The Low Resolution Imaging Spectrometer

Servicing Manual

January 11, 1993

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Optical Alignment

Dimensions

Collimator focal length = 78.92 in (2004.6 mm)
Telescope scale = 1.7178 in/arcmin (43.633 mm/arcmin)
At the entrance aperture:

ray at	4.0 arcmin	6.871 in (174.532 mm)
ray at	6.5 arcmin	11.166 in (283.610 mm)
ray at	9.0 arcmin	15.460 in (392.697 mm)
ray at	10.0 arcmin	17.178 in (436.330 mm)

The field flattener is 3.00 in beyond the on-axis focal plane of the telescope.
The central rays at the collimator are at:

ray at	4.0 arcmin	8.131 in (206.524 mm)
ray at	6.5 arcmin	12.270 in (311.658 mm)
ray at	9.0 arcmin	16.410 in (416.826 mm)
ray at	10.0 arcmin	18.067 in (458.896 mm)

The collimator mirror inner edge is at $x = 1.570$ in (38.88 mm). The collimator mirror outer edge is at $x = 22.970$ in (583.44 mm).

The nominal 6.5 arcmin beam from the collimator to the pupil is at an angle of 8.1°.

The pupil is centered at $x = +1.558$ in (39.57 mm) and $z = +3.00$ in (76.2 mm). The pupil diameter (including mirror "ears") is 5.546 in (140.868 mm).

The grating is centered on the pupil center.

The angle between the light incident on the grating (for the 6.5 arcmin ray) and the direction to the camera is 44.1°.

A simple drawing of the optical train is shown in Figure 1 and the optical train with surrounding hardware in Figure 2.

Alignment of the collimator

(1) The alignment is best done using a special slit mask with a roughly 2-inch diameter hole centered at 6.5 armin off axis in x. The slit mask should be located at its nominal position which corresponds to a gap of 0.25 inches between the end of the enclosing frame and the end of the actual slit-mask frame.
(2) Mount a cross wire in front of the collimator so that one wire is in the x direction and the other in the y direction. They should cross at the center of the collimator. Note that you must take the collimator off to do this.
(3) Note where y=0.0 and x= 6.5 arcmin is located on the slit mask. In y it corresponds to the support bar across the slit mask.
(4) Put a bright source at x=6.5 arcmin and y just below the cross bar.
(5) Tilt the mirror on the red grating turret about 8.1 degrees so light from the collimator is reflected back to the slit mask and the bright 1:1 image is aligned in x above the cross bar. This is accurate enough to do the following steps.
(6) Illuminate a small area just below the cross bar and at x=6.5 arcmin.

(7) If you now look in towards the collimator with your eye near the y=0.0, x=6.5 arcmin position you will see the cross wire and its reflection against the brightly illuminated mirror on the turret.
(8) Tilt the collimator until the x-direction cross wire and its image are coincident and so that the projected x crosswire is centered on the grating. This completes the alignment in the y direction.
(9) If you now look at the image as in (8) above you now need to tilt the collimator so that the y axis crosswire bisects the mirror on the turret. You can judge the mirror center in y by looking at the screws on the cover that holds the mirror in its cell on the red turret. Note that because of the tilt of the collimator the y crosswire and its projection off the mirror are not coincident. You need to use the right-most one, i.e. at the largest positive x distance.
(10) When you have carried out (8) and (9) above the collimator is properly aligned.
(11) Now measure the spacing between the three "ears" on the collimator cell and the flat surface that the hold-down screws attach to.
(12) Note again where the small source and the auto-collimated image are located at the slit mask.
(13) Remove the collimator, keeping the three leveling screws fixed. Remove the wire cross wires in front of the collimator. Again attach the collimator cell to the spectrograph. If necessary adjust the collimator leveling screws so the image noted in (12) is at the same position as before. Check that the three holddown bolts on the collimator cell are tight. You are now finished with the collimator alignment.

Alignment of the gratings

(1) Set up a bright source at the slit mask as in (6) above..
(2) Rotate the mirror on the grating turret so the return auto-collimated beam has the same x position as the bright source. Note the angle required to do this. This angle must be put in the computer control program.
(3) Note the distance of the image above the cross bar (y direction). If it is the same distance above the cross bar as the source is below it, no adjustment of the mirror is needed. This should be satisfactory since this mirror was used to align the collimator in the first place.
(4) Now select one of the gratings for alignment. Rotate it approximately by the same angle as the mirror so you can see the zero-order image.
(5) Now repeat step (2) just above.
(6) Repeat step (3) just above. If the return image is not close enough in y it will be necessary to shim the grating to make it so. This can only be done by shimming under the hold-down rectanglular frame that holds the grating in its box. Do the shimming with good transparent tape and repeat steps (2) and (3).
(7) Repeat the process for all the gratings.

Alignment of the camera

The camera is installed mechanically as accurately as possible. No further adjustments are needed.

Alignment of the CCD

The CCD must be at the proper depth in the CCD Dewar and have a zero tilt. This is done with an accurate depth probe and leveling screws on the CCD mount. Note that these measured depths are recorded in the blue book which goes with the spectrograph.

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Servicing the Dust cover, Calibration Lamps

Servicing the Moving and Slit-Viewing Guider

The Moving Guider

The moving guider is designed to look at an extended area just beyond one end of the slit-mask field. It is designed to move over the full width of the slit-mask field. This is done by driving a pick-off mirror M1 with a motor. There is an attached absolute encoder. Since the telescope focal plane is highly curved it is also necessary to vary the focus. This is done by having a second motor with its absolute encoder which moves lens L1, diagonal mirror M2, the filter wheel, the imaging lens, and the CCD camera. Because this motion was already needed it was amde large enough to accomodate the change in focus which would occur if a fiber system was mounted on the end of the spectrograph.

Once the front-end shroud is removed all the components of the moving guider are readily accessible from the front of the instrument. Most of the components are not critical and no alignment is necessary. The CCD housing is however pinned.

If the CCD housing is touched, be sure that the Nikon lens focus is not moved. It should be set at m. Also be sure that the lens aperture is at maximum.

The filter wheel is enclosed and can carry four filters. The filters provided are (1) a clear aperture, (2) a Rolyn 66-2500 which transmits from 4000 to 7000 Angstroms, (3) an RG610 which transmits above 6100 Angstroms, and (4) a xxxx. Half of the cover of the filter wheel can be swung out of the way and the filter wheel itself removed.

The Slit-Viewing Guider

The slit-viewing guider is fixed and looks at the area of field where the fixed slits are located. The slit-jaws reflect light to a collimating lens L2, after which the light is bent by a diagonal mirror and goes to a Nikon 28mm lens and the CCD camera. The components are all accessible once the shroud is removed. The CCD housing is pinned. No other elements are critical or need alignment.

The guider is completely insensitive to temperature changes so there is no motorized focus mechanism. The focus on the barrel of the Nikon lens should be set at xxm. The filter wheel is similar to that for the moving guider.

Light Sources

The light sources are mostly penray discharge tubes which are mounted on surface areas of the moving guider. There is also a quartz halogen incandescent lamp. There are two sets of lamps, on on each side of the slit-mask area. The moving guider must be moved inwards to the smallest value of x (towards the optic axis of the spectrograph) for the lamps to illuminate the dust cover (closed) properly.

Servicing the Slit-Mask mechanism and Field Lens

The Slit-Mask Mechanism

The slit mask mechanism is attached to four hard points on the spectrograph body by a series of bolts as shown in Figure 1. The wehole mechanism cannot be removed unless the slit-viewing guider and the moving guider have first been removed since the two mechanisms are tied together for rigidity. The grab bar mechanism can be removed after a slit mask has been removed so that the grab-bar ball is not captured. Once removed it can be disassembled enough to get at the microswitches for repair. The motor and brake can be detached without removing the mechanism.

The various roller bearings on which the slit masks move are easily accessible once the shroud is removed.

The manifold with the slit-mask changing machinery can be partially serviced in place. The encoding switches are mounted on a plate which is on one side of the box. The probe which keeps the slit masks themselves captured can be service from the outside of the box. There is also a limit switch mounted on the side of the box and an interlock switch for the door. The slit-mask changing motor and drive chain is also accessible from outside the box.

If it is necessary to remove the manifold first remove all the slit masks. It is then possible to get at the screws inside the box which attach it to the rest of the slit-mask mechanism.

The Field Lens

The field lens is mounted just inside the area where the slit masks are inserted. This lens is coated and it is imperative that people not get finger marks on it. The field lens is accessed brom the access door just below the slitmask. The lens is in a frame which is held in place with two bolts which one can get at through the large rectangular spectrograph aperture as long as there is no slit mask in place. Once the bolts are removed the frame simply slips out through the accesss port. Be sure to note how the lens is oriented since it must be replaced in the same way.

The Interference-Filter Spectropolarimeter Area

This is an area between the field lens and the slit masks where a variety of things can be installed. There is a shelf, a clamping mechanism, and two connectors for wiring in the access door.

Removal of the slitmask box

(1) Send the slit mask selector to "home".
(2) Remove the plate with the electrical connections and microswitches.
(3) Remove all of the removable slitmask frames as described in the users manual. To remove the last frame it must be partially deployed and the ball carefully moved out of the capure hole in the slitmask frame.
(4) Remove the box which held the slitmask frames by removing the screws at the top and bottom of the box.
(5) You now have access to the bolts which hold the outer box to the spectrograph body. Remove these and remove the box.

(6) You can now also remove the grabber by disconnecting the cables and removing the bolts which hold it in place.

Removal of the Grabber Only

(1) Deploy one of the slit mask frames partially so you can reach the grabber.
(2) Carefully push or pull the grabber ball out of the capture hole in the frame.
(3) Disconnect the cables from the grabber mechanism on the opposite side of the spectrograph, remove the bolts, and withdraw the grabber.

Installation of the Grabber and Slitmask Box

This is simply the reversal of the steps outlined above. Note that the "home" switch must be at the same physical depths as when it was removed to allow the mechanism to work properly.

Removal and Installation of Collimator

Note: The Collimator cell was designed and built in England. It uses metric screws and components. The large adjusting and hold-down screws are metric while the screws that attach the collimator cell to the white spectrograph are American screws.

Removal

The collimator and its support structure consists of the following items. (a) the collimator itself, (b) the base plate with the levelling screws, (c) a round ring which holds the collimator hold-downs, (d) an adaptor (white) which introduces the angle that the collimator must be placed relative to the spectrograph body.

(1) The instrument optical axis should be horizontal as when mounted in the Cassegrain module.
(2) Support the collimator with a sling and crane.
(3) Loosen the bolts that hold the white angle adapter to the spectrograph and remove the whole unit from the spectrograph. It is positioned by two pins.
(4) Put the unit on a table with the white angle adapter down.
(5) Somehow clamp the levelling screws (they fit into a pivot, slot and flat surface) so they cannot move.
(6) Remove the three large hold-down bolts.
(7) Remove the black collimator cell from the white angle adapter. Turn it over and place on blocks on a table. Note that the mirror is now face up and exposed.
(8) Remove the bolts in the outer ring from the under side of the cell. Note that there is now a gap between the two parts of the cell which should be about 0.025-0.030 mils.
(9) Carefully lift the ring from around the collimator mirror. This ring carries the three defining hold-downs which rest on the front surface of the collimator.
(10) Note how all the parts line up with the collimator. The collimator is an off-axis paraboloid with the direction to the optical axis of the collimator and the spectrograph marked by a black line on the side of the collimator.
(11) The collimator can now be removed for coating if desired.
(12) The collimator rests on three radial supports which are held in place by small Allen screws which come in from the rear of the cell. They should not be tightened but are used only to keep things from falling apart. Under the three pads are stacks of Belleville washers (10 washers with three turned to show three gaps in the stack. The overall thickness of the stack should be 0.550 inches). These stacks provide the spacing noted in (8) above.

Installation

(1) Check the three axial supports if necessary.
(2) Place the collimator on the three supports, with the black mark on the side of the mirror pointed in the correct location.
(3) Carefully place the metal ring around the mirror, again being sure that the orientation is correct.
(4) Note the spacing which should be as in (8) above.

(5) Attach the ring to the cell base with the bolts around the perimeter. These should be tightened gradually and uniformly until completely tight.
(6) Pick up the collimator and cell, flip it over, and attach to the angle adapter. Again be sure the orientation is correct.
(7) Put the cell and angle adapter back on the spectrograph body.
(8) Realign the collimator if necessary. See separate schedule for doing this.

Removal and Installation of Red Grating Turret

Note: The Red Grating Turret was designed and built in England. It uses metric screws and components. Later modifications were made using American Standard screws. These are marked with yellow dots. The turret cover is held on by American screws.

Removal

A large number of motors encoders, etc are located on the red grating turret. They can be serviced to a considerable extent by rotating the turret so the problem grating is at the grating installation hole. Once the grating is removed there is enough access to get to microswitches, the small box of electronics, the encoder, and the rotator motor and clamp motor. For some purposes it may be necessary to remove the red grating turret completely. This is done as follows.

(1) The spectrograph should have its optical axis horizontal. This is the way it is normally supported in the Cassegrain module.
(2) Remove the main box with the slit mask machinery and field lens (see another schedule for this).
(3) disconnect the two(?) cables which go to the indent activator and the rotation mechanism on the red grating cover.
(4) Remove the slit viewing lens-prism mechanism from the cover.
(5) Remove the plate with the power supplies for the lamps which are mounted on the turret cover.
(6) Remove the four roller mechanisms on the cover. .....
(7) Remove the screws which hold down the cover. These are all on the outside flange of the cover.
(8) Carefully remove the cover. It should come off in a straight out direction so it does not hit the red turret itself.
(9) Disconnect the large harness which goes from the red rurret through a wrap-up and out through holes in the spectrograph, finally to an 8-inch square black box near the colllimator. Note the wire labels.
(10) While removing the harness remove the connector to the turret encoder switch.
(11) Loosen the set screw which clamps the 2-inch diameter nut on the grating turret axle.
(12) Loosen the 2-inch diameter nut.
(13) support the turret with a sling and a very well secured clamp on the turret.
(14) Remove the 2-inch nut and the conical washer under it.
(15) Carefully slide the turret outwards on its rotation axis until it is free. Be careful with the wrap up cable and note how the cable is layed out for the wrap-up process.
(16) thread the wrap up cable through the spectrograph until it is free.
(17) Place the red grating turret on a table, flat side down for servicing.

Installation

This is basically the reverse of the process above but there are additional steps which must be taken.

(1) Attach the sling to the turret as above and pick up the turret.
(2) thread the wrap-up cable through the spectrograph with the cable properly layed out in the wrap-up area on the top of the turret. (See drawing).
(3) Carefully slide the turret over the axle keeping the cable wrap-up properly arranged.
(4) Put on the conical washer and the 2-inch nut loosely.
(5) Rotate the instrument in its handling fixture so the turret is at the top, i.e. the spectrograph looking at the zenith.
(6) make sure the turret is on its axis properly. Tighten the 2-inch nut and tighten the nut clamp.
(7) Return the spectrograph so it is horizontal (pointing to the horizon).
(8) Insert the turret cover. Be sure that the mechanical limits are in the correct place relative to the mechanical stop on the turret. You must turn the turret relative to the cover to engage the six dowels which couple the turret to its rotation drive which is on the cover.
(9) Replace the screws around the flange on the outside of the turret cover. Leave the screws loose.
(10) Again point the spectrograph to the zenith.
(11) Tighten the bolts that hold the cover on.
(12) Point the spectrograph to the horizon again.
(13) Attach the electrical cables to the cover.
(14) Thread the cable wrap-up through the spectrograph and attach the wires in the 8-inch by 8-inch outlet box near collimator.
(15) Attach the encoder switch to the turret shaft inside the spectrograph. (more here from Steve!!!!!)
(16) Test all turret functions for proper operation.
(17) Reinstall the slit viewing mechanism and the light source power supplies.
(18) Reinstall the slit mask mechanism.

Grating Rotation Drives

The Worm Drive

(1) The worm drive for the grating rotation mounts above a wedge which has two elongated holes. To change the meshing clearance the wedge is slid back and forth. The wedges should not be mixed up between drives although the wedges are nominally identical. At the outer end of the worm shaft there is an Allen wrench socket so the shaft can be rotated manually. When the turret cover is on there is a small access hole to reach this Allen socket but the slit-mask mechanism must be off for this to be reached and it ios still a difficult process. The worm can be rotated even if the drive motor is attached but the motor power must be off.

(2) Each grating has an electronics box with several connectors. These boxes are daisy-chained together. One connector has the motor input from the Compumotor AX units. Another connector has a cable which splits into two connectors, one for each motor. A third connector has the low noise level connections to the outside world. A fourth connector is for the grating angle encoder.

(3) Limit switches are wired through a separate cable to the outside world. The cable runs through terminal strips at each grating. They are mainly in series.

(4) There is a home sensor which is an LED-photsensor pair which is used to tilt the grating to near the stow position. (The grating surfaces are in the plane of the turret wheel when in the stow position.)Light form the LED shines through a tiny hole in the brake disk and is detected by the photosensor. The tiny hole is drilled so that light passes through it when the grating rotator is near the home position. To set the LED-photsensor pair put the grating rotator as close to the stow position as possible and move the sensor until a signal is seen. The LED-sensor pair is then clamped. The LED needs a 60 ma current, i.e. 5 volts and a 70 ohm resistor in series with the diode. The photdiode can be tested by simply connecting it to an ohmeter. The resistance is very large when there is no signal and about 75,000 ohms when illuminated through the tiny hole in the brake disk.

(5) Note that the gratings must all be in the stow position before the turret can be rotated. Otherwise the grating cells hit.

(6) The black daisy-chained electronics boxes with each grating can be removed as follows. First put the relevant grating in the access port. Remove the grating. Rotate the grating drive to the maximum angle possible. Loosen the clamps which hold the box in place. Disconnect the cables. Remove the box. After servicing the box reverse the process to re-install it.

(7) The grating rotator brake system consists of a caliper which is operated by a double cam drive. A microswitch is used to tell the computer when the clamp is engaged. The clamp can be adjusted as follows. (Mike Carr input here.)

turret ~~Grating~~ **Rotation Encoder**

The grating rotation is encoded by a 10-position switch. It is mounted on the end of the grating rotation axle inside the spectrograph body. This must be disconnected if the red grating turret is removed. It must also be adjusted by unclamping, rotating, and reclamping, to provide the correct turret position. (More input from Steve here.)

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Installation of Red Gratings in Their Boxes

Procedure for Mounting Gratings in Grating Boxes

It is best to mount gratings so that they are more nearly normal to the camera direction when in use. This makes the aperture larger than the beam but eliminates groove-shadow effects. The grating blaze should point in the direction opposite to the direction towards the camera.

The tools that are needed are: (a) 2.5 mm Allen wrench, preferably a driver (a $\frac{3}{32}$ inch Allen driver will do but do not use for final tightening); (b) large blade and normal blade screwdriver; (c) the 8 by 10 inch grating loading fixture with the four 3-inch high posts (in the tool chest).

(1) Clean the grating box and cover.
(2) Remove the top frame from the box. There are about thirty screws. Note that the end ones and some others may be short.
(3) Back off all side alignment screws so they do not protrude into the box. Some of these are solid, some have springs.
(4) Remove the three large screws ($\frac{3}{4}$ inch diameter) in the bottom of the box.
(5) Place the box over the fixture.
(6) Place the grating on the fixture. Note the blaze direction (away from the single slot end).
(7) Raise the box around the grating and place the combination on a clean bench.
(8) Screw in the two solid side alignment screws so they do not protrude outside the box. Adjust the grating squeue as well as you can.
(9) Screw in the two opposite sprung screws so they are finger tight.
(10) Screw in the single end solid alignment screw so it is about 0.5 mmin.
(11) Screw in the two close spring screws opposite so they are finger tight.
(12) Put the top frame in place over the grating ans secure with three or four screws.
(13) Insert all the other screws (end ones short). Use gthe dust cover to protect the grating while you do this. Tighten all these screws.
(14) Put on the dust cover, and turn the grating box over and insert the three large screws. Tighten these down. Make sure the grating does not bind.
(15) Tighten the four sprung side alignment screws one turn each.
(16) Label the box with the grating characteristics where it can be seen. Also show the blaze direction.

Servicing The Red Filter Box and Grabber

Nearly all the machinery involved in moving the filter selector box is outside of the box itself and can be serviced without removing the box from the spectrograph. Removing the box is fairly difficult and should be done only if absolutely necessary. Below specified directions assume that the spectrograph optical axis is horizontal and you are facing the red filter box. See attached pictures.

Procedure for Removing the Red Filter Box and Grabber

(1) Send the red grating selector mechanism to "home".
(2) Remove the plate with the electrical connections and microswitches from the top of the box.
(3) Remove the round "home" switch on the left side of the box, noting how far it is threaded into the hole. It is probably necessary to disconnect the wires from the junction box in (2) above to do this. This switch has a very fragile sapphire plunger which is easy to break!
(4) Remove the five removable filter frames. The sixth one always is captured by the ball on the grabber. It can only be released by pulling the frame part way out of the changing box and physically pulling the ball and shaft to one side.
(5) You can now remove the box which holds the filters by several screws on the top and bottom.
(6) You can now get at the screws which hold the large filter box to the spectrograph assembly.
(7) You can now service the box. Note that the filter carrier has two lead screws which must be kept synchronized for proper operation.

Procedure for Removing the Red Filter Box Grabber

(1) If you wish to remove the grabber mechanism from the other side of the spectrograph you deploy one of the filters part way out of the box. release the ball as in (4), disconnect the cables and remove the whole mechanism. There are two limit microswitches inside the mechanism which can be accessed.

Procedure for Reinstalling the Red Filter Box and Grabber

The procedure is the reverse of that outlined above. Note that the home switch must be positioned in its threaded hole at the depth as it was when it was taken out in order for the mechanism to work properly.

The Epps Lens

The lens and its cell are very complex designs. Any servicing should be done only by an optician and someone who is very familiar with the mechanical cell design. The persons who know about these things are (1) Gerard xxx at Lick Observatory who polished the optics and did the contacting and assembly of all lens parts, (2) Michael Carr who designed the cell and supervised the assembly of the optical components into the cell, and (3) Bev Oke who stood around, wrote notes , and helped when needed during the assembly.

Disassembly

(1) Remove the flat window on the front of the lens (Norris lens only). This is held on by eight screws.
(2) Remove the large CaF2 lens in its cell. The cell is held on by eight screws.
(3) Remove the shutter-ring which carries the shutter mechanism and the small field flattener of the lens. It is held by eight screws.
(4) Remove the doublet retainer ring and the 6 springs.
(5) Unscrew the retainer ring (Mike????). Install the screws all the way in and then back out one turn.
(6) Attach the lifting handles (stored in tool cabinet). Thewse consist of six posts four inches long plus a ring.
(7) Lift out the doublet in its cell.
(8) Remove the retainer ring. Gently lower the doublet in its cell over a 3-inch high post. The post should be soft since the lens surface rests on it. You now have the doublet removed from the cell.
(9) By carefully sliding one piece of the doublet relative to the other it should be possible to separate the two lenses of the doublet. They are held together by the optical coupling gel. THIS SHOULD ONLY BE DONE IF THERE IS A PROBLEM WITH THE COUPLING OF THE TWO LENSES!
(10) Remove the steel 6-inch long spacer tube from the barrel. (Mike ???).
(11) Set the lens barrel so the brass triplet cell is facing up.
(12) Remove the screws that hold the cell onto the outer barrel.
(13) Carefully turn the barrel with the brass cell over. Be careful, the brass cell is loose!!!
(14) Remove the outer barrel of the lens.
(15) Remove the triplet retainer. It is held on by eight screws. This comes off the large diameter end of the triplet cell.
(16) Lower the cell and lenses over a three inch tall post which is covered with soft material since the lens rests on this.
(17) At this point the triplet is free of its cell. By sliding the top lens relative to the middle lens it should be possible to separate it. It is held on by the optical coupling gel. It should also be possible to separate the remaining doublet in the same way. THE TRIPLET SHOULD ONLY BE SEPARATED IF THERE IS A PROBLEM WITH THE COUPLING!

Assembly of the Epps Lens

Installation of the CaF2 singlet into its cell

(1) Place the cell on a bench so that the element can be inserted from the top.
(2) Put some soft ring spacers inside the cell and place the CaF2 element on the spacers. Be sure the flatter side of the CaF2 is down.
(3) Make sure that the orange coloured thin ring is in place on the cell surface.
(4) Carefully raise the cell so it picks up the CaF2 element.
(5) Set the cell with the CaF2 element down.
(6) Place the o-ring in the groove of the clamping part of the cell.
(7) Carefully lower this clamping ring down onto the CaF2 and the lower cell.
(8) Slowly tighten the screws to compress the o-ring until the screws are tight.

Assembly of the triplet

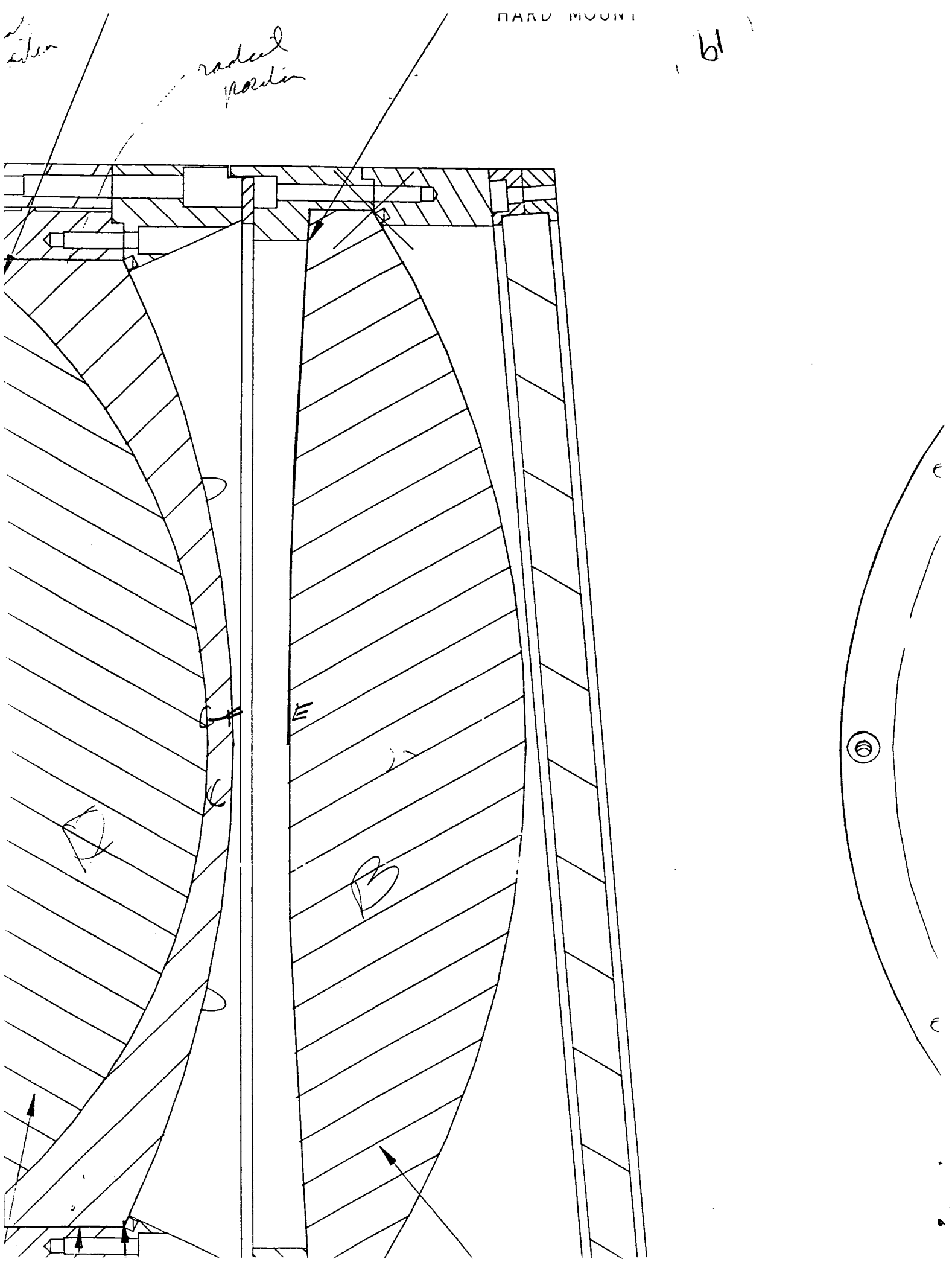
The three pieces of the triplet must be coupled using Dow Corning xxxxxxx material which is a clear transparent jelly-like material. The first step is to couple the CaF2 element to the slightly larger KZF2 lens.

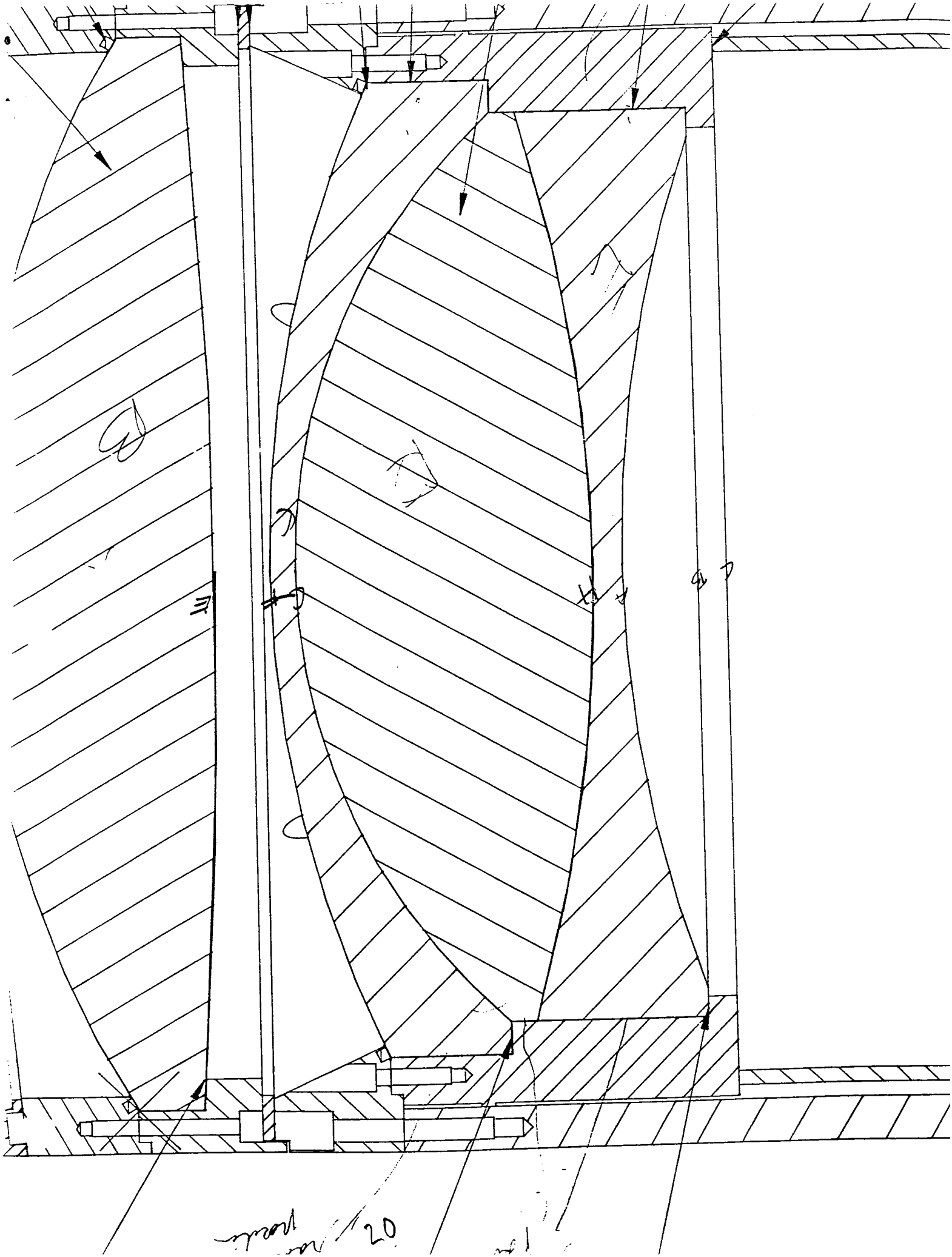
(1) Place the CaF2 on a soft towel with the steeper curve up.
(2) Place x.x grams of Dow Corning fluid which has been pre-prepared(note 1) on the center of the CaF2 surface.
(3) Place three small pieces of Scotch tape at 120 degrees on the edge of the CaF2 surface. This provides a 0.005 inch defining spacer.
(4) Gently couple the concave side of the KZF2 to the CaF2 by pressing and gently sliding the one surface relative to the other. This must be done by an optician! This is done until the surfaces are contacted with no bubbles or non contacting areas. The weight of Dow Corning fluid specified insures that this can happen.
(5) Clean off any excess Dow Corning fluid. Xylene or isopropal alcohol are fair solvents for this stuff.
(6) Now turn over the doublet and couple the BAK5 to the CAF2 surface using xx.x grams of Dow Corning fluid. Use the same technique as above.
(7) Place the triplet cell with the side into which the optics go up on a soft piece of towel.
(8) Place some rings of soft material inside the cell and place the optical triplet on this stack. Be sure it is the right way.
(9) Be sure the orange coloured thin washer is resting in its groove properly.
(10) raise the cell up and work the triplet into the cell carefully.
(11) Be sure that the o-ring is in the groove of the clamping part of the cell.
(12) Gently lower the clamping cpart of the cell onto the lower cell and slowly bolt the two parts of the cell together until the bolts are tight.

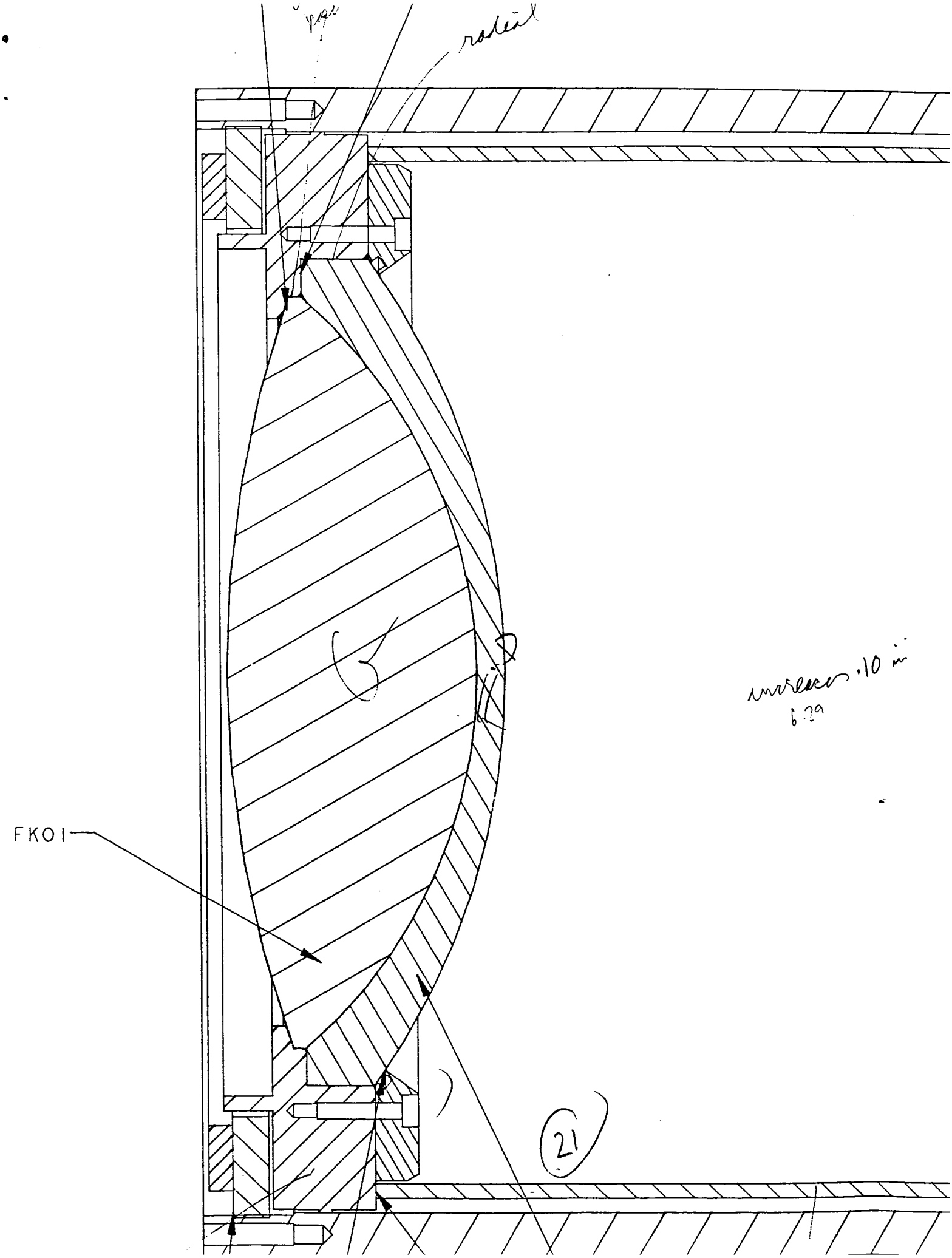
Assembly of the doublet

(1) Place the double convex FK01 onto a soft towel with the more convex side up.
(2) Place xx.x grams of specially prepared Dow Corning fluid (Note 1) onto thwe center of the surface.

(3) place three pieces of Scotch tape at 120 degrees around the perimeter of the lens. This provides a 0.005 inch spacer.
(4) Couple the concave side of the SK5 lens to the FK01 in the same manner as before. Make sure the coupling is perfect, i.e. no bubbles or non contacting patches anywhere.
(5) Place the larger part of the cell on a soft cloth.
(6) Be sure that the thin ornaged coloured washer is in place.
(7) Place a stack of soft spacers inside the cell and put the doublet lens on it. Be sure it is the right way.
(8) Gently raise the cell to pick up the optics.
(9) Place the cell and optics on a cloth.
(10) Be sure the o-ring is in the groove in the clamping part of the cell.
(11) Gently lower the clmamping part of the cell over the optics and slowly bolt the two tofgether until the bolts are tight.


HARD MOUNT
b1
radial
position
C
E
B




FKO1
21

Servicing the Red Shutter Mechanism

(1) Check that the proper TTL logic is reaching the shutter control box.
(2) Check that the shutter control box is producing the correct voltage (18 volts DC) on pins xxx and yyy.
(3) Remove gthe Dewar from the focus mechanism on the end of the red lens.
(4) Remove the focus mechanism from the end of the lens. It is held by circle of 8 bolts.
(5) Remove the focus mechanism from the rear of the lens. It is held by eight bolts.
(6) Note that the optical field flattener is mounted on this mechanism. Do not touch it or allow it to get dirty.
(7) Service the shutter mechanism. It consists of two solenoids working in opposite directions. It also has two microswitches to read the shutter status.
(8) Reinstallation is the reverse of steps (1) to (5).

Red CCD Dewar

Installation

The Dewar and especially the CCD are fragile and very expensive. Great care should always be taken when handling the Dewar.

(1) The LRIS should be in the module and rotated so that the cameras are on the side of the instrument for easy access.
(2) Carefully insert the Dewar inside the four focussing posts an slowly push inwards several inches. The pump-out valve should face outwards towears the 2-meter mounting ring.
(3) Rotate the Dewar to align the notches in the Dewar flange with the four guide bars. Push the Dewar all the way in.
(4) Rotate the Dewar a few degrees clockwise to "capture" the Dewar. Still support the Dewar by hand for safety.
(5) Clamp the Dewar flange with the three clamps. Do this by rotating the brass underside clamp clockwise until it catches the flange and then rotate the finger clamp clockwise to tighten the clamp.
(6) Attach the electrical cable from the Saddlrebsg to the Dewar connector.
(7) Attach the heater cable to the Dewar base.
(8) You will need to test that the CCD pixels are perpendicular to the dispersion or parallel to it. This should be done as accurately as possible, i.e. to better than 0.5 pixels over 2000 pixels. This is done by slightly unclamping the Dewar, rotating it slightly, and then reclamping it. A more elegant approach which uses a stop may be installed but even so the stop will need adjusting from time to time.

Removal

(1) Disconnect the electrical cables to the saddlebag and to the heater power supply.
(2) Supporting the Dewar by hand carefully unclamp the three clamps. Check that the brass clamps are backed off from the flange.
(3) Rotate the Dewar counter clockwise until the slots in the flange are aligned with the rods.
(4) Carefully withdraw the Dewar.

Servicing the CCD Dewar

Installation of a CCD into the Dewar

Handling a sensitive CCD is always dangerous and every precaution must be taken to guarantee that no static charge is ever developed. There are a number of obvious rules to follow: (1) always work on a properly grounded bench, preferrably a laminar flow one, (2) Wear only natural fiber materials, not artificial fiber materials, (3) Always wear a grounding strap which hasd been tested for effectiveness. (4) Handle CCDs very carefully and never touch the surface of the device. (5) Note that there are very fine bonding wires which are very fragile. (6) CCDs have many pins and insertion and removal from sockets is difficult.

In the LRIS Dewar we use two amplifiers, which at present are A and B. This requires a specific harness between the CCD and the circular board inside the Dewar. The circular board has five connections: heater and termperature control, a 16 pin harness, a second 16 pin harness, a 2-wire video connection for amplifier A, and a 2-wire video connection for amplifier B. It is imperative that the two 16-pin and two video connectors not be mixed up.

The following steps are taken.

(1) Collect the socket-harness to be used, the Dewar base, the Dewar LN2 container, and the CCD.

(2) Read all the literature on the CCD to be used.

(3) Plug all the harness connectors into the special shorting socket device. This is absolutely essential!

(4) Remove the CCD from its shipping container and insert it in the socket-harness. The socket is not polarized so you must know which pin on the CCD is 1 and which socket pin is also 1. This is done with the cover still over the CCD (if Tektronix).

(5) Now insert the CCD and its socket into the gold plated CCD holder. Again be sure it is oriented correctly. See Figure 1. Now remove the CCD cover. Place the gold frame over the CCD holder and attach with the four screws. A square plate should be used to protect the CCD from errant screws during this process. Tighten the four screws on the frame since the frame is what holds the CCD firmly.

(6) Now attach the gold plated CCD holder to the plate with the three posts. Note that each post has a nylon screw for height adjustment and a small central screw to hold it down and lock it.

(7) Put the plate with the gold plated CCD holder into the Dewar base. It is held by three standoffs which are alos used to fasten the circular board. Refer to Figure 2 to orient the plate properly in the Dewar base.

(8) At this point it is necessary to adjust the height and tilt of the CCD on the three posts. For the present Tektronix CCD the back flat side of the gold plated CCD holder should be 1.315 inches below the o-ring surface of the Dewar base. An accurate digital depth probe is a good way to set the height correctly. It should be done to an accuracy of 0.0005 inches or 10 microns.

(9) Carefully feed the shorting fixture and leads through the center of the circular board. Disconnect each connector from the shorting fixture and plug it into the circular board. Which connector goes to which socket must be known in advance by recording the information during disassembly!!!

(10) Fasten the circular board to the standoffs making sure that none of the harness wires are caught.
(11) Making sure that none of the harness wiring is in the way, place the Dewar base onto the Dewar itself and fasten it with the eight screws. Again the Dewar base must be correctly oriented on the Dewar. Note the mark on the Dewar where the large connector is located. Be sure that the thermal contact has a very thin layer of graycoat on the contacting surface to insure thermal contact. The Dewar should now be pumped. A vacuum of $4x10^{-}7Tor$ should be achieved.
(12) Attention must be taken to keep the molecular sieve material from being exposed to moist air. This material is in two small containers under the radiation shield at the bottom of the Dewar. No pieces of molecular sieve material can be left in the vacuum where they do not reach LN2 temperatures.

Removal of a CCD from the Dewar

Removal of a CCD is essentially the reverse of the process outlined above with the following precautions.

(1) Do not even think about opening a Dewar to service the CCD if the weather is dry and static likely.
(2) never solder components on the circular board unless the CCD has been completely disconnected from it.
(3) Never solder the harness connections unless the CCD has been removed from the socket and harness.
(4) Note the orientation of the dewar base on the Dewar itself.
(5) Before removing the dewar base the dewar should be back-filled with dry nitrogen. A plastic bag over the Dewar opening and a slow flow of dry nitrogen will keep the molecular sieve dry.
(6) When disconnecting the CCD harness be sure the harnesses are plugged into the shorting device when each is disconnected. Note which piece of harness is attached where!!!!
(7) Note the orientation of the gold plated CCD holder relative to the three standoffs and the position of the plate with the standoffs in the Dewar base.
(8) If the CCD is removed from the harness it should be stored in its shipping container which properly grounds all pins.

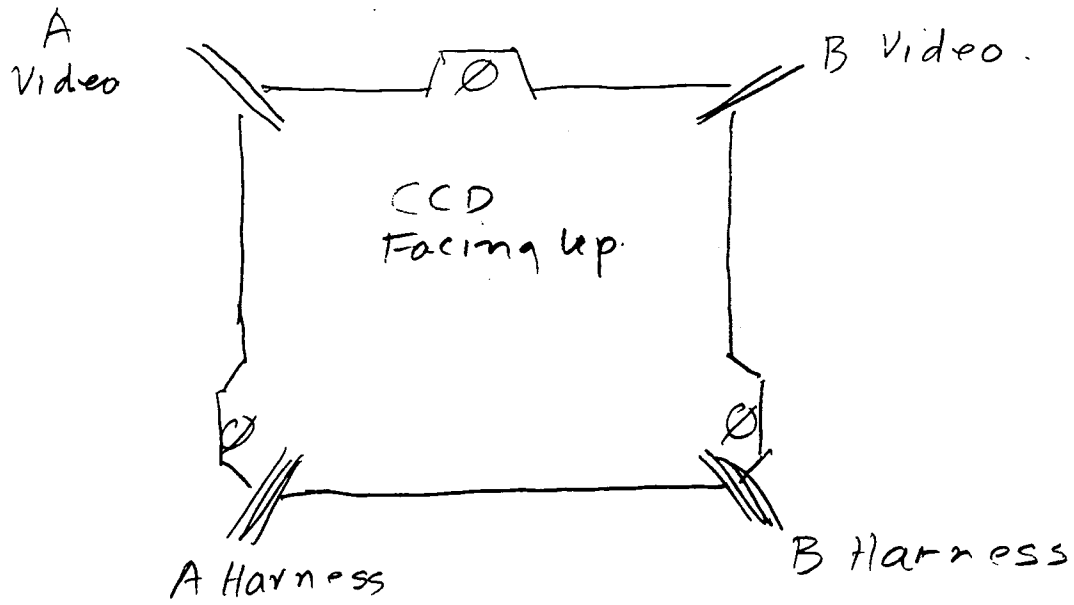
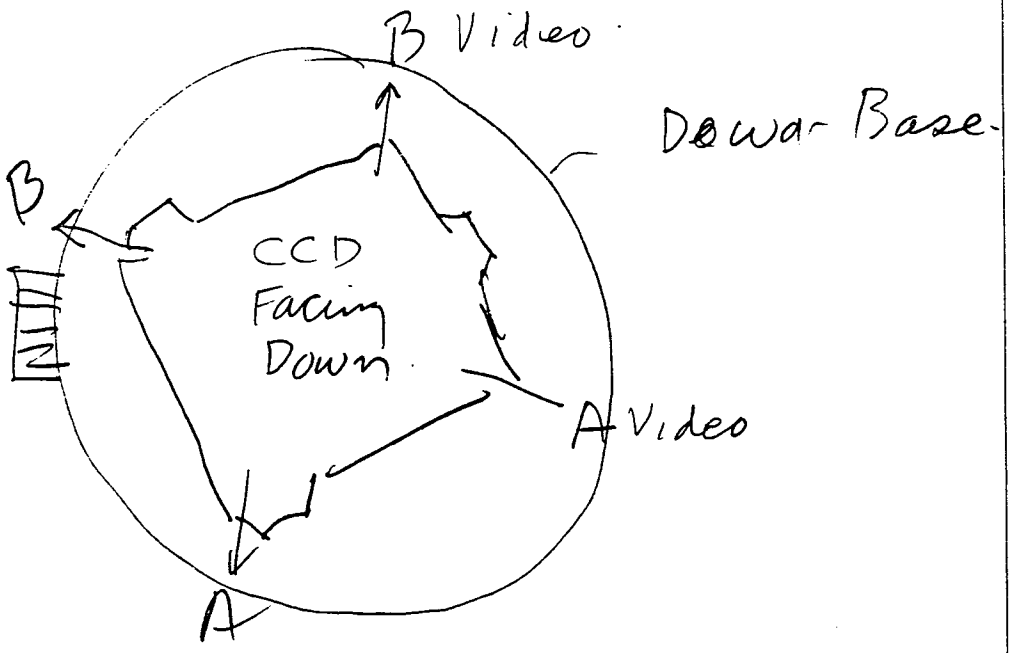

A
Video
B Video.
CCD
Facing up
A Harness
B Harness

Figure. 1


B Video.
Dewar Base.
B
CCD
Facing
Down.
A Video
A

Spare Components

The numbers in the parentheses indicate the numbers of spares available.

(–) Motor, Parker Compumotor Division, AX 57-51, 71-006875-02 (low torque).
(–) Motor, AX , 71-006877-02 (med Torque).
(–) Motor, AX , 71-006880-02 (high torque).
(–) 72-I/O Module (not used).
(–) Absolute Encoder, AR23, Parker (focus, guider).
(–) APX Controller (not used).
(–) API Controller.
(–) Grating Encoder, Cannon R-1L.
(–) Grating Encoder full box, 5x5x2 inches, black.
(–) Limit Decode Boards, DEC-1.
(–) Grating Rotator MUX boards, LRIS-SPC01-1039.
(–) Digital CCD Board, CCDTBD REV 5D 4/24/91.
(–) Analog CCD Board, CCDANALOG ABD REV 2K May 30/1991.
(–) Utility Board.
(–) Multiplexer Board MUX-10.
(–) Discharge Penray Lamp, Neon.
(–) Discharge Penray Lamp, Argon.
(–) Discharge Penray Lamp, Mercury(Ar).
(–) Discharge Penray Lamp, Krypton.
(–) Discharge Lamp Power Supply, Oriel, 6043, use with Neon.
(–) Discharge Lamp Power Supply, Oriel, 6045, use with Ar, Kr, Hg(Ar).
(–) Discharge Lamp Power Supply, Oriel, 6047, use with Hg(Ar).
(–) CCD Dewar base (wired) and LN2 container.
(–) CCD Saddlebag, complete, no cooling system.
(–) CCD Harness for Tektronix 2048x2048, Amplifiers C and D.
(–) CCD Mounting for 2x2 Ford Mosaics.
(–) CCD Power supply, complete.
(–) Circulating cooler, radiator, pump, quick disconnect hoses.
(–) Power Supply for Multiplexer Box.

Red Grating Turret

(–) Red Turret rotation encoder switch.
(–) Connector, Bendix, PT02A-12-10P
(–) Connector, Bendix, PT06A-12-10S(SR).
(–) Connector, Bendix, PT02A-18-11P.

(–) Connector, Bendix, PT06A-18-11S(SR).
(–) Connector, Bendix, PT02A-22-21P.
(–) Connector, Bendix, PT06A-22-21S(SR).

CCD Saddlebag

(–) Connector, Bendix,PT02E-14-19S.
(–) Connector, Bendix,PT06E-14-19P(SR).
(–) Connector, Bendix,PT02E-14-19P.
(–) Connector, Bendix,PT06E-14-19S(SR).

Motor Controls

(–) Connector, Bendix,PT02A-10-6S.
(–) Connector, Bendix,PT06A-10-6P(SR).
(–) Connector, Bendix,PT02A-8-3S.
(–) Connector, Bendix,PT06A-8-3P(SR).

Special LRIS Tools

(1) A special plate with four legs used to install gratings into their boxes. The plate is about 6 by 8 inches.
(2) A special handle used to help disassemble or assemble the Epps lens. It is about 3 inches long.
(3) Slit mask with a pattern of 0.040inch diameter holes on a 1 in square pattern over the whole mask. One corner has an extra hole for orientation.
(4) Slit mask with a pattern of 2 inch spaced holes on a rectangular grid. Also has a big hole in the center for tests.
(5) CARA should have a digital depth gauge for adjusting CCD packages in the Dewar base. I can procure such a device. (Palomar has one).
(6) CARA should have a flow meter device similar to the Palomar one to measure the flow out of cooled Dewars. This gives an instantaneous measure of the hold time. I can procure such a device.
(7) 4-liter Dewar for LN2.
(8) Funnels for use with Dewars.
(9) Two small Dewars to load LN2 into CCD Dewar.
(10) Two probes for using CCD Dewars upside down.
(11) One extra CCD Dewar with all components inside.

Special LRIS Tools

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LRIS POWER CONSUMPTION

The power input to devices on each of the coldplates is listed.

Coldplate	Unit	Power(watts)	Total Power(watts)
1	API-1	13.75	
	API-2	13.75	
	Abs. Encoder 1	9.24	
	Abs. Encoder 2	9.24	46.0
2	Photometric PS 1	90.5	
	API-1	13.75	104.3
3	CCD PS	39.7	39.7
4	Photometrics PS 2	90.5	
	FLM-1 Ser. Mux	4.1	
	API-0	13.75	108.4
5	MUX PS	36.0	
	Shutter	3.2	
	Abs. Encoder 3	9.2	
	Abs. Encoder 4	9.2	57.6
6	CCD Saddlebag	50.5	50.5
		Total	406.5

The above power levels do not include power being used by motors, brakes, etc since they are on only a tiny fraction of the time. The comparison lamps which are about 16 watts each are also not included since they also are only on for a very short fraction of the time.

It is very hard to estimate what fraction of the above power is carried away by the cooling liquid. Each photometric power supply runs a thermoelectric cooler which uses about 20 watts. All of this heat is carried away by the liquid. The Photometrics boxes are not designed for a cool plate to dump their heat. Most of the other power supplies above are designed to have heat removed by the cool plates.

I would guess that we carry away at least half of the 406 watts above. We will try to measure this.
\bye

cdr_power.tex

LRIS DRAWINGS

January 6, 1993

Note: Drawings which have a notation "disk x" refer to AutoCad drawings. The disk number is the floppy on which the drawing is located.

LRIS-1xx Main Structure

101- Structure assembly

102- Assembly details

103- Forward mounting panel

104- Forward mounting panel weldment

105- Forward mounting panel details

106- Side panel (2 sheets)

107- Face plate

108- Side panel details

109- Top plates

110- Rear flange

111- Red camera mount

112- Red camera mount weldment

113- Blue camera mount

114- Blue camera mount weldment

115- Blue camera mount clamps/brace

116- Collimator mount

117- Mounting ring (2 sheets)

118- T and B brackets and struts (2 sheets)

119- Side struts and bracket (2 sheets)

120- Bottom plates

121- Optical layout

122- Honeycomb panel

123- VOID

124- VOID

125- 108692 Left panel module location det.

126- 108693 Panel center brace

127- 108694 Honeycomb panel left

128- 108695 Honeycomb top closeout

129- 108696 Honeycomb bottom closeout

130- 108697 Honeycomb end closeout

131- 108698 Honeycomb diagonal closeout

132- 108699 Honeycomb face shllt

133- 108700 Right honeycomb panel assembly

134- 108701 Right honeycomb panel cutouts

135- 108702 Left honeycomb panel cutouts

136- 108705 Red camera mount pieces

137- 108706 Red camera mount pieces

138- 108707 Red camera mount pieces

139- 108708 Red camera mount assembly

140- 108709 Red camera mount weldment

141- 108710 Red amera mount, machining, dimensions

142- 108715 LRIS assembly, side view

143- 108716 LRIS assembly, end view

144- 108717 LRIS assembly, top view

145- Electronics platform (2 sheets)

146- Support base

147- Support stands

148- Centering tool

149- (CES-108718) Forward Mounting panel

150- (CES-108719) Blue camera mount hole locations

151- Shims

152- Cover plates

153- Shroud

154- Shroud, detail A

155- Shroud, detail B

LRIS-2xx Epps Lens, CCD focus and shutter

201- (CES-108723) Camera cross-section

202- (CES-108764) Triplet retainer

203- (CES-108652) Spacing ring

204- (CES-108765) Shim ring

205- (CES-108654) Window ring (more detail)

206- (CES-108655) Window ring (more detail)

207- (CES-108656) Compression ring (rear cam)

208- (CES-108657) Spring retainer

209- (CES-108766) Doublet retainer

210- (CES-108659) Camera barrel

211- (CES-108767) CaF2 retainer

212- (CES-108761) CaF2 cell

213- (CES-108768) triplet cell

214- (CES-108769) Doublet cell

215- (CES-108681) Exploded view of camera

216- (CES-108682) Exploded view of triplet cell

217- (CES-108686) Kapton shims

218- (CES-108761) Epps camera elements

219- (CES-108770) Linear rail mount

220- (CES-108771) Dewar mounting plate

221- (CES-108772) Focus housing

222- (CES-108773) Gusset rail mount

223- (CES-108774) Focus brackets

224- (CES-108775) Solenoid mount

225- (CES-108776) Focus assembly

226- (CES-108777) Shutter linkeage

227- (CES-108780) Focus assembly isometric

228- (CES_108781) Focus encoder mount

LRIS-3xx Red Filter changer

301- (CES-108664) Grabber body

302- (CES-108665) Grabber motor mount

303- (CES-108666) Grabber rack and misc.

304- (CES-108667) Groove plate

305- (CES-108668) Lead screw nut blocks

306- (CES-108669) Red filter mount

307- (CES-108670) Alignment rods

308- (CES-108671) Red filter box end plates

309- (CES-108672) Slide block

310- (CES-108673) Red camera baffles

311- (CES-108674) Guide rails

312- (CES-108675) Guide rail assembly

313- (CES-108676) Red filter rack assembly

314- (CES-108677) Rack top and bottom plates

315- (CES-108678) Red filter box assembly

316- (CES-108679) Red filter box, right side

317- (CES-108680) Red filter box, left side

318- (CES-108683) Red filter grabber assembly

319- 108687 Red filter box rear plate

320- 108688 Red filter box drive

321- 108689 Red filter box drive assembly

322- 108711 Red filter box grabber swithc assembly

323- 108712 Red filter box groove plates modifications

324- 108713 Red filter box bottom plate switch modification

325- 108714 Red filter box switch assembly

326- 108747 Red filter box rear plate mod

326- (CES-108793) Red filter box bottom plate mod

327- (CES-108794) Red filter box selector mechanism assembly

328- (CES-108795) Red filter box Selector housing

329- (CES-108798) Red filter box door assembly

330- (CES-108799) Red filter box key assembly

LRIS-4xx Slit Mask changer, field lens, small inserts

401- (CES-108684) Slit mask frame

402- (CES-108685) Slit mask/field lens structure

403- (CES-108703) Field lens

404- (CES-108704) Handle, red filter/slit mask

405- (CES-108732) Slit mask motion housing

406- (CES-108736) Load plate plus hardware

407- (CES-108737) Slit mask load plate hardware

408- (CES-108738) Slit mask mount blocks

409- (CES-108739) Slit mask rack plates

410- (CES-108740) Slit mask rack hardware

411- (CES-108741) Slit mask rack assembly

412- (CES-108742) Slit mask box

413- (CES-108743) Slit mask box front plate

414- (CES-108744) Slit mask load plate hardware 2

415- (CES-108745) Slit mask inner rail

416- (CES-108746) Slit mask inner rail

417- (CES-108748) Slit mask hardware

418- (CES-108750) Slit mask grab block body

419- (CES-108751) Slit mask back plate

420- (CES-108752) Slit mask instrument load plate

421- (CES-108753) Slit mask end plates

422- (CES-108754) Slit mask grabber hardware

423- (CES-108755) Slit mask rack

424- (CES-108756) Slit mask base plate

425- (CES-108757) Slit mask field lens frame

426- (CES-108758) Field lens retainer

427- (CES-108759) Slitmask instrument rails

428- (CES-108760) Slit mask selector hardware

429- (CES-108761) Slit mask housing plate

430- (CES-108762) Grabber assembly

431- (CES-108763) Slit mask selector housing plate

432- (CES-108783) Offset guider mirror 1 cell assembly

433- (CES-108784) Offset guider base plate

434- (CES-108785) Offset guider mount plate

435- (CES-108786) Offset guider mirror 2 cell

436- (CES-108790) Offset guider motor mounts

437- (CES-108791) Offset guider M1 motor mount

438- (CES-108792) Slit mask mount blocks mod.

439- (CES-108796) Slit mask rack, right side mod.

440- (CES-108797) Slit mask box switch assembly

441- (CES-108800) SLM key assembly

442- (CES-108801) Offset guider cam mount

443- (CES-108802) Offset guider nut mount

444- (CES-108803) Offset guider filter assembly

445- (CES-108804) Fixed guider cam housing

446- (CES-108805) Fixed guider panels

447- (CES-108806) Fixed guider optics mount

448- (CES-108807) Fixed guider camera mount plate

449- (CES-108808) Fixed guider optical mount

450- (CES-108809) Fixed guider assembly

451- (CES-108810) Fixed guider camera lens plate

452- (CES-108811) Slit mask plate

453- (CES-108812) Fixed slit mask plate

454- (CES-108813) Trap door base plate

455- (CES-108814) Trap door

456- (CES-108815) Trap door hardware

457- (CES-108816) Trap door gear box

LRIS-5xx Multi-slit collimator

501-

502-

503-

504-

505-

LRIS-6xx Red Grating turret, grating boxes

601- (UCL DL58-1) Collimator assembly

602- (UCL DL58-2) Grating cell assembly

603- (UCL DL58-3) Cell support assembly

604- (UCL DL58-4) clamp assembly

605- (UCL DL58-5) Cell drive assembly

606- (UCL DL58-6) Turret shaft assembly

607- (UCL DL58-7) Turret assembly

608- (UCL DL58-8) Mounting plate and cover assembly

609- (UCL DL58-9) Plunger stop assembly

610- (UCL-DL58-10) Main drive assembly

611- (UCL-58 schemel)

612- (CES-108778) Turret cone shim

613- (CES-108787) Brake hardware #1

614- (CES-108788) Brake hardware #2

615- (CES-108789) Brake switch/cam assembly

616-

Cell Support Assembly

620- (UCL 58-3-1) Right Hand support plate Disk 10

621- (UCL 58-3-2) Left hand support plate Disk 10

622- (UCL 58-3-3) Front support block Disk 10

623- (UCL 58-3-4) Lower support block Disk 2

624- (UCL 58-3-5) Right hand pivot Disk 2

625- (UCL 58-3-6) Left hand pivot Disk 2

626- (UCL 58-3-7) Bearing housing Disk 2

627- (UCL 58-3-8) Left hand bearing spacer Disk 2

628- (UCL 58-3-9) Retaining ring Disk 10

629- (UCL 58-3-10) Locking ring Disk 2

630- (UCL 58-3-11) Right hand bearing spacer Disk 2

631- (UCL 58-3-12) Left hand support block Disk 10

632- (UCL 58-3-13) Right hand support block Disk 2

633- (UCL 58-3-14) Bearing block web Disk 2

634- (UCL 58-3-15) Disk 2

635- (UCL 58-3-16) Disk 2

636- (UCL 58-3-17) Disk 2

637- (UCL 58-3-18) Toggle Disk 10

638- (UCL 58-3-19) Spring holder Disk 2

639- (UCL 58-3-20) Pins Disk 10

Clamp Support Assembly

640- (UCL 58-4-1) Pin Disk 3

641- (UCL 58-4-2) Drive converter Disk 3

642- (UCL 58-4-3) Cylinder Disk 3

643- (UCL 58-4-4) Cylinder end Disk 3

644- (UCL 58-4-5) Front support plate Disk 3

645- (UCL 58-4-6) Back support plate Disk 3

646- (UCL 58-4-7) Left hand clamp plate Disk 3

647- (UCL 58-4-8) Right hand clamp plate Disk 3

648- (UCL 58-4-9) Clamp plate spacer block Disk 3

649- (UCL 58-4-10) Base block Disk 3

650- (UCL 58-4-11) Spring washer Disk 3

651- (UCL 58-4-12) Motor mounting plate Disk 3

652- (UCL 58-4-13) Contact washer Disk 3

653- (UCL 58-4-14) Washer (Obsolete) Disk 3

654- (UCL 58-4-15) Clamp disk Disk 3

655- (UCL 58-4-16) Clamp pads

656- (UCL 58-4-17) MC61 stepping motor

657-

658-

659-

Cell Drive Assembly

660- (UCL 58-5-1) Gear wheel modification Disk 4

661- (UCL 58-5-2) Adapter boss

662- (UCL 58-5-3) Worm mounting block Disk 4

663- (UCL 58-5-4) Worm retaining plate Disk 4

664- (UCL 58-5-5) Worm spacer

665- (UCL 58-5-6) Worm modification Disk 4

666- (UCL 58-5-7) Worm gear insert Disk 4

667- (UCL 58-5-8) Worm insert Disk 4

668- (UCL 58-5-9) Motor mount Disk 4

669- (UCL 58-5-10) Retaining washer Disk 4

Turret Shaft Assembly

670- (UCL 58-6-1) Turret shaft Disk 5

671- (UCL 58-6-2) End cap Disk 5

672- (UCL 58-6-3) Twin bearing housing Disk 5

673- (UCL 58-6-4) Nut Disk 5

674- (UCL 58-6-5) Bearing spacer Disk 5

675- (UCL 58-6-6) Bearing spacer Disk 5

676- (UCL 58-6-7) Conical insert Disk 5

677- (UCL 58-6-8) Locking nut Disk 5

678- (UCL 58-6-9) Bearing housing Disk 5

679- (UCL 58-6-10) Bearing spacer(large) Disk 5

Turret Shaft Assembly

680- (UCL 58-7-1) Cell mounting plate Disk 6

681- (UCL 58-7-2) Support web Disk 6

682- (UCL 58-7-3) Large sprocket Disk 6

683- (UCL 58-7-4) Sleeve Disk 6

684- (UCL 58-7-5) Support pads Disk 6

685-

686-

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688-

689-

Mounting Plate and Cover Assembly

690- (UCL 58-8-1) Main mounting plate Disk 7

691- (UCL 58-8-2) Turret cover Disk 7

692- (UCL 58-8-3) Cam guide Disk 7

693- (UCL 58-8-4) Cam clamp Disk 7

694- (UCL 58-8-5) Cam Disk 7

695-

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699-

Plunger Stop Assembly

700- (UCL 58-9-1) Rigt hand side plate Disk 10

701- (UCL 58-9-2) Left hand side plate Disk 8

702- (UCL 58-9-3) Large end plate Disk 8

703- (UCL 58-9-4) Small end plate Disk 8

704- (UCL 58-9-5) Top plate Disk 8

705- (UCL 58-9-6) Plunger arm swivel Disk 8

706- (UCL 58-9-7) Bearing cover Disk 8

707- (UCL 58-9-8) Swivel arm Disk 10

708- (UCL 58-9-9) Pin Disk 8

709- (UCL 58-9-10) Roller holder Disk 8

710- (UCL 58-9-11) Roller Disk 8

711- (UCL 58-9-12) Movement actuator Disk 8

712- (UCL 58-9-13) Movement converter Disk 8

713- (UCL 58-9-14) Pins Disk 8

713- (UCL 58-9-15) Microswitch bracket (bot) Disk 8

713- (UCL 58-9-16) Microswitch bracket (top) Disk 8

713- (UCL 58-9-17) Clamp Disk 8

713- (UCL 58-9-18) Cover Disk 8

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Main Drive Assembly

720- (UCL 58-10-1) Bottom bearing plate Disk 9

721- (UCL 58-10-2) Main bearing tube Disk 9

722- (UCL 58-10-3) Bevel gear housing Disk 9

723- (UCL 58-10-4) Top plate Disk 9

724- (UCL 58-10-5) Side plate Disk 9

725- (UCL 58-10-6) Bearing spacer Disk 9

726- (UCL 58-10-7) Drift shaft Disk 9

727- (UCL 58-10-8) Bevel gear spacer Disk 9

728- (UCL 58-10-9) Large bevel gear mod Disk 9

729- (UCL 58-10-10) 10-tooth sprocket Disk 9

730- (UCL 58-10-11) Small bevel gear mod Disk 9

Collimator Cell

740- (UCL 58-1-1) Cell base

741- (UCL 58-1-2)

742- (UCL 58-1-3) Tube

743- (UCL 58-1-4) Fixed plunger

744- (UCL 58-1-5) Sprung plunger

745- (UCL 58-1-6) Radial screw (fixed)

746- (UCL 58-1-7) Radial screw (sprung)

746- (UCL 58-1-8) Fixed pin

748- (UCL 58-1-9) Block/ fixed axial

749- (UCL 58-1-10) Pad/ spring axial

750- (UCL 58-1-11) Spacer

751- (UCL 58-1-12) Retainer cap

752- (UCL 58-1-13) Cone pad

753- (UCL 58-1-14) Groove pad

754- (UCL 58-1-15) Flat pad

755- (UCL 58-1-16) Kinematic screw

756- (UCL 58-1-17) Cup

757- (UCL 58-1-18) Cone

758- (UCL 58-1-19) Plunger/ block pin

759- (UCL 58-1-20) Stud

760- (UCL 58-1-21) Lid

761- (UCL 58-1-22) Interface plate

762- (UCL 58-1-23) Contact washer

763-

Grating Cell Assembly

770-	(UCL 58-2-1) Red grating cell	Disk 1
771-	(UCL 58-2-2) Cell lid	Disk 1
772-	(UCL 58-2-3) Lock nut	Disk 1
773-	(UCL 58-2-4) Adjusting screw	Disk 1
774-	(UCL 58-2-5) Pad	Disk 1
775-	(UCL 58-2-6) Grating spring adj/ side	Disk 1
776-	(UCL 58-2-7) Grating adjustment point/ side	Disk 1
777-	(UCL 58-2-8) Grating spring retainer	Disk 1
778-	(UCL 58-2-9)	
779-	(UCL 58-2-10)	
780-	(UCL 58-2-11)	
781-	(UCL 58-2-12)	
782-	(UCL 58-2-13) Grating cover	Disk 1
783-	(UCL 58-2-14) Stand for mting grating in cell	Disk 1

LRIS-8xx Light sources, dust cover, shroud

See LRIS-457-457

LRIS-9xx

LRIS-10xx Spectrograph Control Electronics

1001- (LRIS-SYS01-0101) LRIS control electronics, system block diagram

1002- (LRIS-SYS01-0108) LRIS control electronics, multiplexer system

1003- (MTRRSTRNG) Block diagram, motor drivers nad MUX

1004- (APIOMTMC-01) API-0 mid-torque motor controller

1005- (API1MTMC-01) API-1 xxx-torque motor controller

1006- (API2MTMC-01) API-2 xxx-torque motor controller

1007- (API3MTMC-01) API-3 xxx-torque motor controller

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LRIS-11xx MUX and motor controllers

1101- (MPXBOARD-01) schematic for multiplexer board #1

1102- (MPXBOARD-02) schematic for multiplexer board #2

1103- (MPXBOARD-03) schematic for multiplexer board #3

1104- (MPXBOARD-04) schematic for multiplexer board #4

1105- 4-pole relay mounting plate for multiplexer

LRIS-12xx Dust cover

LRIS-13xx Calibration lamps

1301- (LMPCTRLR-01) Reference lamp controller

LRIS-14xx Guider

1401- Photometrics CCD camera block diagram

1402- Guider limit switches

LRIS-15xx Slit mask changer

1501- (SLMSKWRG-01) Slit mask electrical parts

1502- (SLMSKWRG-02) Slit mask wiring

1503-

LRIS-16xx Grating turret

1601- (RGTBLD1A-01) Red grating turret block diagram

1602- (LRIS-SPC01-1039) Red grating turret grating rotator MUX card

1603- (LRIS-SPC01-1039) Red grating rotator MUX board PWB outline

1604- Red grating turret MUX board silk screen layout, component side

1605- Red grating turret MUX board silk screen layout, layer 2

1606- Red grating turret MUX board silk screen layout, solder side, layer 1

1607- Red grating turret grating component box layout #1

1608- Red grating turret grating component box layout #2

1609- Red grating turret grating component box, fix for Cannon connector

1610- Red grating turret grating component box cover

1611- Red grating turret grating component box, relay cutout template

1612- Red grating turret grating component box layout, dual relay mount

1613- (MPXRSST) Red grating turret MPX-red grating station steering

1614- (LRIS_SPC01-1017) Red grating turret organization

1615- (LRIS_SPC01-1025) Red grating turret rotator MUX 1 wiring

1616- (LRIS_SPC01-1022) Red grating turret rotator motor wiring

1617- (LRISRGRT) Red grating turret home detect circuit

1618- (RGCABLES-04) Red grating turret daisy-chained motor drive

1619- (RGCABLES-03) Red grating turret daisy-chained limit switches

1620- (RGCABLES-02) Red grating turret encoder/logic/power bus

1621- (RGCABLES-01) Red grating turret cabling

LRIS-17xx Red filter changer

1701- (REDFLWRG-01) red filter electrical parts

1702- (REDFLWRG-02) red filter wiring

1703-

LRIS-18xx Shutter and Camera focus

1801- (RCSHCTRL-01) Red camera shutter controller

LRIS-19xx Future expansion

1901- (LRIS-SPC01-xxxx) Dichroic electrical components

1902- (LRIS_SPC01-xxxx-x) Dichroic grabber wiring

1903- (LRIS_SPC01-xxxx-x) Dichroic selector wiring

1904- (LRIS_SPC01-xxxx) Grism electrical components

1905- (LRIS_SPC01-xxxx) Grism grabber wiring

1906- (LRIS_SPC01-xxxx) Grism selector wiring

1907- (LRIS_SPC01-xxxx) Blue filter electrical components

1908- (LRIS_SPC01-xxxx) Blue filter grabber wiring

1909- (LRIS_SPC01-xxxx) Blue filter selector wiring

LRIS-20xx CCD controller

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