejector lever. Ease the lamp out of the socket into a cloth or glove. Be careful, the lamp may still be hot.
3. Slide the new lamp parallel into the socket. Keep the front face of the lamp parallel against the bracket front. Center the lamp front on the bracket opening.
4. Check the cooling fan and clean if necessary.
5. Replace cover panel.
6. Reconnect power cord and check lamp operation.

Lubrication

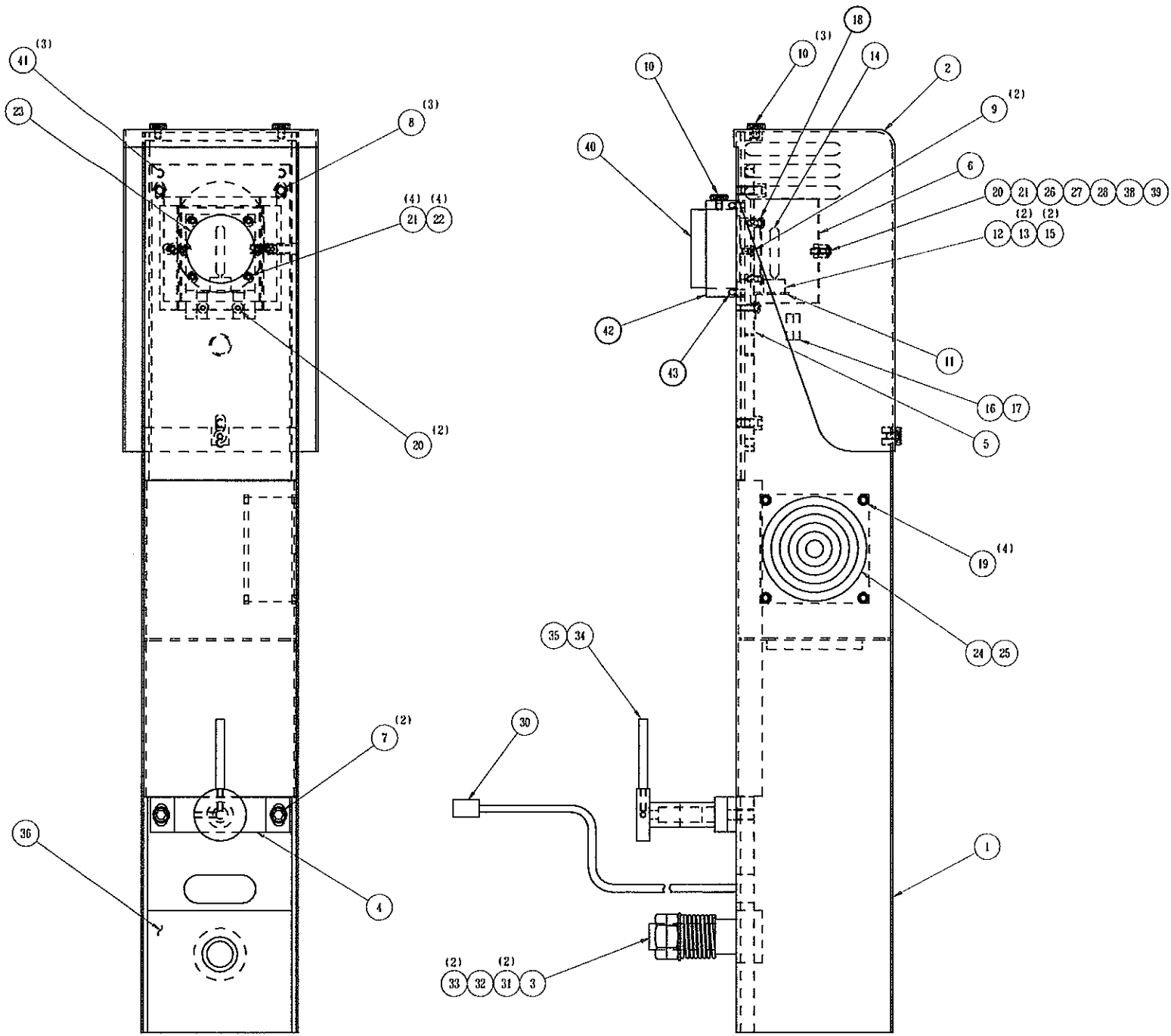
Lubricate ballways and ball bearings of measuring stage with light oil occasionally, to prevent corrosion and keep motion smooth. Use a light grease preferably with Teflon^R to lubricate leadscrews.

Parts Identification

Compare the part numbers on sub-assembly and part illustrations with their respective parts lists to identify parts.

Parts Ordering

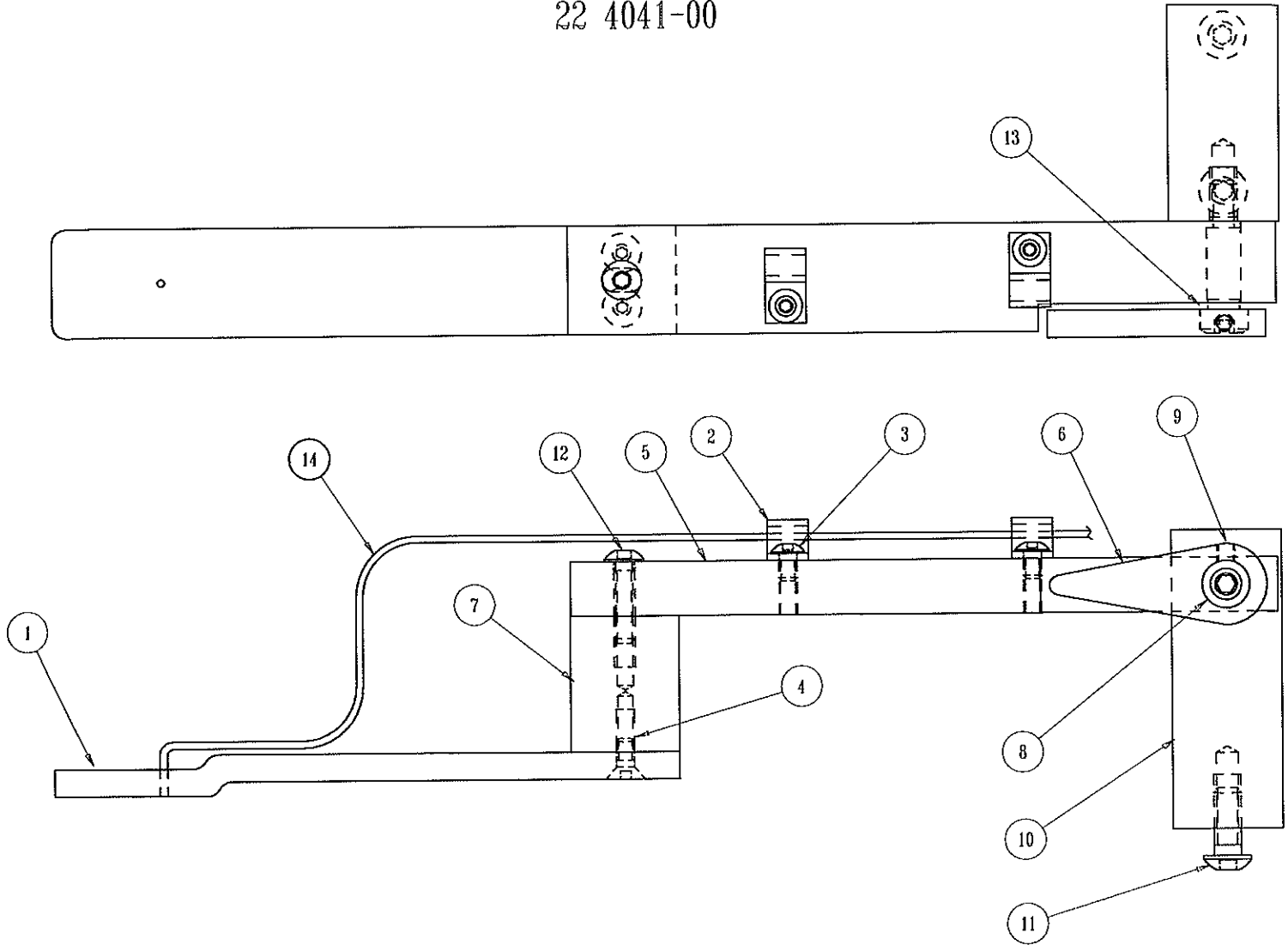
1. Furnish the comparator model and serial number
2. State the part number, description and quantity of each part required.
3. State shipping instructions.



LAMPHOUSE ASSY.

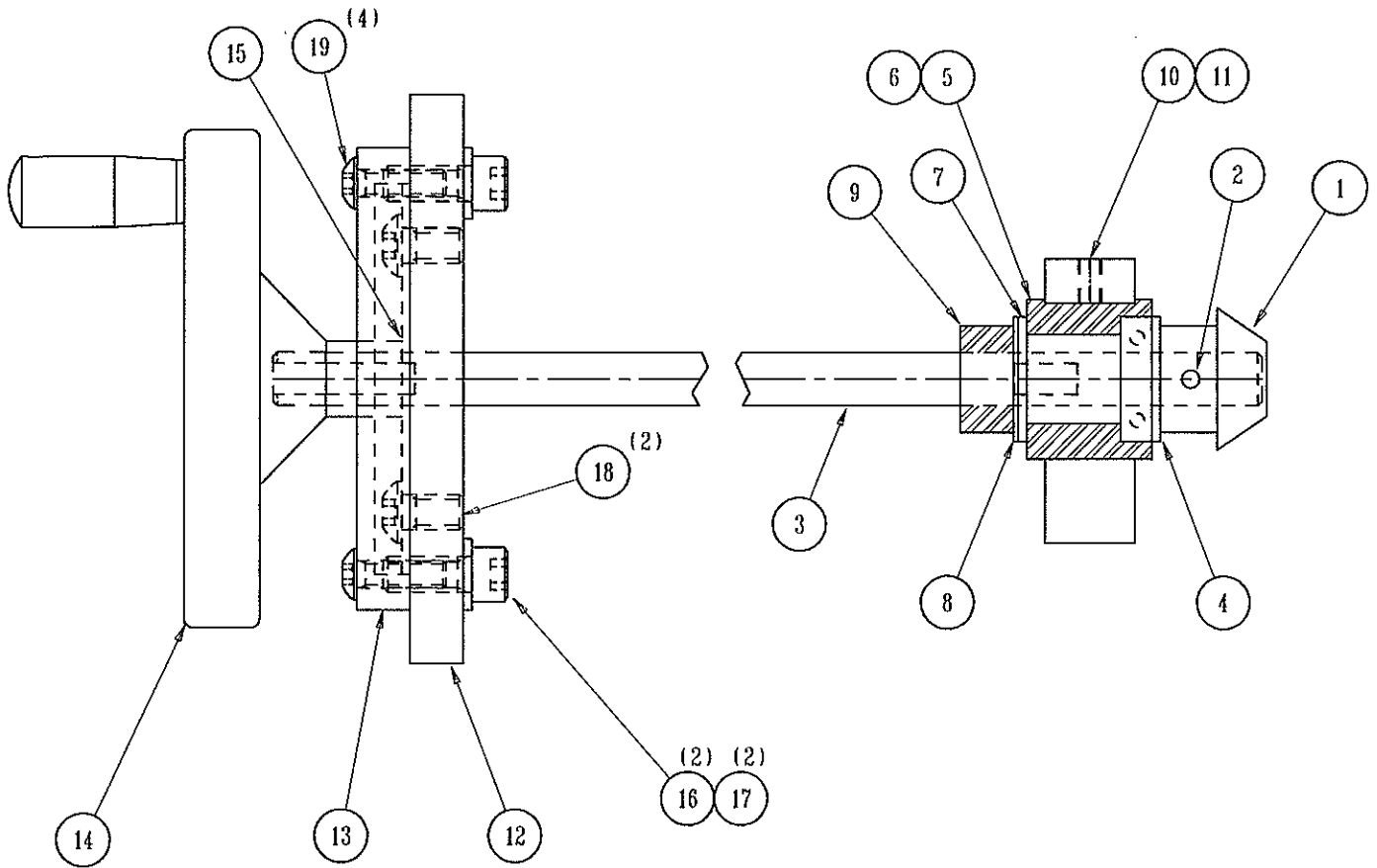
| 2 | 43 | 48 5438 | SCREW, BHCS 8-32 X 3/8 LG. |
|-------------------|------|------------|-------------------------------|
| 1 | 42 | 22 4028-05 | COND. LENS MOUNT |
| 3 | 41 | 48 5052 | SET SCREW 1/4-20 X 1/4 LG. |
| 1 | 40 | 48 8145 | CONDENSER LENS |
| 1 | 39 | 48 5797 | WASHER |
| 1 | 38 | 48 5185 | SCREW, BHCS 8-32 X 3/4 LG. |
| | 37 | | |
| 1 | 36 | 22 4028-04 | PLASTIC SPACER |
| 1 | 35 | 48 8189 | HANDLE |
| 1 | 34 | 48 6035 | WASHER |
| 2 | 33 | 48 6173 | JAM NUT 3/4-16 |
| 1 | 32 | 22 3985-16 | COMPRESSION SPRING |
| 2 | 31 | 48 8186 | WASHER |
| 1 | 30 | 22 4028-03 | LAMPHOUSE CABLE ASSY. |
| | 29 | | |
| 1 | 28 | 48 5196 | HEX NUT 8-32 |
| 1 | 27 | 48 5339 | SCREW, BHCS 4-40 X 1/4 LG. |
| 1 | 26 | 22 3599 | CLAMP, FIBER OPTIC |
| 1 | 25 | 48 6778 | FAN GUARD |
| 1 | 24 | 22 3426 | FAN |
| 1 | 23 | 48 8165 | HEAT ABSORBING LENS D30, 792 |
| 4 | 22 | 48 8032 | SCREW, FLANGE 8-32 X 3/8 LG. |
| 5 | 21 | 22 3948-05 | STAND OFF |
| 3 | 20 | 48 5126 | SCREW, BHCS 8-32 X 1/2 LG. |
| 4 | 19 | 48 6479 | SCREW, BHCS 10-32 X 1/2 LG. |
| 1 | 18 | 22 4028-02 | APPERATURE PLATE |
| 2 | 17 | 48 6189 | PIN |
| 2 | 16 | 48 7273 | 1 CIRCUIT PLUG |
| 2 | 15 | 48 7991 | SPACER |
| 1 | 14 | 48 7271 | BULB 150W 24V |
| 2 | 13 | 48 5319 | SCREW, SHCS 6-32 X 1/2 LG. |
| 1 | 12 | 48 7425 | SOCKET |
| 1 | 11 | 22 3948-03 | SOCKET MOUNT, BULB |
| 4 | 10 | 22 2107-19 | THUMB SCREW |
| 2 | 9 | 48 5111 | SCREW, BHCS 8-32 X 1/4 LG. |
| 3 | 8 | 48 5321 | SCREW, SHCS 1/4-20 X 1/2 LG. |
| 2 | 7 | 48 5403 | SCREW, SHCS 5/16-18 X 5/8 LG. |
| 1 | 6 | 22 3981-12 | BULB COVER |
| 1 | 5 | 22 3981-11 | LAMPHOUSE ADJUSTING PLATE |
| 1 | 4 | 22 3981-09 | LOCK BAR |
| 1 | 3 | 22 3981-08 | PIVOT PIN |
| 1 | 2 | 22 4028-01 | LAMPHOUSE COVER, PAINTED |
| 1 | 1 | 22 4029-00 | WELDMENT, LAMPHOUSE |
| QTY. | ITEM | PART NO. | DESCRIPTION |
| LIST OF MATERIALS | | | |

OPTIC MOUNT ARM ASSY.
22 4041-00



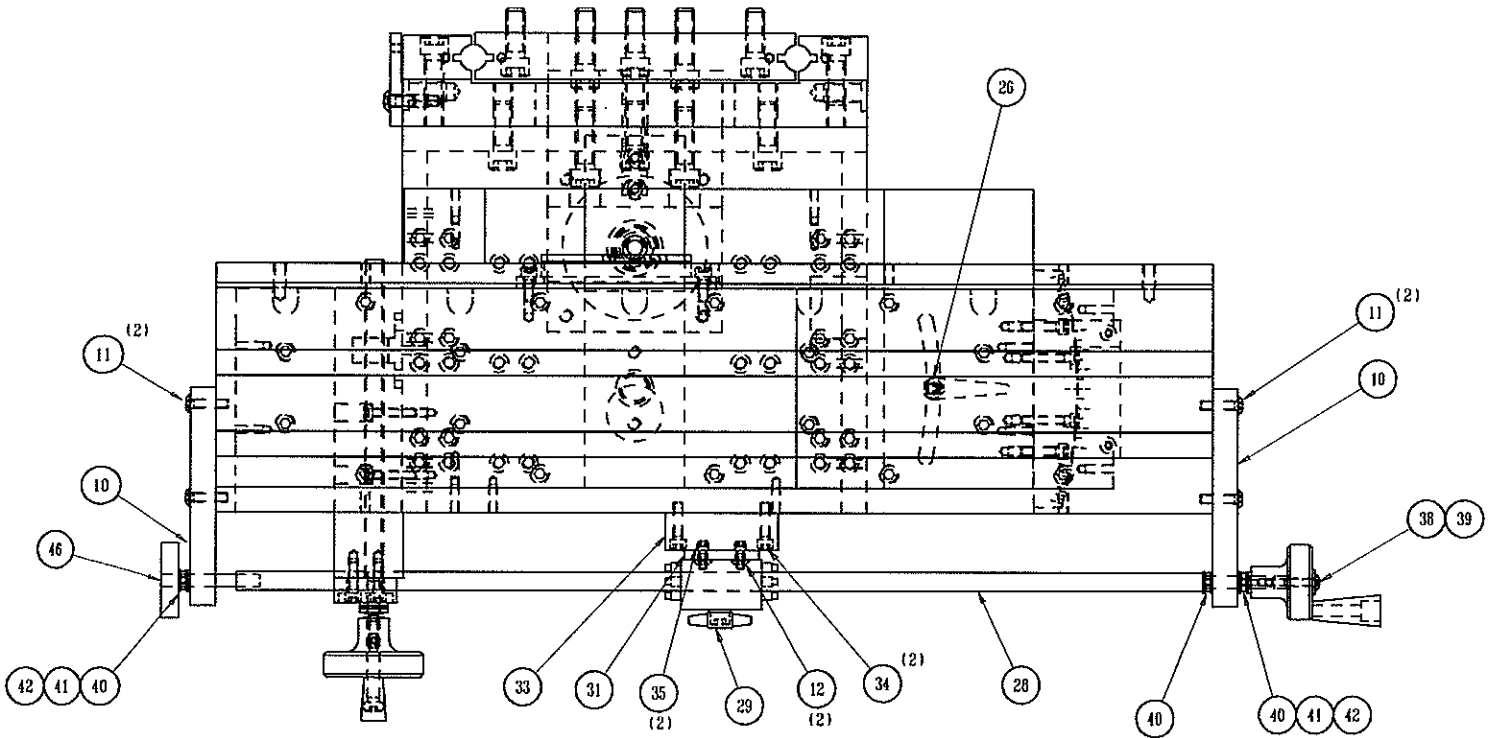
| REF | QTY. | ITEM | PART NO. | DESCRIPTION |
|-----|------|------|------------|------------------------------|
| | 1 | 14 | 48 7785 | FIBER OPTIC CABLE |
| | 1 | 13 | 48 6630 | WASHER, WAVE |
| | 1 | 12 | 48 6684 | SCREW, BHCS 10-24 X 3/4 LG. |
| | 2 | 11 | 48 5284 | SCREW, BHCS 1/4-20 X 5/8 LG. |
| | 1 | 10 | 22 4041-02 | RISER BLOCK |
| | 1 | 9 | 48 5244 | SCREW, SET 8-32 X 3/16 LG. |
| | 1 | 8 | 48 7805 | SHOULDER SCREW |
| | 1 | 7 | 22 3757-03 | SPACER |
| | 1 | 6 | 22 3747-03 | LEVER |
| | 1 | 5 | 22 4041-01 | SWIVEL ARM |
| | 2 | 4 | 48 5382 | SCREW, FHCS 8-32 X 3/8 LG. |
| | 2 | 3 | 48 5111 | SCREW, BHCS 8-32 X 1/4 LG. |
| | 2 | 2 | 48 7352 | CLAMP |
| | 1 | 1 | 22 3747-05 | MOUNT, PLASTIC |
| REF | QTY. | ITEM | PART NO. | DESCRIPTION |

PINION DRIVE ASSY.



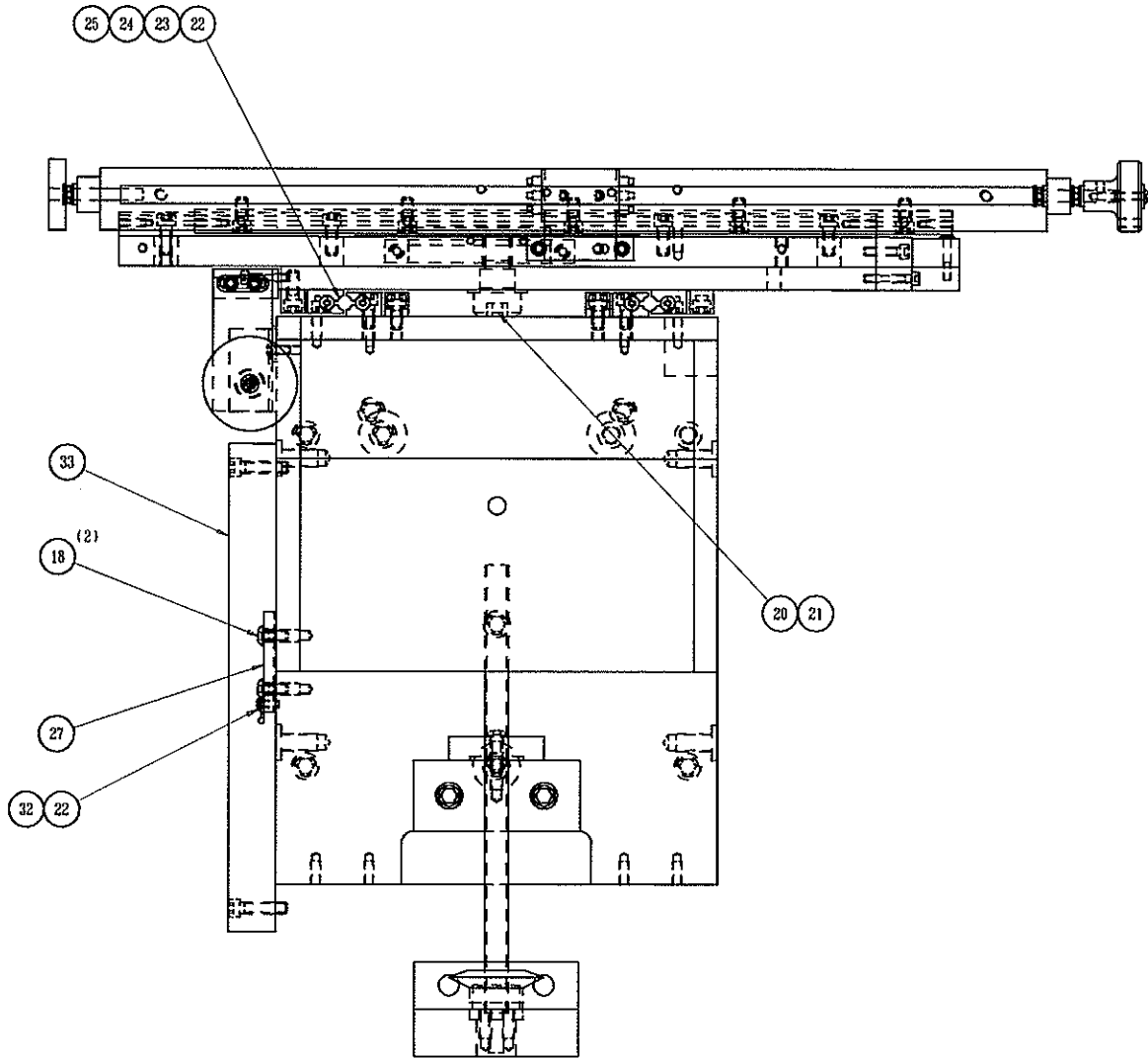
| | | | |
|------|------|------------|------------------------------|
| 4 | 19 | 48 5622 | SCREW, BHCS 10-32 X 5/8 LG |
| 2 | 18 | 48 5430 | SCREW, BHCS 1/4-20 X 3/8 LG. |
| 2 | 17 | 48 6000 | WASHER |
| 2 | 16 | 48 5160 | SCREW, SHCS 1/4-20 X 5/8 LG. |
| 1 | 15 | 48 7690 | BEARING FLANGE |
| 1 | 14 | 22 3831 | HAND WHEEL 2 SPOKE PLASTIC |
| 1 | 13 | 22 3936-08 | COVER |
| 1 | 12 | 22 4034-03 | BEARING MOUNT |
| 1 | 11 | 48 5244 | SET SCREW 8-32 X 3/16 LG. |
| 1 | 10 | 22 4034-02 | BEARING BRACKET |
| 1 | 9 | 22 3123 | SETSCREW COLLAR |
| 1 | 8 | 48 7695 | WASHER, TEFLON |
| 1 | 7 | 48 5979 | WASHER .39 I.D. X .88 O.D. |
| 1 | 6 | 22 3713-02 | ADJ. BUSHING |
| 1 | 5 | 48 7691 | BEARING |
| 1 | 4 | 48 7696 | WASHER .38 I.D. X .63 O.D. |
| 1 | 3 | 22 4034-01 | DRIVE SHAFT (16" COMP) |
| 1 | 2 | 48 5124 | 1/8 SPRING PIN |
| 1 | 1 | 22 2079 | BEVEL GEAR |
| QTY. | ITEM | PART NO. | DESCRIPTION |

STAGE "TOP VIEW"



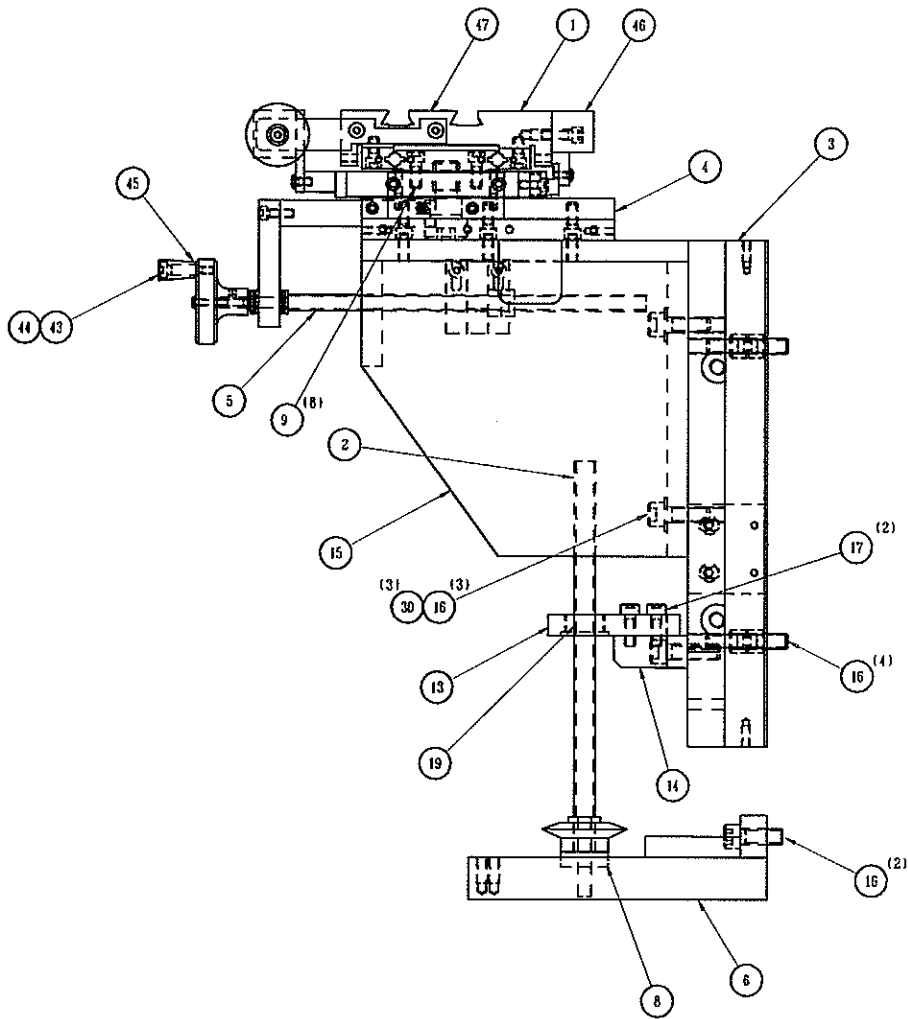
| | | | |
|------|------|------------|------------------------------|
| 1 | 46 | 48 7790 | KNOB 1 1/2" DIA. |
| 2 | 42 | 48 7437 | BEARING, FLANGE |
| 2 | 41 | 48 6630 | WASHER, WAVE |
| 3 | 40 | 48 7646 | BEARING, THRUST |
| 1 | 39 | 48 6083 | WASHER |
| 1 | 38 | 48 5329 | SCREW, BHCS 8-32 X 5/8 LG. |
| 2 | 35 | 48 5412 | SCREW, SHCS 6-32 X 3/8 LG. |
| 2 | 34 | 48 5018 | SCREW, SHCS 10-32 X 7/8" LG. |
| 1 | 33 | 22 4030-05 | ROH-LIX BLOCK |
| 1 | 31 | 22 4030-04 | ROH-LIX PLATE |
| 1 | 29 | 22 4016-00 | ROH-LIX QUICK RELEASE |
| 1 | 28 | 22 4030-07 | "X" AXIS LEAD SCREW |
| 1 | 26 | 48 8196 | THREADED HANDLE |
| 2 | 12 | 48 5358 | SCREW, BHCS 10-32 X 3/8 LG. |
| 4 | 11 | 48 5275 | SCREW, BHCS 10-32 X 3/4 LG. |
| 2 | 10 | 22 4030-01 | LEAD SCREW MOUNT "X" AXIS |
| QTY. | ITEM | PART NO. | DESCRIPTION |

STAGE "FRONT VIEW"



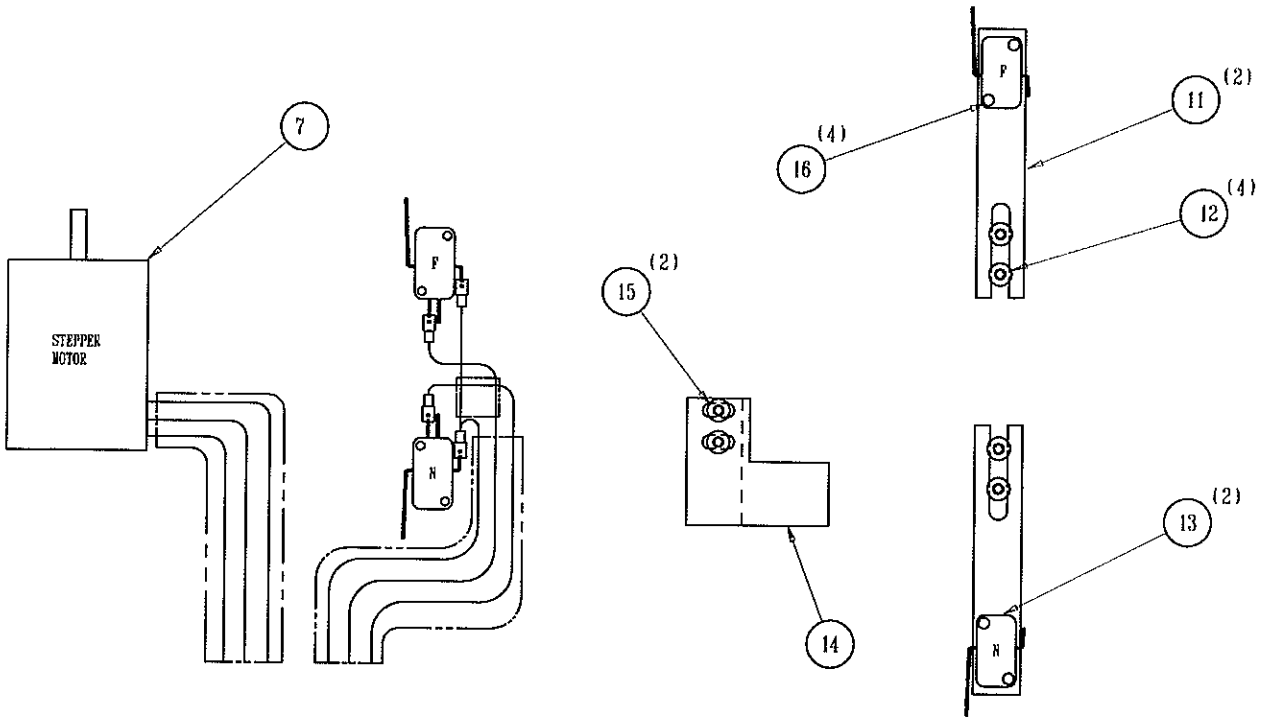
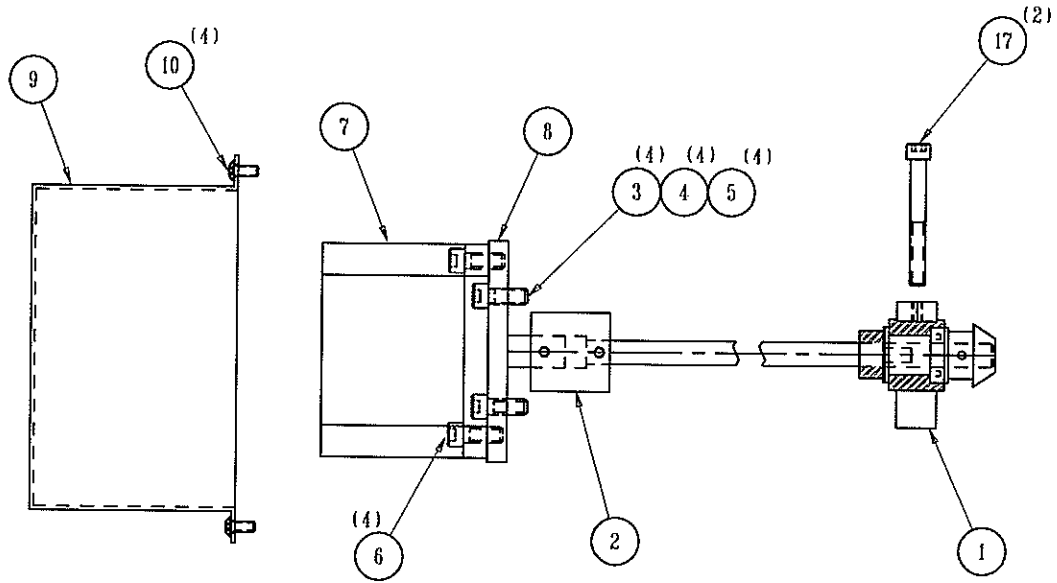
| | | | |
|------|------|------------|-----------------------------------|
| 1 | 33 | 48 8092 | VERTICAL SCALE 6" |
| 1 | 32 | 48 8140 | CABLE TIE |
| 1 | 27 | 22 3977-41 | VERT. ENCODER MOUNT |
| 12 | 25 | 48 7679 | BALL |
| 2 | 24 | 22 3977-42 | BALL RETAINER (FOCUS) |
| 8 | 23 | 48 7693 | WASHER |
| 9 | 22 | 48 5438 | SCREW, BHCS 8-32 X 3/8 LG. |
| 2 | 21 | 48 8116 | WAVE WASHER |
| 1 | 20 | 48 8172 | SHOULDER SCREW 3/4 DIA. X 1/2 LG. |
| 2 | 18 | 48 6425 | SCREW, BHCS 1/4-20 X 1/2 LG. |
| QTY. | ITEM | PART NO. | DESCRIPTION |

STAGE "SIDE VIEW"



| | | | |
|------|------|------------|-------------------------------|
| 1 | 47 | 22 4031-01 | TOP PLATE |
| 1 | 46 | 48 7796 | 12" SCALE .000050 |
| 2 | 45 | 48 6135 | WASHER |
| 2 | 44 | 48 5131 | SHOULDER SCREW |
| 2 | 43 | 22 1007 | HANDLE |
| 3 | 30 | 48 5979 | WASHER |
| 1 | 19 | 48 8212 | PLASTIC NUT |
| 2 | 17 | 48 5057 | SCREW, SHCS 1/4-20 X 3/4 LG. |
| 9 | 16 | 48 5115 | SCREW, SHCS 3/8-16 X 1.00 LG. |
| 1 | 15 | 22 3977-51 | STAGE MOUNT ASSY. |
| 1 | 14 | 22 4030-03 | BEARING BLOCK |
| 1 | 13 | 22 4030-02 | BEARING PLATE |
| 8 | 9 | 48 5160 | SCREW, SHCS 1/4-20 X 5/8 LG. |
| 1 | 8 | 48 8072 | BEARING |
| 1 | 6 | 22 4033-00 | GEAR MOUNT WELDMENT |
| 1 | 5 | 22 3977-56 | FOCUS SCREW ASSY. |
| 1 | 4 | 22 3977-53 | SPACER PLATE ASSY. |
| 1 | 3 | 22 3977-50 | VERTICAL CRB ASSY. |
| 1 | 2 | 22 4032-00 | VERTICAL SCREW & GEAR ASSY. |
| 1 | 1 | 22 4031-00 | CENTER PLATE ASSY. |
| QTY. | ITEM | PART NO. | DESCRIPTION |

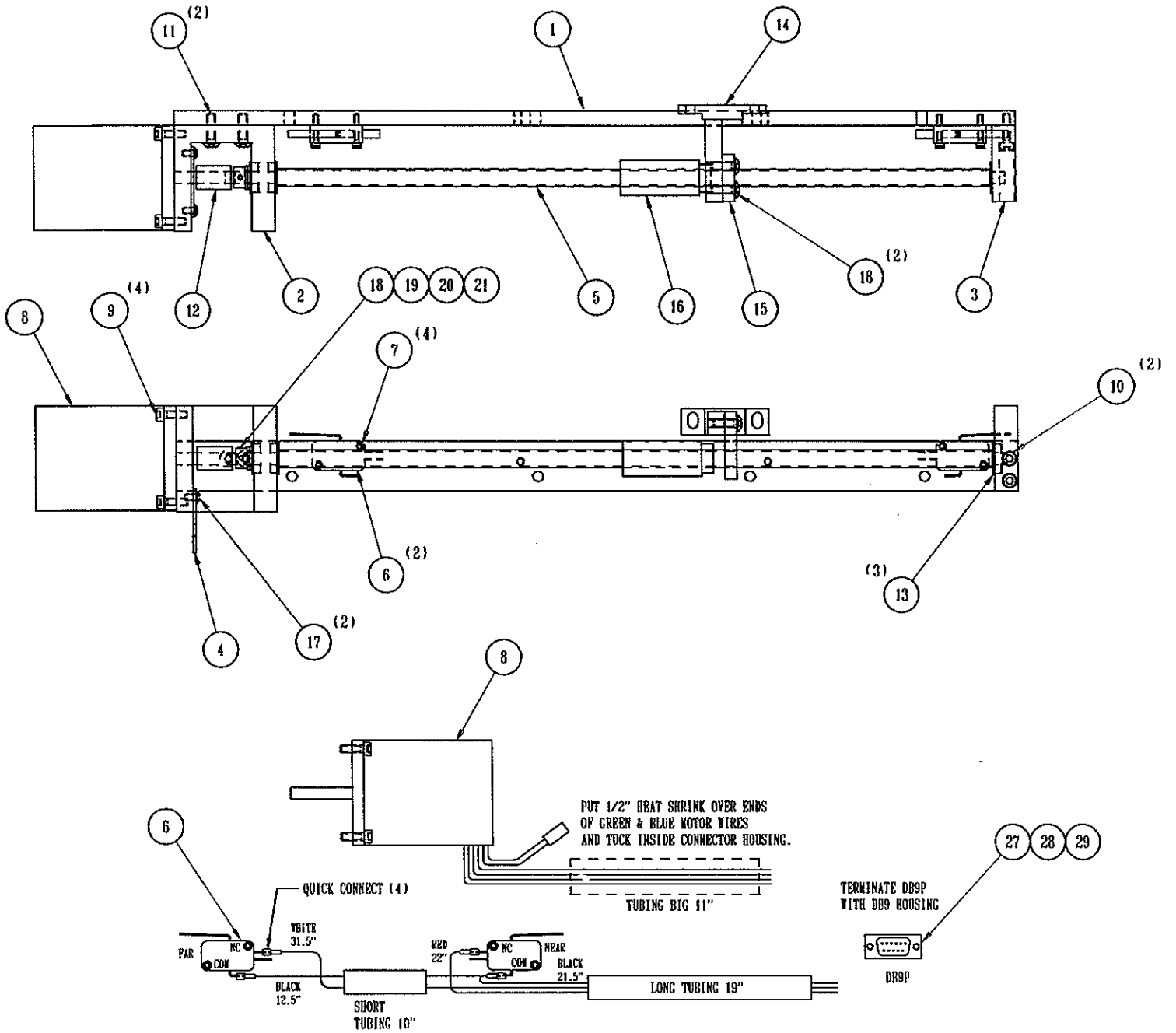
VERTICAL MOTOR DRIVE



VERTICAL MOTOR DRIVE

| | | | |
|-------------------|------|------------|--------------------------------|
| 2 | 17 | 48 5391 | SCREW, SHCS 1/4-20 X 1 3/4 LG. |
| 4 | 16 | 48 6760 | SCREW, BHCS 4-40 X 5/8 LG. |
| 2 | 15 | 48 5275 | SCREW, BHCS 10-32 X 3/4 LG. |
| 1 | 14 | 22 4052-06 | VERT. SWITCH STOP |
| 2 | 13 | 48 8044 | MICRO LIMIT SWITCH |
| 4 | 12 | 48 6425 | SCREW, BHCS 1/4-20 X 1/2 LG. |
| 2 | 11 | 22 4052-05 | VERT. SWITCH MOUNT |
| 4 | 10 | 48 5438 | SCREW, BHCS 8-32 X 3/8 LG. |
| 1 | 9 | 22 4052-10 | MOTOR COVER |
| 1 | 8 | 22 4052-03 | STEPPER MOTOR MOUNT |
| 1 | 7 | 22 3985-28 | VERT. MOTOR & WIRE ASSY. |
| 4 | 6 | 48 5321 | SCREW, SHCS 1/4-20 X 1/2 LG. |
| 4 | 5 | 48 6077 | LOCK WASHER |
| 4 | 4 | 48 6072 | HEX NUT |
| 4 | 3 | 48 5057 | SCREW, SHCS 1/4-20 X 3/4 LG. |
| 1 | 2 | 48 8236 | COUPLER |
| 1 | 1 | 22 4052-08 | PINION DRIVE ASSY. |
| QTY. | ITEM | PART NO. | DESCRIPTION |
| LIST OF MATERIALS | | | |

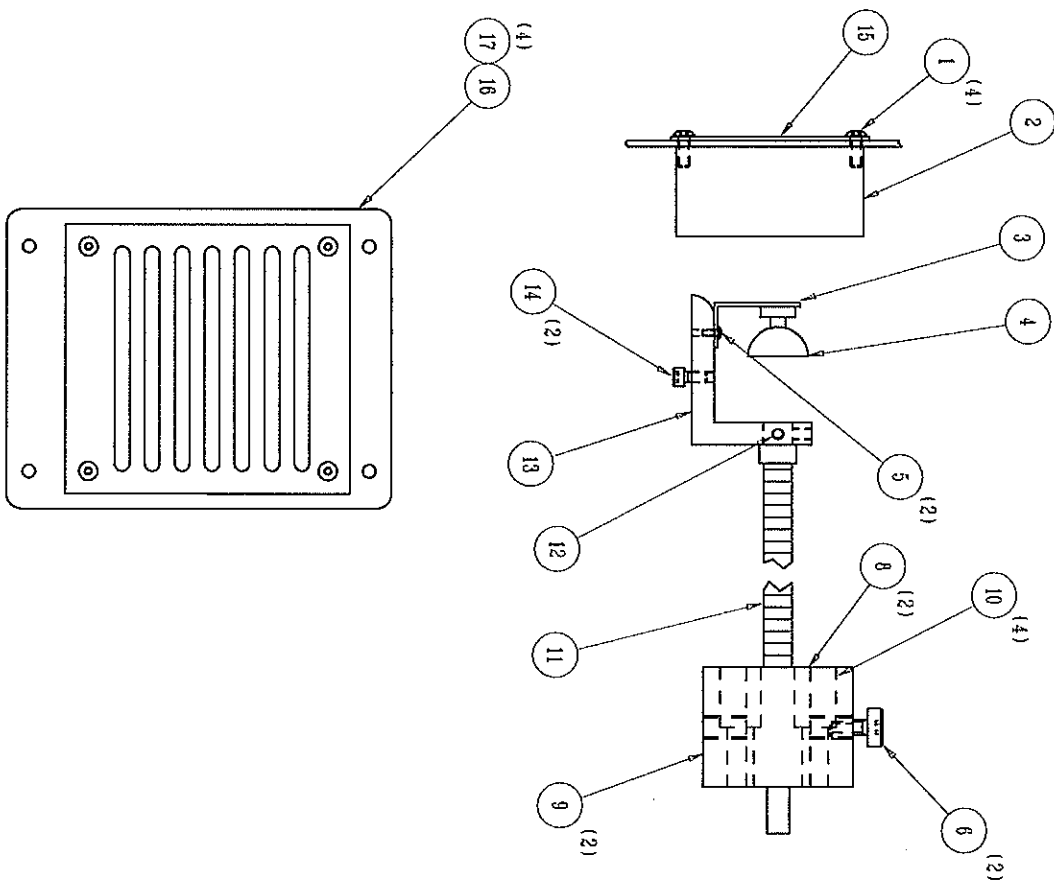
"X" AXIS MOUNT BAR ASSY.



"X" AXIS MOUNT BAR ASSY.

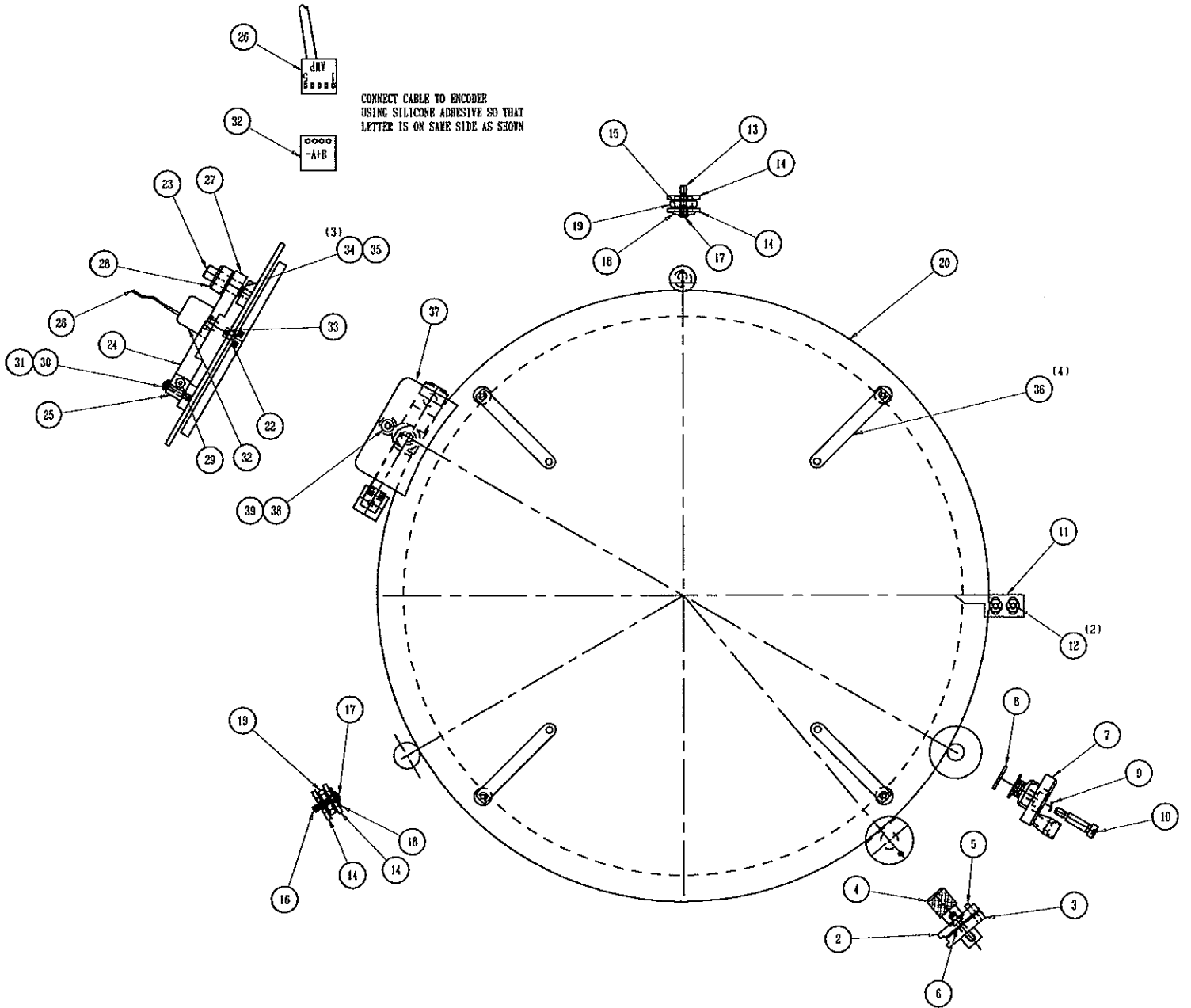
| | | | |
|-------|------|------------|-----------------------------|
| 11" | 32 | 48 5660 | TUBING (BIG) |
| 29" | 31 | 48 8054 | TUBING |
| | 30 | | |
| 1 | 29 | 48 7658 | DB9P CONNECTOR |
| 1 | 28 | 48 7659 | DB HOUSING |
| 1 | 27 | 48 8079 | DB LONG HARDWARE |
| 31.5" | 26 | 48 7415 | WHITE WIRE #22 |
| 22" | 25 | 48 7413 | RED WIRE #22 |
| 34" | 24 | 48 7416 | BLACK WIRE #22 |
| 4 | 23 | 48 7994 | QUICK CONNECT TERMINAL |
| | 22 | | |
| 1 | 21 | 48 5813 | SET SCREW 4-40 X 1/8 LG. |
| 1 | 20 | 22 2761 | COLLAR, SPINDLE |
| 1 | 19 | 48 6630 | WASHER, WAVE |
| 1 | 18 | 48 6000 | WASHER |
| 2 | 17 | 48 5137 | SCREW, BHCS 6-32 X 1/4 LG. |
| 1 | 16 | 48 8177 | SUPERNUT |
| 1 | 15 | 22 3977-09 | NUT MOUNT |
| 1 | 14 | 22 3977-10 | NUT BRACKET |
| 3 | 13 | 48 7928 | BEARING |
| 1 | 12 | 48 8170 | COUPLING |
| 2 | 11 | 48 5329 | SCREW, BHCS 10-32 X 5/8 LG. |
| 2 | 10 | 48 5157 | SCREW, SHCS 8-32 X 5/8 LG. |
| 4 | 9 | 48 5061 | SCREW, SHCS 8-32 X 1/2 LG. |
| 1 | 8 | 22 3977-52 | STEPPER MOTOR |
| 4 | 7 | 48 6760 | SCREW, BHCS 4-40 X 5/8 LG. |
| 2 | 6 | 48 8044 | LIMIT SWITCH |
| 1 | 5 | 22 3977-21 | "X" AXIS LEAD SCREW |
| 1 | 4 | 22 3924-04 | CONNECTOR, HORIZ. MOTOR |
| 1 | 3 | 22 3977-06 | END BEARING BLOCK |
| 1 | 2 | 22 3977-07 | BEARING & MOTOR MOUNT |
| 1 | 1 | 22 3977-05 | "X" AXIS MOUNT BAR |
| QTY. | ITEM | PART NO. | DESCRIPTION |

FIBER OPTIC MOUNT ASSY.



| QTY. | ITEM | PART NO. | DESCRIPTION |
|------|------|------------|--------------------------------|
| 4 | 17 | 48 5106 | SCREW, BRCS 10-32 X 1/4 LG. |
| 1 | 16 | 22 4038-00 | SURF. ILLUM. DOOR ASSY. |
| 1 | 15 | 48 6778 | FAN GUARD |
| 2 | 14 | 48 5007 | SCREW, SHCS 10-32 X 3/8 LG. |
| 1 | 13 | 22 3952-02 | SOCKET MOUNT |
| 1 | 12 | 48 5101 | SOC SET SCREW 10-32 X 5/16 LG. |
| 1 | 11 | 48 7430 | FIBER OPTIC BUNDLE |
| 4 | 10 | 48 5275 | SCREW, SHCS 10-32 X 3/4 LG. |
| 2 | 9 | 22 4039-01 | FIBER OPTIC MOUNT |
| 2 | 8 | 22 3952-03 | STOP BUSHING |
| | 7 | | |
| 2 | 6 | 22 2107-19 | TRUUB SCREW |
| 2 | 5 | 48 5339 | SCREW, BRCS 4-40 X 1/4 LG. |
| 1 | 4 | 48 7747 | PROJ. LAMP 100W/12V |
| 1 | 3 | 22 3714-34 | SOCKET ASSY. SURFACE ILLUM. |
| 1 | 2 | 22 3426 | TAPPED FAN ASSY. |
| 4 | 1 | 48 6479 | SCREW, BRCS 10-32 X 1/2 LG. |

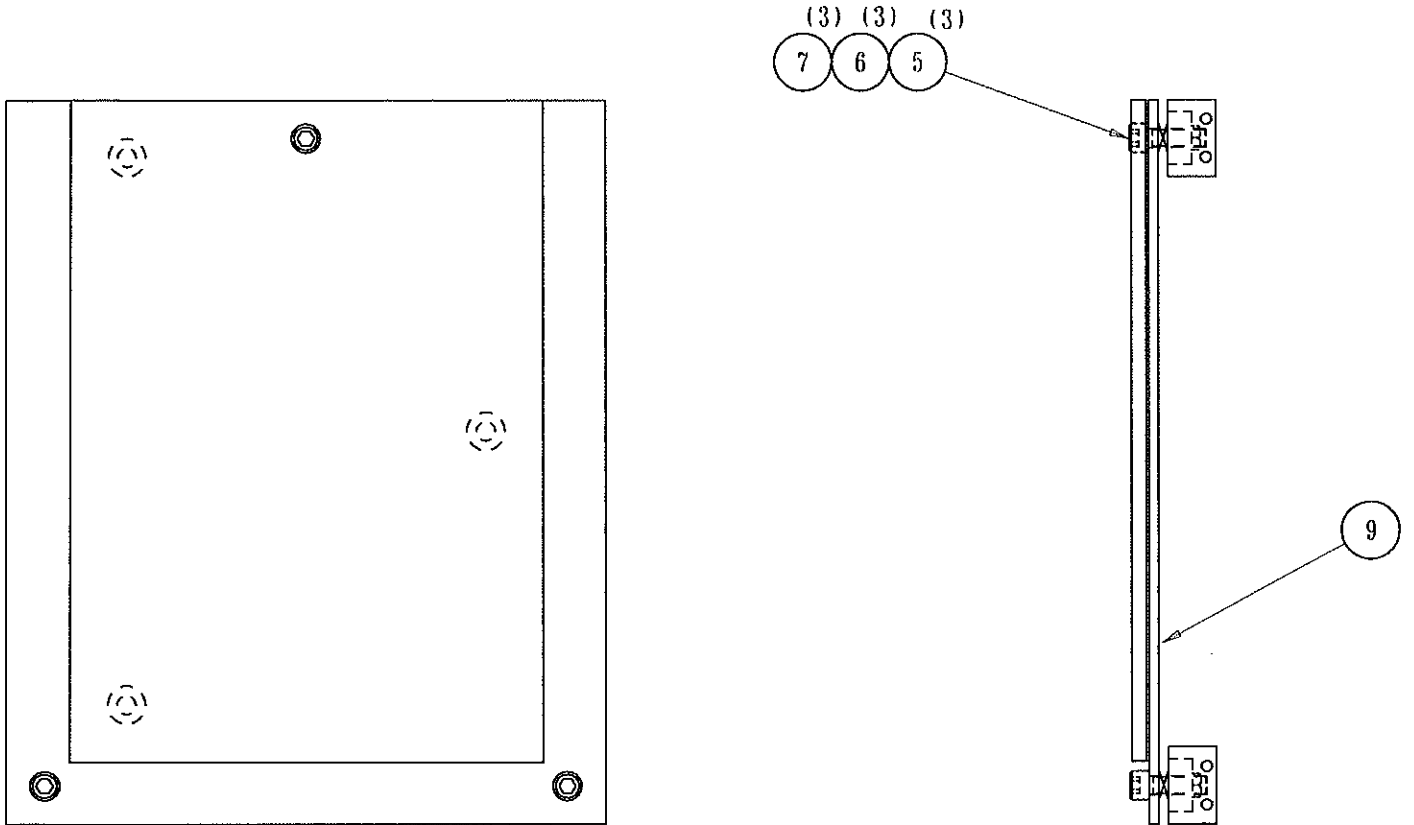
SCREEN ASSY.



SCREEN ASSY.

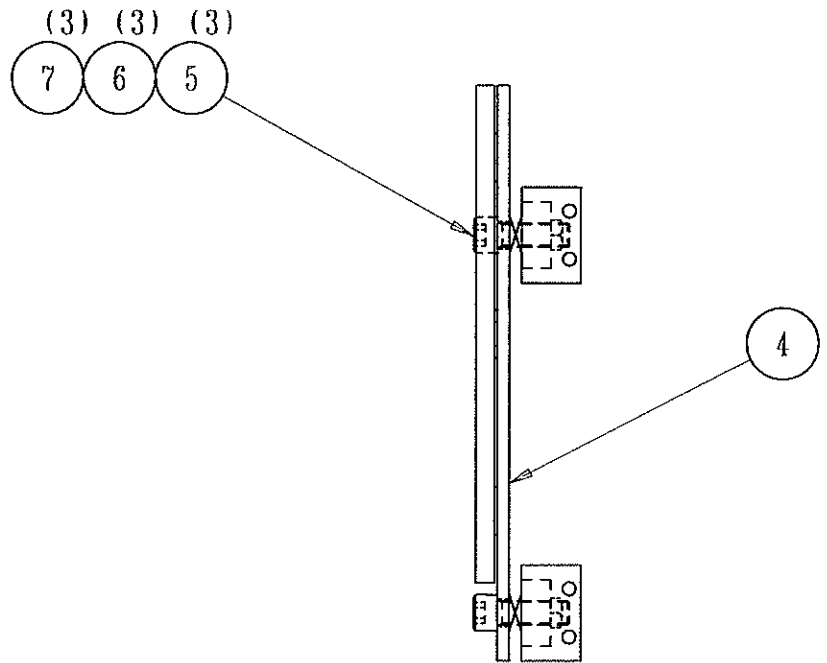
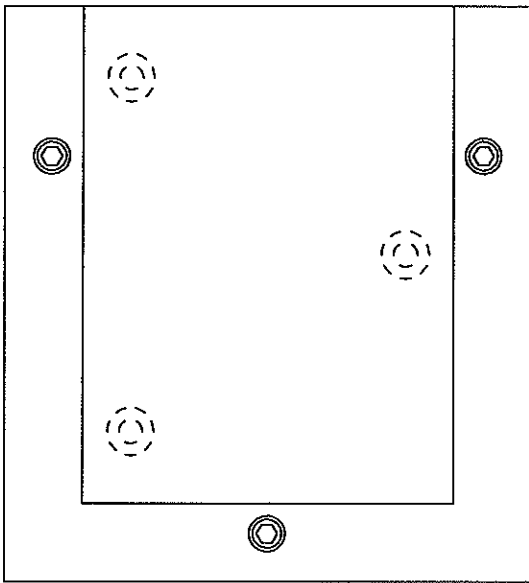
| 1 | 39 | 48 6525 | SCREW BHCS 10-24 X 5/8 LG. |
|------|------|--------------|------------------------------|
| 1 | 38 | 22 4035-04 | SPACER |
| 1 | 37 | 22 4035-03 | ENCODER WHEEL COVER |
| 4 | 36 | 22 3952-09 | SCREEN CLIP |
| 1 | 35 | 48 6737 | WAVE WASHER |
| 3 | 34 | 48 6070 | NYLON WASHER |
| 1 | 33 | 48 5813 | SET SCREW 4-40 X 1/8 LG. |
| 1 | 32 | 48 7692 | ENCODER |
| 1 | 31 | 48 6654 | WASHER, SPRING LOCK |
| 1 | 30 | 48 5185 | SCREW, BHCS 8-32 X 3/4 LG. |
| 1 | 29 | 48 5137 | SCREW, BHCS 6-32 X 1/4 LG. |
| 1 | 28 | 48 5125 | COLLAR, SET SCREW |
| 1 | 27 | 22 3711-02 | PIVOT ARM |
| 1 | 26 | 22 3723-03 | CABLE ASSY. ENCODER |
| 1 | 25 | 22 3711-07 | TENSION BLOCK |
| 1 | 24 | 22 3711-08 | TENSION SPRING |
| 1 | 23 | 22 3711-06 | PIVOT SHAFT |
| 1 | 22 | 22 3711-26 | ENCODER WHEEL |
| | 21 | | |
| 1 | 20 | 74 0008-1625 | 16" GLASS SCREEN |
| 2 | 19 | 48 8003 | BEARING |
| 2 | 18 | 48 6083 | WASHER |
| 2 | 17 | 48 5111 | SCREW, BHCS 8-32 X 1/4 LG. |
| 1 | 16 | 22 3711-29 | THREADED PIVOT STUD 1/2" |
| 1 | 15 | 22 3711-31 | BUSHING, ECCENTRIC |
| 4 | 14 | 22 3711-30 | CAP |
| 1 | 13 | 22 3711-28 | THREADED PIVOT STUD 1/4" |
| 2 | 12 | 48 6560 | SCREW, BHCS 10-24 X 1/4 LG. |
| 1 | 11 | 22 3941-10 | SCREEN POINTER |
| 1 | 10 | 48 5598 | SHOULDER SCREW 1/4 X 3/4 LG. |
| 1 | 9 | 48 8004 | WAVE WASHER |
| 1 | 8 | 48 5521 | WASHER |
| 1 | 7 | 22 4035-01 | DRIVE KNOB & ROLLER ASSY. |
| 1 | 6 | 48 7604 | SPRING |
| 1 | 5 | 48 5153 | DOWEL PIN 1/8 X 5/8 LG. |
| 1 | 4 | 22 3941-08 | LOCK SCREW, SCREEN ASSY. |
| 1 | 3 | 22 3941-06 | TOP SCREEN LOCK |
| 1 | 2 | 22 3941-05 | BOTTOM SCREEN LOCK |
| | 1 | | |
| QTY. | ITEM | PART NO. | DESCRIPTION |

TOP MIRROR ASSY.



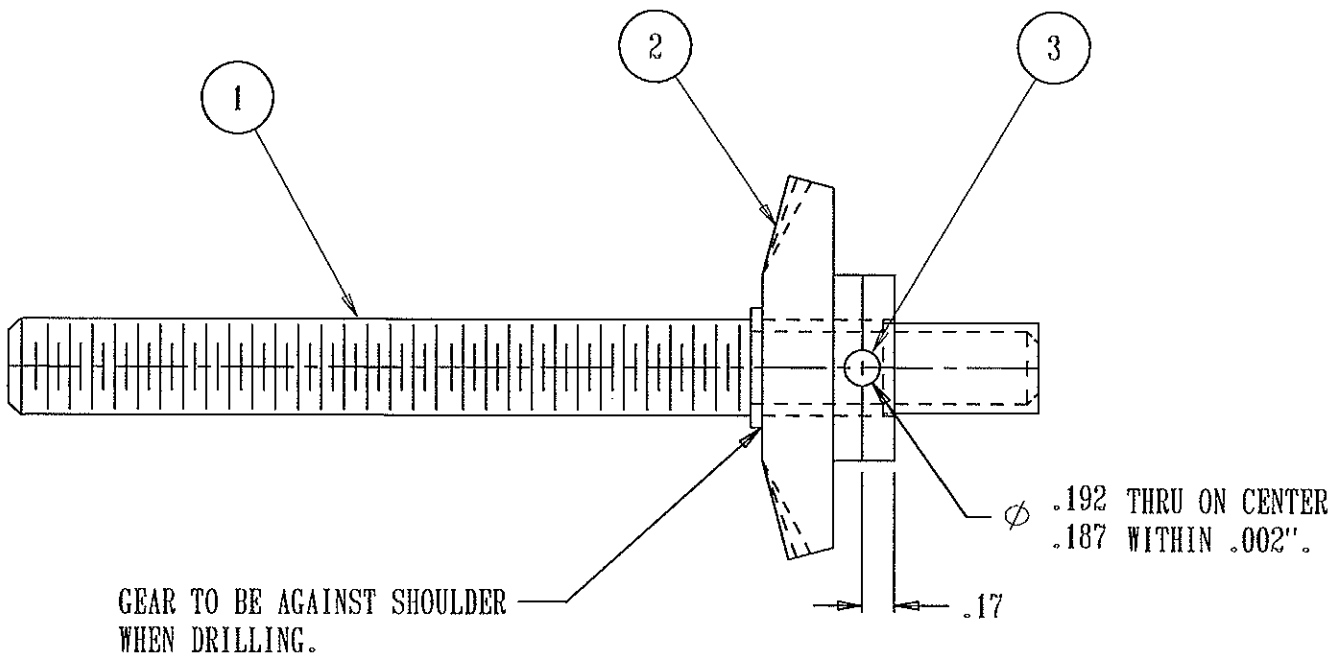
| | | | |
|------|------|--------------|--------------------------------|
| 1 | 9 | 22 4037-00 | TOP MIRROR & PLATE ASSY. |
| 6 | 7 | 48 5035 | HEX NUT |
| 6 | 6 | 22 0474-0088 | SPRING |
| 6 | 5 | 48 8112 | SCREW, SHCS 1/2-20 X 2 1/2 LG. |
| QTY. | ITEM | PART NO. | DESCRIPTION |

BOTTOM MIRROR ASSY.



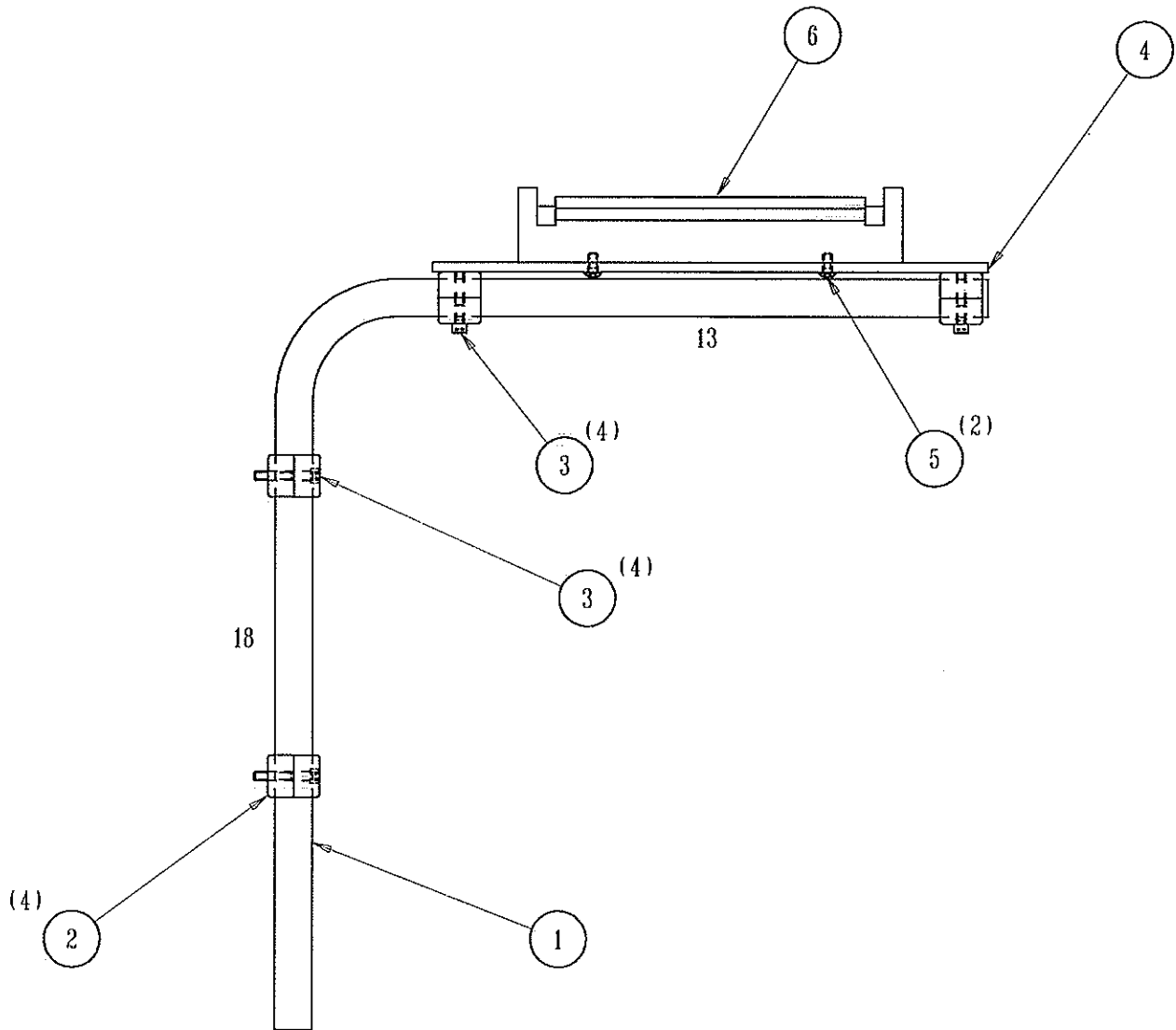
| | | | |
|------|------|--------------|--------------------------------|
| 6 | 7 | 48 5035 | HEX NUT |
| 6 | 6 | 22 0474-0088 | SPRING |
| 6 | 5 | 48 8112 | SCREW, SHCS 1/2-20 X 2 1/2 LG. |
| 1 | 4 | 22 4036-00 | BOTTOM MIRROR & PLATE ASSY. |
| QTY. | ITEM | PART NO. | DESCRIPTION |

VERT. SCREW & GEAR ASSY.



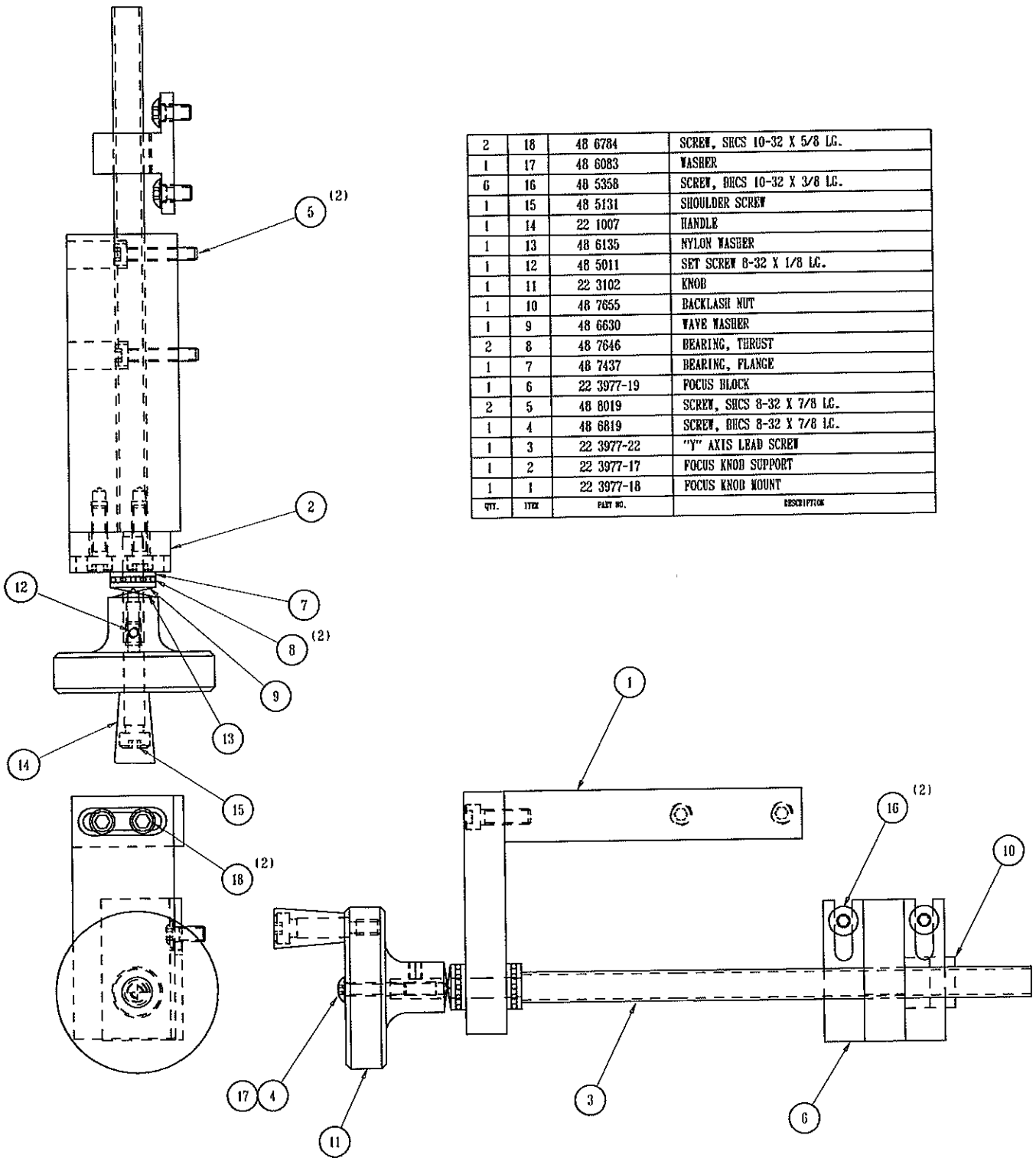
| | | | |
|------|------|------------|-----------------------------------|
| 1 | 3 | 48 5121 | SPRING PIN 3/16 DIA. X 1 1/8" LG. |
| 1 | 2 | 22 3712-56 | GEAR, NYLON BEVEL |
| 1 | 1 | 22 4032-01 | VERTICAL SCREW & BUSHING ASSY. |
| QTY. | ITEM | PART NO. | DESCRIPTION |

READOUT ARM ASSY.



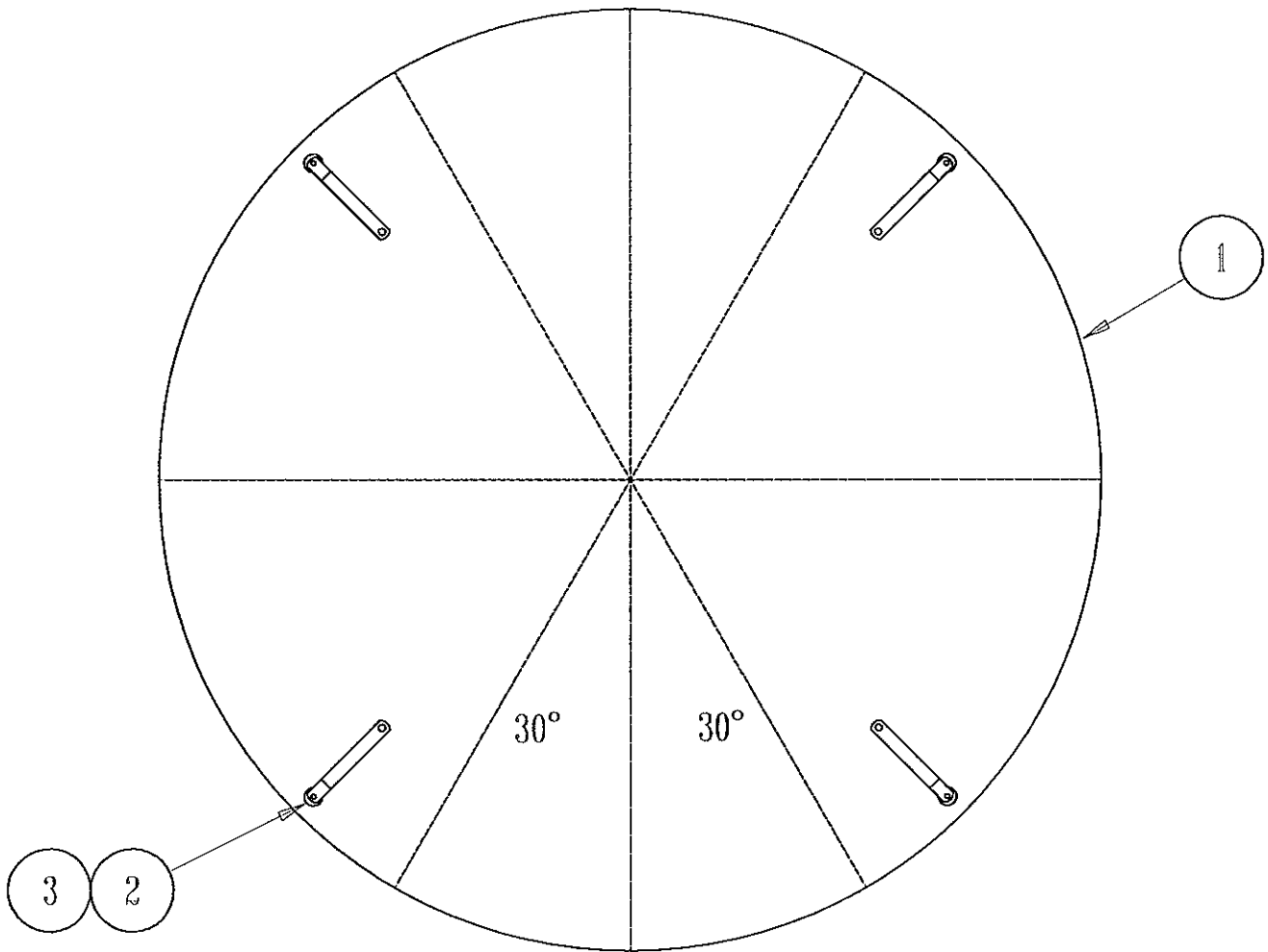
| | | | |
|-------------------|------|------------|--------------------------------|
| 1 | 6 | 48 8238 | OEM MOUNT |
| 2 | 5 | 48 6425 | SCREW, BHCS 1/4-20 X 1/2 LG. |
| 1 | 4 | 22 4047-00 | READOUT PLATE |
| 8 | 3 | 48 5401 | SCREW, SHCS 1/4-20 X 1 1/2 LG. |
| 4 | 2 | 48 8121 | STAUFF CLAMP |
| 1 | 1 | 22 4042-01 | DRO ARM, PAINTED |
| QTY. | ITEM | PART NO. | DESCRIPTION |
| LIST OF MATERIALS | | | |

FOCUS SCREW ASSY.



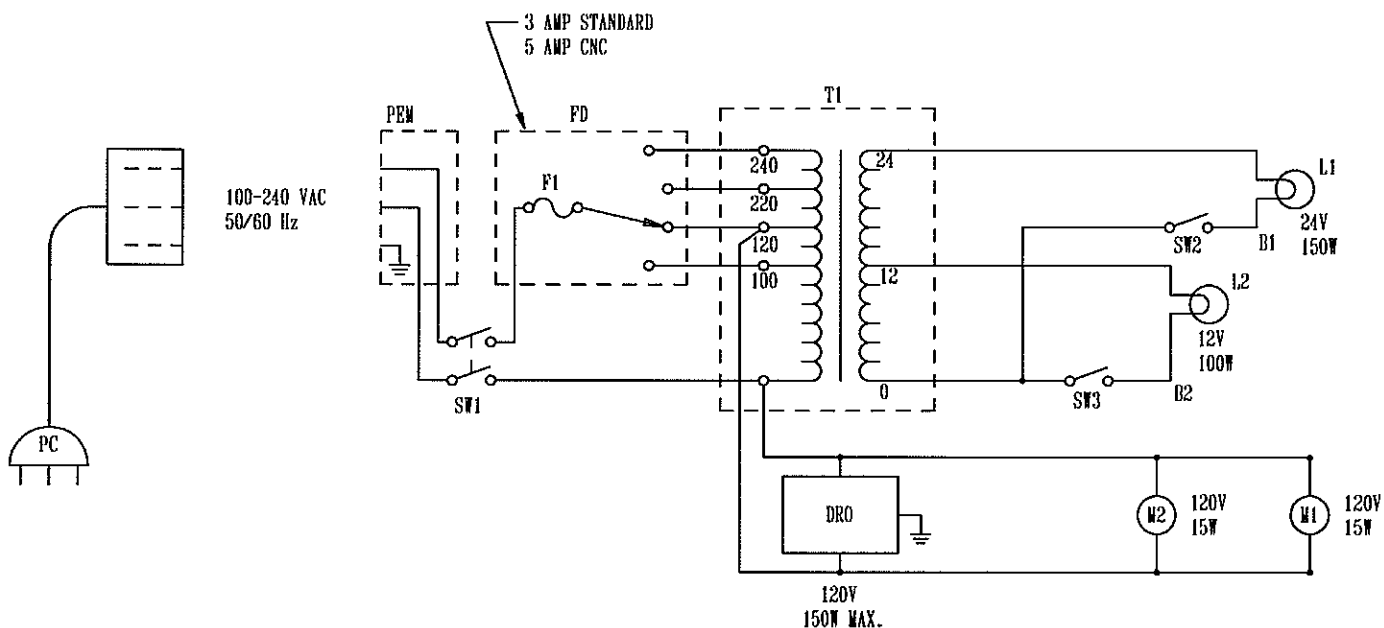
| QTY. | ITEM | PART NO. | DESCRIPTION |
|------|------|------------|-----------------------------|
| 2 | 18 | 48 6784 | SCREW, SRCS 10-32 X 5/8 LG. |
| 1 | 17 | 48 6083 | WASHER |
| 6 | 16 | 48 5358 | SCREW, BRCS 10-32 X 3/8 LG. |
| 1 | 15 | 48 5131 | SHOULDER SCREW |
| 1 | 14 | 22 1007 | HANDLE |
| 1 | 13 | 48 6135 | NYLON WASHER |
| 1 | 12 | 48 5011 | SET SCREW 8-32 X 1/8 LG. |
| 1 | 11 | 22 3102 | KNOB |
| 1 | 10 | 48 7855 | BACKLASH NUT |
| 1 | 9 | 48 6630 | WAVE WASHER |
| 2 | 8 | 48 7646 | BEARING, THRUST |
| 1 | 7 | 48 7437 | BEARING, FLANGE |
| 1 | 6 | 22 3977-19 | FOCUS BLOCK |
| 2 | 5 | 48 8019 | SCREW, SRCS 8-32 X 7/8 LG. |
| 1 | 4 | 48 6819 | SCREW, BRCS 8-32 X 7/8 LG. |
| 1 | 3 | 22 3977-22 | "Y" AXIS LEAD SCREW |
| 1 | 2 | 22 3977-17 | FOCUS KNOB SUPPORT |
| 1 | 1 | 22 3977-18 | FOCUS KNOB MOUNT |

16" GLASS SCREEN



| | | | |
|------|------|--------------|---------------------------|
| 4 | 3 | 48 8149 | REPLACEMENT RUBBER BUMPER |
| 4 | 2 | 22 3952-10 | SCREEN CLIP ASSY. |
| 1 | 1 | 74 0008-1625 | 24" GLASS SCREEN |
| QTY. | ITEM | PART NO. | DESCRIPTION |

3700 ELECTRICAL WIRING SCHEMATIC



| | | |
|-------------------|------------|------------------------|
| WA | 22 4135-00 | WIRE ASSY. |
| T1 | 48 7929 | TRANSFORMER |
| SW1 | 48 7443 | MAIN POWER SWITCH |
| SW2 | 48 7700 | PROFILE ILLUM. SWITCH |
| SW3 | 48 7700 | SURFACE ILLUM. SWITCH |
| L1 | 48 7291 | PROFILE BULB |
| L2 | 48 7747 | SURFACE BULB |
| W2 | 22 3426 | COOLING FAN |
| W1 | 22 3426 | COOLING FAN |
| PEM | 48 7444 | POWER ENTRY MODULE |
| FD | 48 7445 | FUSE DRAWER |
| F1 | 48 6215 | FUSE 3 AMP @ 120 VOLTS |
| PC | 48 7337 | POWER CORD |
| ITEM | PART NO. | DESCRIPTION |
| LIST OF MATERIALS | | |

WARRANTY

Within two years 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 only 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 of this equipment.



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40-0448-0000

Rev. A