Operator Manual Addendum
2500 Nd:YAG Ophthalmic Laser System

When the 2500 Nd:YAG laser system is turned on, a self test/calibration check is automatically performed, verifying that the system is properly calibrated and ready for use.

When the YAG POWER switch, and then the keyswitch, are turned ON, the system performs an automatic self test and calibration as follows:

- The STANDBY display flashes.
- The red aiming beam appears (unless aiming beam knob is turned off).
- Eights are displayed in each position of the upper control panel, except for the last three positions which display the software revision level (either "201" or "211").
- The YAG laser test fires, and after a brief period, default values are displayed. If no error code appears, the system is ready for use. If an error code appears in the SHOTS/BURST window (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ⊏, or ⊊), refer to table below.
- At the conclusion of this sequence, the STANDBY display illuminates, and the results of the self test are printed.
- The ENERGY display flashes, indicating the value is a preset energy level (1.0 mJ for 2500 systems, and 0.8 mJ for 2500LE systems).

To enter the READY mode the user must press the TEST FIRE button up to eight times until the measured energy level is no greater than 120% of the preset energy level. The flashing error code "⊨" could appear while pressing the TEST FIRE button, indicating the measured energy level is not within system tolerances. Continued pressing of the TEST FIRE button is required to eliminate the error code and enter the READY mode.

ERROR CODE & PROBABLE CAUSE	CORRECTIVE ACTION
ERROR 0: Attenuator not in expected position.	If error code flashing, delivered energy is still within tolerance. Footswitch/joystick is active when READY illuminates. System can be used, but call factory for service. If error code ON continuously, attenuator position is not within tolerance. System cannot be used. Call factory for service.
ERROR 1 to 6: Attenuator position not confirmed by feedback circuit.	These errors only occur during power up sequence. Turn system OFF and try again. If errors continue, call factory for service.
ERROR 7: Power supply voltage for system electronics is incorrect.	Service may be needed. Turn power OFF for one minute, then turn back ON.
ERROR 8: Laser power supply is not ready.	Service may be needed. Turn power OFF for one minute, then turn back ON.
ERROR 9: Laser safety shutter is in wrong position.	Service may be needed. Turn power OFF for one minute, then turn back ON.
ERROR ⊏ : An error occurred reading RAM or ROM.	Hardware problem. Call factory for service.
ERROR ⊊ : Low output power during self test.	Service may be needed. Turn power OFF, unplug footswitch, then re-connect footswitch. Turn power ON.
ERROR ⊨ : Laser misfire, or greater than 120% of preset energy level.	Service may be needed. Test fire up to eight times until error disappears and READY mode appears.

CHAPTER 5

SERVICE

CHAPTER FIVE

SERVICE

1.0 INTRODUCTION

This Service chapter of the manual provides information and procedures for adjustment of the 2300/2500 YAG laser system. It is recommended that you review the functional theory of operation in chapter four prior to aligning the system. Alcon Surgical recommends that only a factory-trained technician perform the electrical and laser alignment procedures in this chapter.

2.0 ROUTINE MAINTENANCE

The system operator should be cautioned to have the internal laser energy meter in the system calibrated by a factory-trained technician at least once a year. The following routine maintenance can and should be performed by the operator on an as-required basis.

NOTE: Always keep a dust cover over the instrument when it is not in use.

- Clean external surfaces of system optics as required by wiping them lightly with a photographic lens tissue moistened with acetone or methanol (methanol removes fingerprints). Do not use silicone-based eyeglass cleaning tissues or solutions.

- Clean exterior surfaces of system table, optical head, and pedestal by lightly wiping with a soft cloth moistened with water or a mild, non-abrasive, soap solution. Do not spray cleaning solutions onto system exterior; overspray can contaminate external surfaces of the optics.

- Replace the slit lamp illuminator bulb when output intensity becomes noticeably low or when the filament burns out. Always set lamp intensity to minimum when the 2300/2500 system is turned ON and OFF; this extends the life of the bulb.

- Replace printer paper as required to ensure there is enough for printed treatment reports.

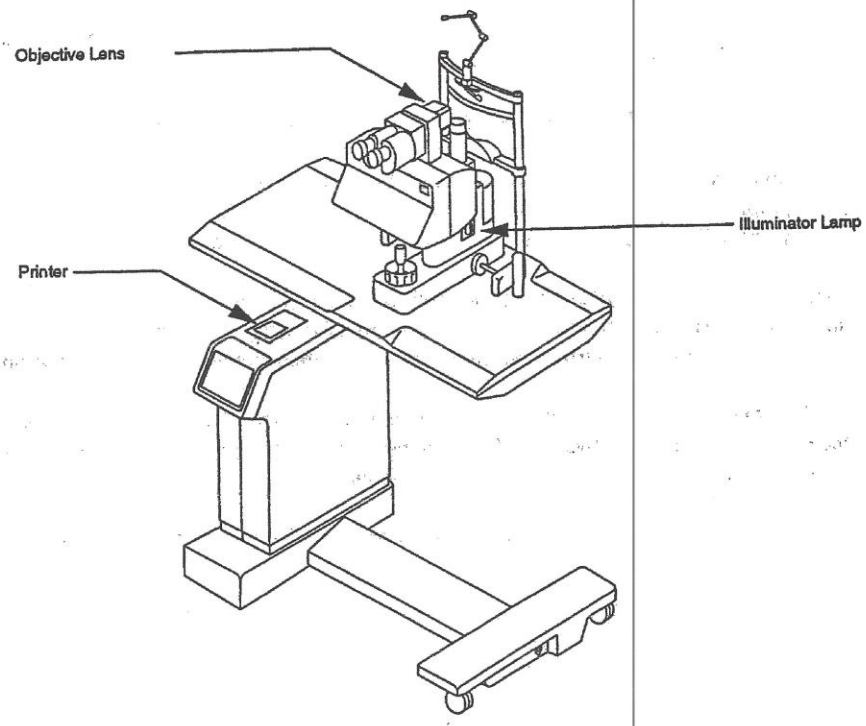


FIGURE 5-1
ROUTINE MAINTENANCE

2.1 CLEANING OBJECTIVE LENS

The objective lens must be cleaned periodically to maintain the full output energy of the laser system. Use the following procedure to clean the lens.

2.1.1 Fold a piece of lens tissue (not facial or other types of tissue) into a square pad approximately the size of the lens. Lens tissue is available at all photographic supply stores.

2.1.2 Grasp the center of the square pad with a pair of plastic hemostats.

2.1.3 Saturate one side of the pad with acetone or methanol; shake off excess.

2.1.4 Gently wipe the moistened edge of the tissue once from top to bottom across the lens surface; discard the tissue.

2.1.5 Repeat this procedure until the entire surface of the lens is clean. Always use a new piece of tissue for each wipe.

2.2 REPLACEMENT OF ILLUMINATOR BULB

Replace the illuminator bulb when output intensity becomes noticeably low, or when the filament burns out. Always set lamp intensity to minimum when the 2300/2500 system is turned ON and OFF; this extends the life of the bulb. Replace the bulb as follows:

2.2.1 Turn SYSTEM KEYSWITCH OFF.

WARNING!

IF THE SYSTEM HAS BEEN IN OPERATION, THE ILLUMINATOR BULB AND THE CONTACTS ON THE LAMP COVER WILL BE HOT. WAIT AT LEAST FIVE MINUTES FOR THE LAMP AND COVER TO COOL BEFORE PROCEEDING WITH BULB REPLACEMENT.

2.2.2 Locate the illuminator lamp cover on the lower right side of the illuminator tower. Grasp the lamp cover and gently pull straight out.

2.2.3 Grasp the rectangular rear portion of the bulb, wiggle the bulb out of the illuminator tower, and discard.

CAUTION

Do not touch the glass on new bulb with your fingers. If it is accidentally touched, it must be thoroughly cleaned with methanol to remove any oil left by fingers. If not clean, the oil will cause rapid deterioration of bulb. Methanol removes skin oil, acetone does not; therefore, several wipes with methanol is recommended.

2.2.4 With locating notch on new bulb oriented left, press bulb into place. The locating notch should precisely engage the lamp housing spring blade.

2.2.5 With male pins at the bottom, and flat contacts at the top, press cover into place. When properly installed the cover is flush with the illuminator tower.

2.3 REPLACE PRINTER PAPER (2500 model only)

2.3.1 Turn SYSTEM POWER keyswitch ON. Turn YAG POWER switch OFF.

2.3.2 Raise table by pressing TABLE UP switch. Turn SYSTEM POWER keyswitch OFF.

2.3.3 Tear off excess paper at the tear bar.

2.3.4 Pull top of printer cover outward, then lift up.

2.3.5 Release roller tension on paper by pulling paper release lever on left side of printer.

2.3.6 Lift paper roll from recess behind printer, tear off paper at roll, and discard.

NOTE: Do not disturb electrical connector in front of paper roll.

2.3.7 Pull remaining paper through printer in normal direction of travel and discard.

2.3.8 Place new roll of paper in recess behind printer, leaving about six inches of paper at bottom of roll.

2.3.9 Insert end of paper under rubber platen, pushing gently with a side-to-side motion until end of paper emerges at top.

2.3.10 Grasp end of paper and gently pull about six inches through printer. Center paper on rubber platen, and maintaining light tension, return paper release lever to locked position.

2.3.11 Holding printer cover over printer, thread paper through opening in cover. Point rear of cover downward and slide into place. Edges of cover and cover slot should line up and engage. Push top portion of cover into place.

2.3.12 Turn SYSTEM POWER keyswitch ON, briefly press the PAPER FEED button, and verify that paper advances normally. If it does not, recheck printer to ensure that paper is feeding from beneath paper roll, and that it is correctly threaded through printer.

2.3.13 Turn YAG POWER switch ON and observe the printed status message at conclusion of system self test. If nothing is printed on paper, paper is installed upside down.

2.4 OPTICAL FOCUS ADJUSTMENT

2.4.1 Turn left and right eyepiece adjustment rings fully CCW. Lower target flag.

2.4.2 Viewing through right eyepiece, rotate adjustment ring CW until crosshair in field of view becomes clear and focused.

2.4.3 Viewing through right eyepiece, use joystick to move assembly until target flag is in focus.

2.4.4 Viewing through left eyepiece, rotate adjustment ring CW until target flag is in focus.

3.0 LASER SYSTEM ELECTRONICS MAINTENANCE

To comply with the regulations of the Food and Drug Administration, the internal electronic calibration of the 2300/2500 YAG laser system must be verified periodically using an external energy meter that has been calibrated against measurement standards traceable to the National Bureau of Standards.

We recommend that the calibration be verified annually or whenever the system fails any part of the Service Checklist Procedure in chapter 3 of this manual. We further recommend that this procedure be performed only by a factory trained technician.

The following procedures assume basic knowledge of test equipment operation. It is recommended that these electronic calibration procedures be performed in the order given. This ensures that the system is checked in a front to back order and that the primary functions are calibrated prior to any secondary operation checks or adjustments. Flow charts at the end of each procedure serve as reference pointers as you progress through the procedures.

CAUTION

If this procedure is performed by anyone other than a qualified, factory-trained technician, it may void the warranty on the laser system.

WARNINGS!

IN THE FOLLOWING SECTION YOU ARE ASKED TO REPLACE THE AUTOCAL EPROM WITH A TEST EPROM. BY DOING THIS THE MANDATORY SAFETY FEATURES ARE DISABLED FOR SERVICE PURPOSES. THE TEST EPROM MUST NOT BE USED FOR PATIENT APPLICATIONS UNDER ANY CIRCUMSTANCES.

ALL PERSONS IN THE LASER AREA MUST WEAR Nd:YAG SAFETY EYEWEAR WHILE THESE PROCEDURES ARE PERFORMED.

3.1 REQUIRED TEST EQUIPMENT, TOOLS, AND SUPPLIES

Test equipment, tools, and supplies required to perform these procedures are listed below. Items other than those listed may be used if they meet or exceed minimum use requirement.

Item	Minimum Use Requirement	Equipment
Standard tool kit	Standard hand tools	
YAG safety goggles	Supplied by Alcon Surgical	L-300-146
Energy meter	Read >40 millijoules (mJ)	Laser Precision RJ7100
Digital multimeter (DMM)	Read 20 VDC	Fluke 8060
Test EPROM	Supplied by Alcon Technical Service	995-1000-011
Interlock bypass jumper	Standard jumper wire	NPN
Foldout mirror	Supplied by Alcon Technical Service	NPN
Offset tool	Supplied by Alcon Technical Service	L-0100-0902
Burn paper	Linagraph direct print	Kodak 1895
Methanol or acetone	Electronic grade	NPN
Lens cleaning paper	Kodak	NPN
Plastic hemostats		NPN

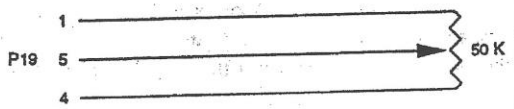
TABLE 5-1
REQUIRED TEST EQUIPMENT, TOOLS, & SUPPLIES

3.2 FRONT PANEL DISPLAY PCB CALIBRATION

3.2.1 Remove EPROMs Z22 & Z23 from CPU PCB. Install test EPROM at location Z22. Turn SYSTEM POWER keyswitch ON and press READY button.

3.2.2 Connect DMM to TP2 and TP1 (GND) on Display Interface PCB. Adjust R49 on Display Interface PCB for 5 VDC.

3.2.3 Disconnect J19 from Display Interface PCB and connect dummy plug (50 K potentiometer) to P19 as shown. This simulates the energy monitor voltage level.



3.2.4 Connect DMM to TP14 and TP10 (GND) and adjust dummy plug for 10 VDC. Fire laser and adjust R42 for 10 mJ on front panel display.

3.2.5 Adjust dummy plug for 0.3 VDC. Fire laser and adjust R50 for 0.3 mJ on front panel display.

3.2.6 R42 and R50 interact. Repeat prior two steps until both conditions are met without further adjustment.

3.2.7 Verify linearity of front panel display at following settings.

DUMMY PLUG SETTING	FRONT PANEL DISPLAY
0.3 VDC	0.3 mJ
1.0 VDC	1.0 mJ
3.0 VDC	3.0 mJ
5.0 VDC	5.0 mJ
7.0 VDC	7.0 mJ
12.0 VDC	12.0 mJ

3.2.8 Remove DMM. Disconnect dummy plug and reconnect J19. Go to step 3.3, 1/2 Wave Attenuator Setup.

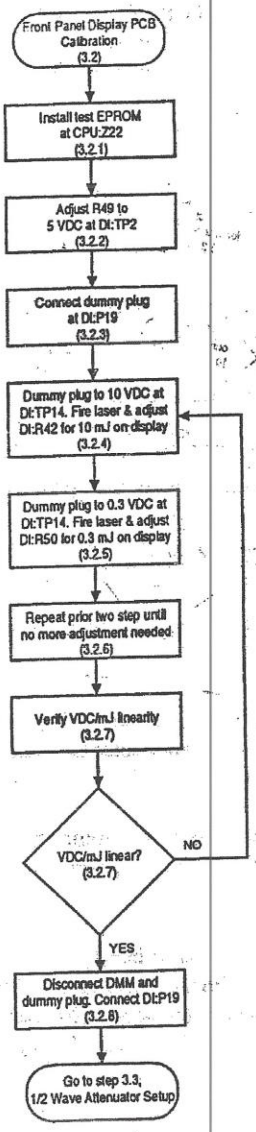


FIGURE 5-2
FRONT PANEL DISPLAY CALIBRATION

3.3 1/2 WAVE ATTENUATOR SETUP

The black protective shield must cover pump cavity when performing the following procedures. The shield prevents scattered energy from affecting readouts.

3.3.1 Disconnect stepper motor connector P15 from Display Interface PCB and mount energy meter at objective lens output. Fire laser and adjust 1/2 wave attenuator screw for maximum output. Energy output reading should be between 10 and 12 mJ. If not, loosen setscrew in stop collar, adjust 1/2 wave attenuator screw CW for maximum output. If 10 mJ is not reached, go to step 4.1, Laser Plate Alignment, and adjust if necessary.

3.3.2 Fire laser and adjust 1/2 wave attenuator CCW for minimum output. Energy output reading should be less than 0.3 mJ. If not, loosen setscrew on 1/4 wave plate, slightly turn 1/4 wave plate until less than 0.3 mJ is obtained at objective lens, and tighten setscrew. If still not less than 0.3 mJ, adjust Q-switch driver pot and measure again. If 0.3 mJ is not reached, go to step 5.0 and replace laser plate.

3.3.3 Repeat prior two steps until no more adjustment is necessary.

3.3.4 If loosened in prior steps, tighten setscrews on stop collar and 1/4 wave plate. Reconnect stepper motor connector P15 to Display Interface PCB. Reset laser.

3.3.5 Set front panel displayed energy to 10 mJ. Select a reference point on the stop collar and mark it with a pencil.

3.3.6 Disconnect stepper motor connector P15 from Display Interface PCB. Fire laser while manually turning 1/2 wave attenuator to achieve maximum energy output at objective lens (≥10 mJ).

3.3.7 Loosen setscrew on stop collar and return to pencil reference point marked in step 3.3.5. Tighten set screw to hold collar in place. Reconnect stepper motor connector P15 to Display Interface PCB.

3.3.8 Reset laser and fire at 1.0 mJ. If energy output at objective lens is between 1.05 mJ and 1.10 mJ, go to step 3.4, Energy Monitor Module Calibration. If actual energy is greater than 1.10 mJ, loosen and rotate stop collar slightly CW, tighten stop collar, and repeat this step; If actual energy is less than 1.05 mJ, rotate stop collar slightly CCW and repeat this step.

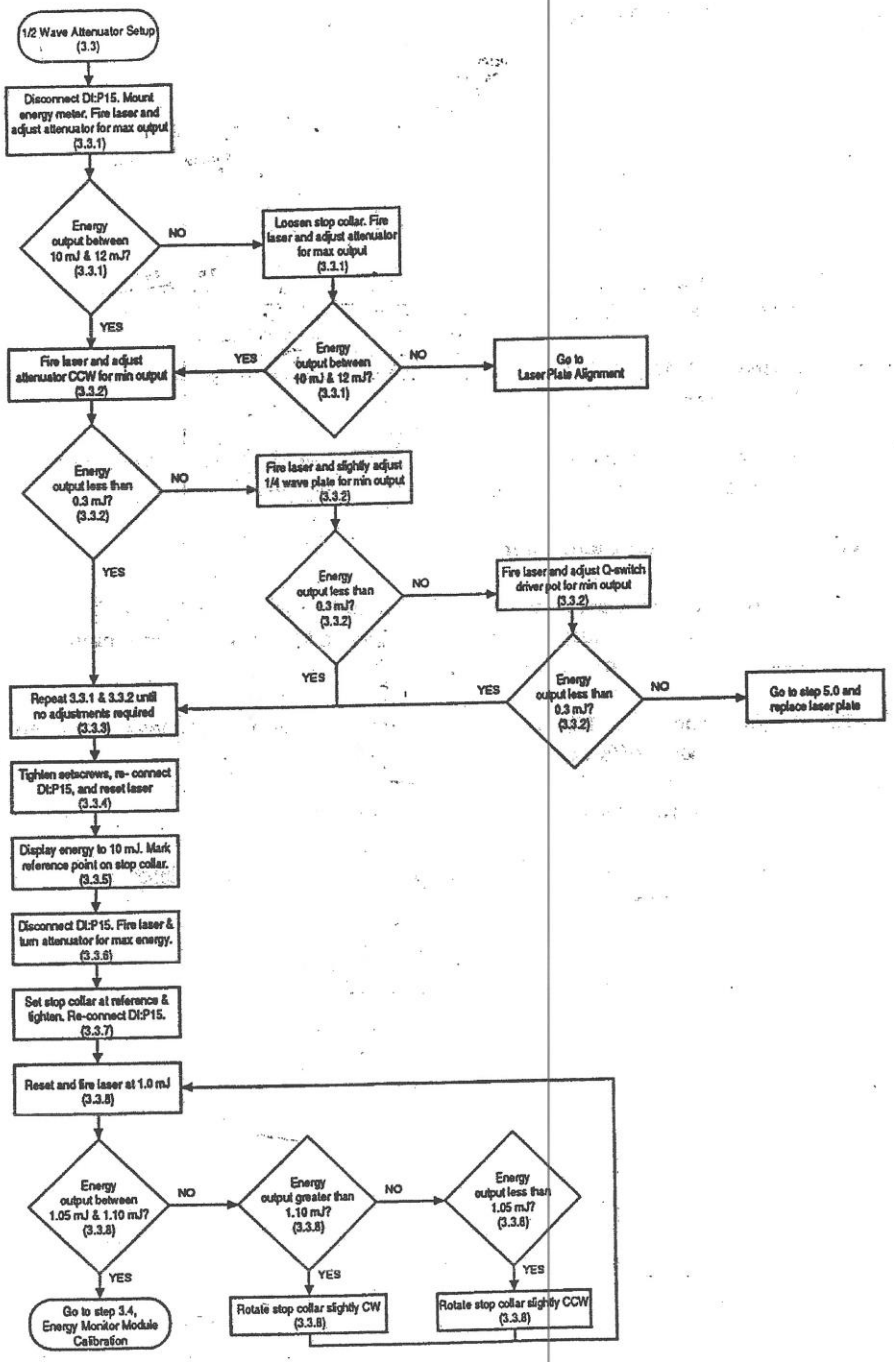


FIGURE 5-3
1/2 WAVE ATTENUATOR SETUP

3.4 ENERGY MONITOR MODULE CALIBRATION

3.4.1 Photo Diode Saturation Point Adjustment

Only adjust this photo diode when infra red sensor or energy monitor module has been replaced, otherwise, go directly to step 3.4.2, Energy Monitor Module Calibration.

3.4.1.1 Disconnect stepper motor connector P15 from Display Interface PCB. Fire laser and rotate 1/2 wave attenuator for maximum output at objective lens.

3.4.1.2 Turn the gain and offset pots fully CW on energy monitor module.Turn screw on photo diode block CCW until only a few threads are left in place.

3.4.1.3 Connect DMM to TP14 on Display Interface PCB. While firing laser, verify reading at TP14 does not change (this indicates photo diode saturation).

3.4.1.4 Turn screw on photo diode block CW, while firing laser, until voltage starts to drop (this is the saturation point). Lock screw in place with glyptol.

3.4.2 Energy Monitor Module Calibration

3.4.2.1 Disconnect stepper motor connector P15 from Display Interface PCB. Fire laser and adjust 1/2 wave attenuator for 10 mJ at objective lens. Adjust energy monitor module gain pot for 10 mJ on front panel display.

3.4.2.2 Fire laser and adjust 1/2 wave attenuator for 0.3 mJ at objective lens. Adjust energy monitor module offset pot for 0.3 mJ on front panel display.

3.4.2.3 Repeat prior two steps until both conditions are met.

3.4.2.4 Verify linearity of energy monitor module throughout range of laser. One volt at TP14 equals 1 mJ at objective lens.

start @ 3.4.2 CALIBRATION OF ENERGY

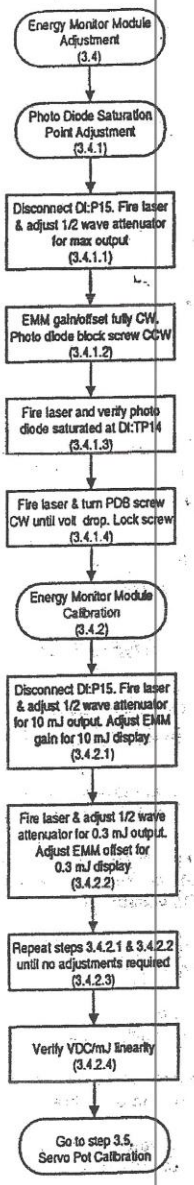


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FIGURE 5-4
ENERGY MONITOR MODULE CALIBRATION

3.5 SERVO POT CALIBRATION

3.5.1 Disconnect stepper motor connector P15 from Display Interface PCB. Connect DMM to TP8 on Display Interface PCB.

3.5.2 Turn R41 (offset) and R37 (gain) pots on Display Interface PCB fully CCW, then turn both pots 10 turns CW.

3.5.3 Turn 1/2 wave attenuator CCW until low peg bumps against servo pot. Loosen and turn white nylon gear for approximately 0.33 VDC. Tighten nylon gear. Adjust R41 for 0.33 VDC ±.03 VDC.

3.5.4 Turn 1/2 waye attenuator four turns CW. Adjust R37 for 4.14 VDC.

3.5.5 Repeat prior two steps until both conditions are met.

3.5.6 Turn system OFF. Disconnect DMM from Display Interface PCB and re-connect stepper motor connector P15. Remove test EPROM from CPU PCB and install EPROMs Z22 & Z23.

3.5.7 Turn system ON and verify no error codes appear on front panel display. If error code appears, repair problem and repeat this servo pot calibration procedure.

ERROR CODES

NOTE: These error codes are related to the servo pot calibration procedure and usually occur during the power-up sequence.

Error 1	Pot reading stuck at maximum value; attempt to step down reading fails.
Possible Cause:	Open circuit on pot, cable, or connector.
Error 2	Pot reading does not reach maximum; attempt to step up reading fails.
Possible Cause:	Five volts not at pot. Reference voltage at pot is greater than voltage at D5. Stepper motor failure. D5 voltage low.
Error 3	Pot reading at maximum unstable.
Possible Cause:	No top peg. Loose mount.
Error 4	Expected value not obtained at 200 steps off top peg (≈ 3.9 VDC).
Possible Cause:	No top peg. Pot not linear. Pot out of calibration.
Error 5	Voltage from pot does not track step counter.
Possible Cause:	Pot not linear. Pot out of calibration.
Error 6	Voltage reading at low peg out of tolerance.
Possible Cause:	Pot not linear. Pot out of calibration.

3.5.8 Perform Service Checklist Procedure in chapter three.

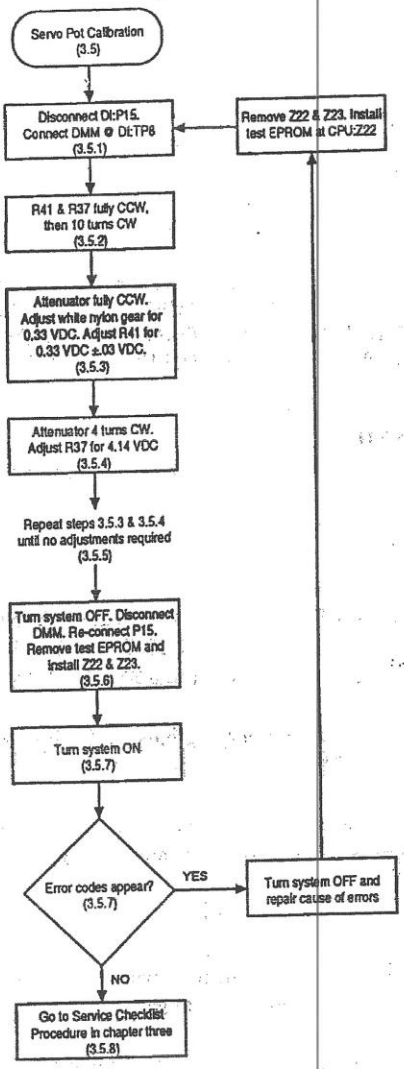


FIGURE 5-5
SERVO POT CALIBRATION

4.0 LASER PLATE AND OPTICS PLATE MAINTENANCE

Perform only as much of these procedures as required to bring the laser to the specified output. Flow charts at the end of each procedure serve as visual reference guides. Refer to Figure 5-6 while performing this procedure.

After approximately 200 continuous laser shots the laser plate becomes warm, causing beam shift. This can affect the alignment when optics plate cools. After 200 shots wait 30 minutes before continuing adjustments.

WARNING!

THE Nd:YAG LASER BEAM IS INVISIBLE AND VERY DIFFICULT TO REALIGN WHEN OUT OF ADJUSTMENT. IT IS RECOMMENDED THAT FOLLOWING PROCEDURES BE PERFORMED ONLY BY A FACTORY TRAINED LASER TECHNICIAN. IT IS FURTHER RECOMMENDED THAT PROCEDURES BE DONE IN ORDER GIVEN, EXACTLY AS STATED; SHORTCUTS MAY RESULT IN A LOST BEAM.

4.1 LASER PLATE ALIGNMENT

The laser plate alignment should be done only after the electrical alignments (sections 3.2 through 3.5) fail to deliver desired results, or when a new laser plate is installed.

4.1.1 Burn Pattern

4.1.1.1 Turn SYSTEM POWER keyswitch OFF. Remove EPROMs Z22 & Z23 from CPU PCB. Install test EPROM at location Z22. Install interlock bypass jumper on Interconnect PCB at J11 pins 1-4. Turn SYSTEM POWER keyswitch ON.

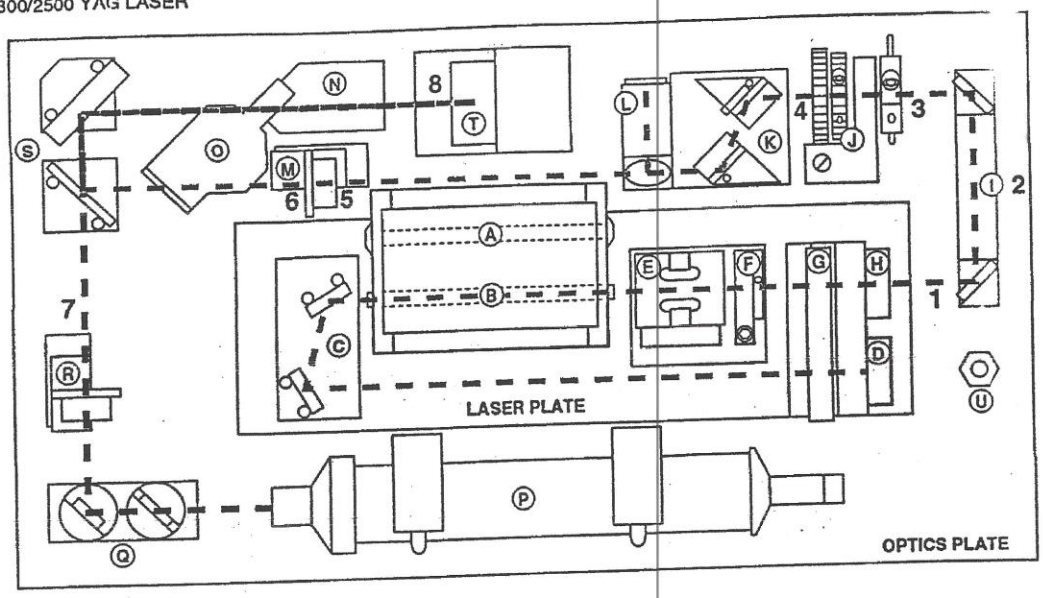
4.1.1.2 Mount foldout mirror, with diverging lens, on folding mirror block. Measure reservoir voltage and adjust to 350 volts.

4.1.1.3 Place burn paper at foldout mirror and fire laser. If burn pattern looks similar to following example, go to step 4.1.2. If not, go to next step.

4.1.1.4 Fire laser and adjust aperture until burn pattern looks similar to prior example. If burn pattern looks similar to example, go to step 4.1.2. If not, go to next step.

4.1.1.5 Clean output coupler lens with acetone drops applied to lens paper pulled over the end of a Q-tip. Discard paper after each wipe. Fire laser. If burn pattern looks similar to prior example, go to step 4.1.2. If not, go to next step.

4.1.1.6 Remove aperture. Adjust reservoir voltage to 325 volts and fire laser. If burn pattern looks similar to following example, replace or repair aperture and go to step 4.1.1.2. If burn does not look similar to example, go to next step.



OPTICS PLATE & LASER PLATE COMPONENTS

A: Flash lamp
B: YAG laser rod
C: Folding cavity polarizer block
D: High reflector
E: Q-switch
F: 1/4 wave plate
G: Aperture
H: Output coupler
I: Folding mirror block
J: 1/2 wave attenuator
K: Polarizer block
L: Photo diode block
M: YAG diverging lens
N: Shutter Detector PCB
O: Safety shutter
P: HeNe laser tube
Q: HeNe beam splitter block
R: HeNe diverging lens
S: Combining mirrors (combining mirror block)
T: Prism mounting block
U: Front panel interlock switch

HeNe/YAG LASER CHECK POINTS

1: Laser plate burn check
2: Foldout mirror energy check
3: 1/2 wave attenuator burn check
4: 1/2 wave attenuator burn check
5: YAG diverging lens burn check
6: YAG diverging lens burn check
7: HeNe check
8: Prism HeNe check
9: Objective lens HeNe focus & power checks; YAG burn, energy, and focus checks (not shown)

FIGURE 5-6
OPTICS PLATE/LASER PLATE FOR 2300/2500 Nd:YAG LASER SYSTEM

4.1.1.7 Fire laser and adjust high reflector until burn pattern looks similar to prior example. If burn pattern looks similar to example, install aperture and go to step 4.1.1.2. If not, go to next step.

4.1.1.8 Remove high reflector and clean with acetone, or replace, if necessary. Place energy meter at foldout mirror. Fire laser and adjust high reflector for maximum output, then fire laser at burn paper. If burn pattern at foldout mirror looks similar to example, install aperture and go to step 4.1.1.2. If burn pattern does not match example, go to next step.

4.1.1.9 Disconnect Q-switch driver connector and rotate 1/4 wave plate 45°. Adjust reservoir voltage for 350 V. Hold energy meter in front of foldout mirror and fire laser. If output is 32 mJ to 34 mJ, go to next step. If not 32 mJ to 34 mJ, go to step 4.1.1.11.

4.1.1.10 Install new Q-switch driver. Re-position 1/4 wave plate and adjust reservoir voltage for 325 V. Fire laser at burn paper and adjust high reflector until burn pattern looks similar to prior example. If burn pattern looks similar to example, install aperture and go to step 4.1.1.2. If not, replace laser plate (step 5.0).

4.1.1.11 Fire laser and adjust high reflector for an output of 32 mJ to 34 mJ. If output is 32 mJ to 34 mJ, go to step 4.1.1.10. If not 32 mJ to 34 mJ, go to next step.

4.1.1.12 Increase reservoir voltage in five volt increments and measure output energy. **DO NOT EXCEED 380 VOLTS.** If output is 32 mJ to 34 mJ, go to step 4.1.1.10. If not 32 mJ to 34 mJ, go to next step.

4.1.1.13 Install new flash lamp. Adjust reservoir voltage for 350 V. Fire laser and adjust high reflector for 32 mJ to 34 mJ. If output is 32 mJ to 34 mJ connect Q-switch driver, re-position 1/4 wave plate, and go to step 4.1.1.15. If not 32 mJ to 34 mJ, go to next step.

4.1.1.14 Increase reservoir voltage in five volt increments and measure output energy. DO NOT EXCEED 380 VOLTS. If output is 32 mJ to 34 mJ, go to next step. If not 32 mJ to 34 mJ, replace laser plate (step 5.0).

4.1.1.15 Adjust reservoir voltage to 325 volts and fire laser. If burn pattern looks similar to following example, install aperture and go to step 4.1.1.2. If burn does not look similar to example, go to next step.

4.1.1.16 Fire laser and adjust high reflector until burn pattern looks similar to prior example. If burn pattern looks similar to example, install aperture and go to step 4.1.1.2. If not, go to next step.

4.1.1.17 Install new Q-switch driver. Fire laser at burn paper. If burn pattern looks similar to example, install aperture and go to step 4.1.1.2. If not, replace laser plate (step 5.0).

4.1.2 Laser Power

4.1.2.1 Hold energy meter in front of foldout mirror and fire laser. If output is 15 mJ to 17.5 mJ, laser plate is acceptable. Remove foldout mirror and perform the optics plate alignment procedure (step 4.2). If output is not 15 mJ to 17.5 mJ, go to next step.

4.1.2.2 Adjust reservoir voltage up in five volt increments and fire laser. **DO NOT EXCEED 380 VOLTS.** If output is 15 mJ to 17.5 mJ, laser plate is acceptable. Remove foldout mirror and perform the optics plate alignment procedure (step 4.2). If output is not 15 mJ to 17.5 mJ, go to next step.

4.1.2.3 Adjust Q-switch driver and fire laser. If output is 15 mJ to 17.5 mJ, laser plate is acceptable. Remove foldout mirror and perform the optics plate alignment procedure (step 4.2). If output is not 15 mJ to 17.5 mJ, go to next step.

4.1.2.4 Turn system power OFF and install new Q-switch driver. Turn system power ON and adjust reservoir voltage for 350 volts. Fire laser. If output is 15 mJ to 17.5 mJ, laser plate is acceptable. Remove foldout mirror and perform the optics plate alignment procedure (step 4.2). If output is not 15 mJ to 17.5 mJ, go to next step.

4.1.2.5 Adjust reservoir voltage up in five volt increments and fire laser. **DO NOT EXCEED 380 VOLTS.** If output is 15 mJ to 17.5 mJ, laser plate is acceptable. Remove foldout mirror and perform the optics plate alignment procedure (step 4.2). If output is not 15 mJ to 17.5 mJ, go to next step.

4.1.2.6 Adjust Q-switch driver and fire laser. If output is 15 mJ to 17.5 mJ, laser plate is acceptable. Remove foldout mirror and perform the optics plate alignment procedure (step 4.2). If output is not 15 mJ to 17.5 mJ, replace laser plate (step 4.5).

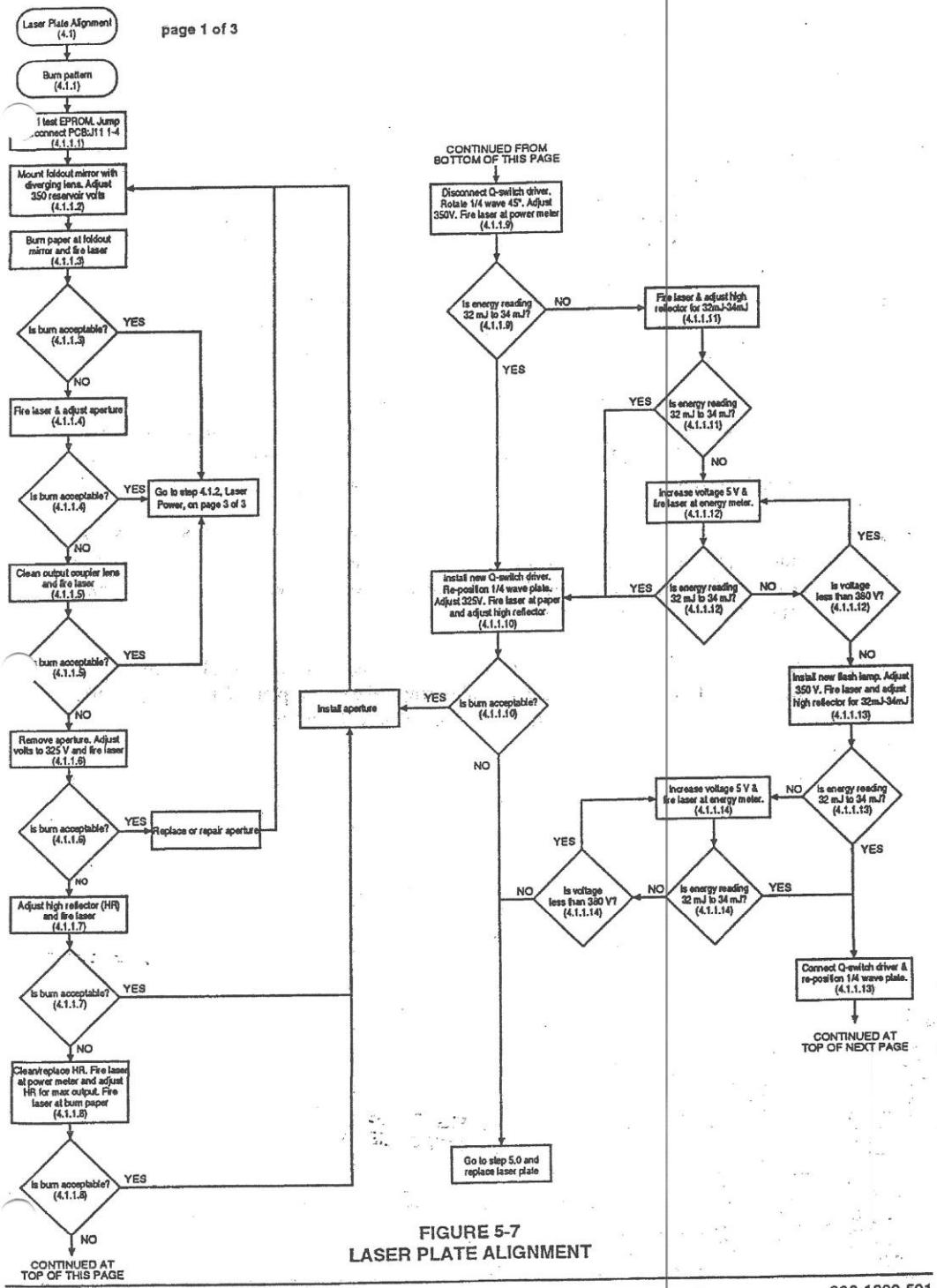
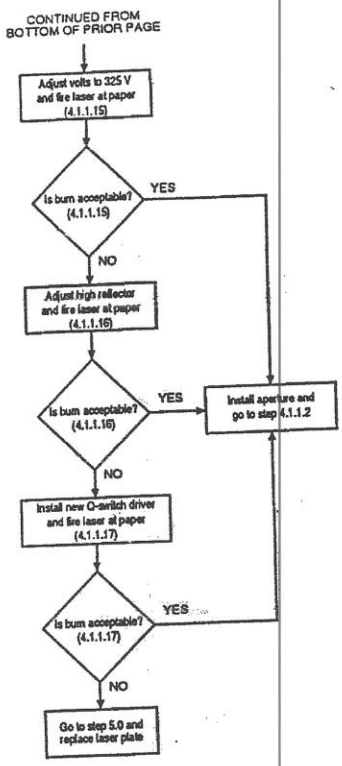
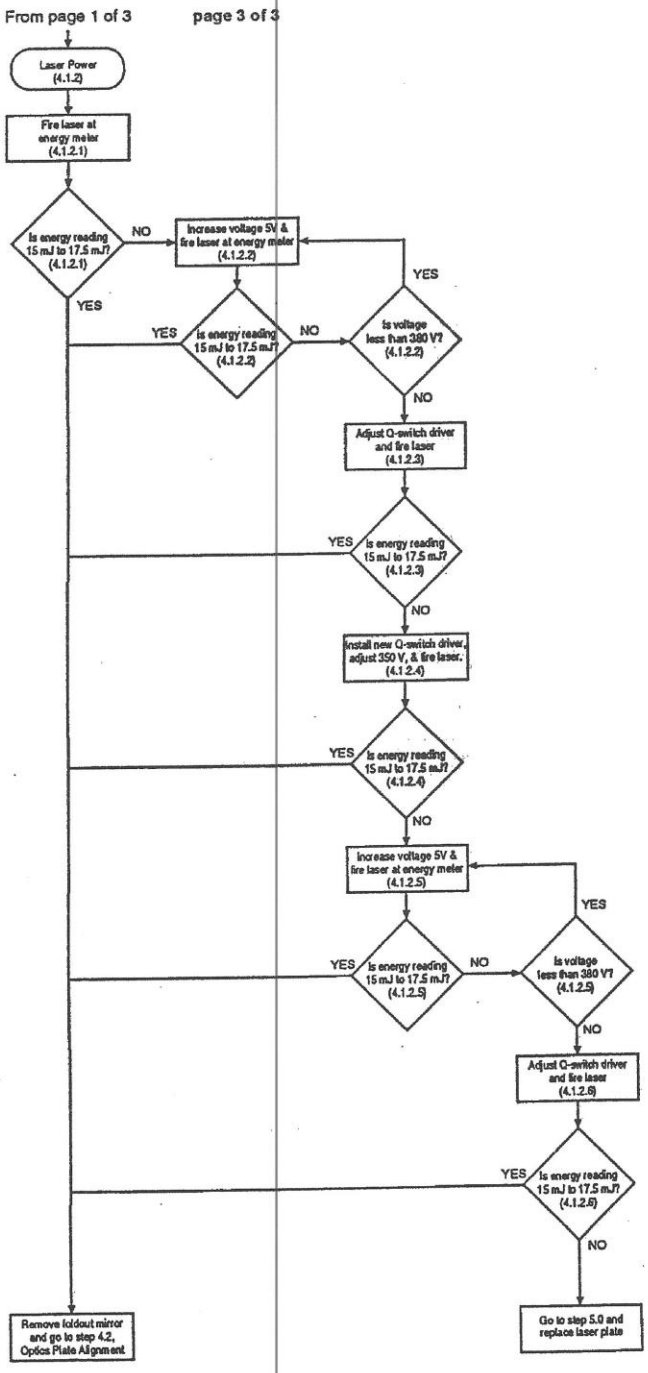


FIGURE 5-7
LASER PLATE ALIGNMENT


CONTINUED FROM BOTTOM OF PRIOR PAGE
Adjust volts to 325 V and fire laser at paper (4.1.1.15)
Is burn acceptable? (4.1.1.15)
YES
NO
Adjust high reflector and fire laser at paper (4.1.1.16)
Is burn acceptable? (4.1.1.16)
YES
Install aperture and go to step 4.1.1.2
NO
Install new Q-switch driver and fire laser at paper (4.1.1.17)
Is burn acceptable? (4.1.1.17)
YES
NO
Go to step 5.0 and replace laser plate


From page 1 of 3
page 3 of 3
Laser Power (4.1.2)
Fire laser at energy meter (4.1.2.1)
Is energy reading 15 mJ to 17.5 mJ? (4.1.2.1)
NO
Increase voltage 5V & fire laser at energy meter (4.1.2.2)
YES
YES
Is energy reading 15 mJ to 17.5 mJ? (4.1.2.2)
YES
NO
Is voltage less than 380 V? (4.1.2.2)
NO
Adjust Q-switch driver and fire laser (4.1.2.3)
YES
Is energy reading 15 mJ to 17.5 mJ? (4.1.2.3)
NO
Install new Q-switch driver, adjust 350 V, & fire laser. (4.1.2.4)
YES
Is energy reading 15 mJ to 17.5 mJ? (4.1.2.4)
NO
Increase voltage 5V & fire laser at energy meter (4.1.2.5)
YES
YES
Is energy reading 15 mJ to 17.5 mJ? (4.1.2.5)
NO
Is voltage less than 380 V? (4.1.2.5)
NO
Adjust Q-switch driver and fire laser (4.1.2.6)
YES
Is energy reading 15 mJ to 17.5 mJ? (4.1.2.6)
NO
Remove foldout mirror and go to step 4.2, Optics Plate Alignment
Go to step 5.0 and replace laser plate

4.2 OPTICS PLATE ALIGNMENT

The laser plate alignment procedure should be performed prior to performing this optics plate alignment procedure. This is to ensure that problems encountered are in the optics plate and not in the laser plate.

The test EPROM, installed during laser plate alignment, must remain installed in CPU PCB in order to perform this optics plate alignment. The interlock bypass jumper, installed on Interconnect PCB at J11 pins 1-4 during laser plate alignment, must remain connected during this optics plate alignment.

NOTE: In the following procedures, adjustment of folding mirror block may require the use of spacer shims between the block and optics plate.

4.2.1 Burn Pattern

4.2.1.1 Disconnect stepper motor connector P15 from Display Interface PCB and manually rotate 1/2 wave attenuator for maximum output. Place burn paper at point between objective lens and laser focal point and fire laser. If burn is round, go to step 4.2.1.5. If not, go to next step.

4.2.1.2 Place burn paper in front of photo diode block and fire laser. If burn is approximately in center of input to photo diode block, go to next step. If not, fire laser and adjust folding mirror block until burn is centered.

4.2.1.3 Place burn paper in front of YAG diverging lens and fire laser. If burn is approximately in center of input to YAG diverging lens, go to next step. If not, fire laser and adjust folding mirror block until burn is centered.

4.2.1.4 Place burn paper at objective lens, fire laser, and make very slight adjustments to folding mirror block until burn is round. Tighten two screws on folding mirror block and check again.

4.2.1.5 Place burn paper at point between objective lens and laser focal point and fire laser. If burn looks similar to prior baseball pattern example, go to step 4.2.2, Laser Power. If not, go to next step.

4.2.1.6 Place burn paper at objective lens, fire laser, and make very slight adjustments to folding mirror block until baseball pattern is centered, then tighten two screws on folding mirror block and check again. Go to step 4.2.2, Laser Power.

4.2.2 Laser Power

4.2.2.1 Place energy meter at point between objective lens and laser focal point. Fire laser and note maximum energy reading. If maximum energy is ≥10 mJ, go to step 4.2.3, Final Laser Burn Pattern and Power Check. If not ≥10 mJ, go to next step.

4.2.2.2 Clean folding mirrors, polarizers, YAG diverging lens, combining mirrors, prism, and objective lens. Surfaces can be cleaned with drops of acetone applied to lens cleaning paper, and wiping the paper across laser surfaces with a plastic hemostat. Fire laser and note maximum energy reading. If maximum energy is ≥10 mJ, go to step 4.2.3, Final Laser Burn Pattern and Power Check. If not ≥10 mJ, go to next step.

4.2.2.3 The folding mirror block may be burnt, or it may be an old style folding polarizer block. Remove folding mirror block and replace with new folding mirror block, then go to step 4.2.1.2 and repeat Optics Plate Alignment procedure.

4.2.3 Final Laser Burn Pattern and Power Check

4.2.3.1 Turn system OFF, wait 15 minutes to let optics plate cool, then re-check baseball pattern and energy at objective lens. If baseball pattern and energy are still good, go to step 4.3 and perform Coaxiality Alignment. If not good, go to step 4.2 and repeat Optics Plate Alignment procedure.

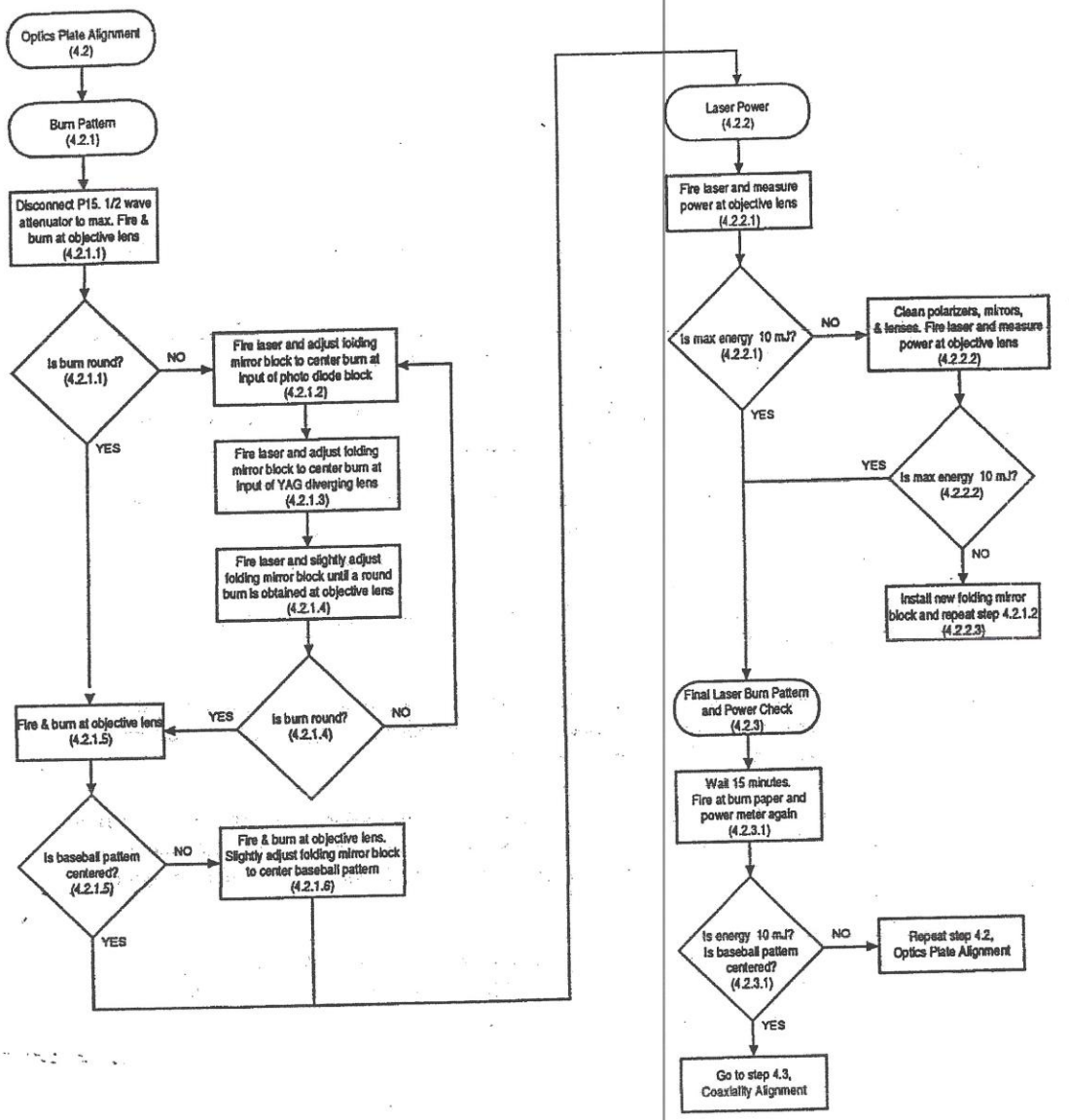


FIGURE 5-8
OPTICS PLATE ALIGNMENT

4.3 COAXIALITY ALIGNMENT

The coaxiality alignment procedure should be completed after performing the optics plate alignment procedure. Coaxiality alignment ensures the HeNe aiming beam and Nd:YAG treatment beam are properly aligned with each other.

The interlock bypass jumper, installed on Interconnect PCB at J11 pins 1-4 during laser plate alignment, must remain connected during this coaxiality alignment.

4.3.1 Turn slit lamp power OFF. Lower target flag and place a piece of black electrical tape on flag.

4.3.2 Hold a piece of paper at objective lens and observe two HeNe spots. If HeNe spots are perfectly round, go to step 4.3.4. If not round, go to next step.

4.3.3 Adjust folding mirror on HeNe beam splitter block until both spots are perfectly round (shims may be necessary under folding mirror).

4.3.4 Remove paper and move joystick until HeNe spots become one spot on tape. Fire laser at 1 mJ and note position of burn. If burn is directly over HeNe spot, go to step 4.4, Crosshair Alignment. If burn is not on HeNe spot, go to next step.

4.3.5 Fire laser, and adjust lower combining mirror (or combining mirror block) until HeNe and YAG spots are horizontally aligned.

4.3.6 Adjust HeNe diverging lens until HeNe spot is directly over YAG burn (don't slide diverging lens up or down on block). If spot is directly over YAG burn, go to step 4.3.8. If spot is not on YAG burn, go to next step.

4.3.7 Make a slight adjustment to YAG diverging lens (don't slide diverging lens left or right on block). Place a new piece of black electrical tape on flag, fire laser, and note position of burn. If burn is not on HeNe spot, repeat this step. If burn is on HeNe spot, go to next step.

4.3.8 Hold a piece of paper at objective lens and observe two HeNe spots. If HeNe spots are perfectly round, go to step 4.4, Crosshair Alignment. If not round, repeat procedure from step 4.3.3.

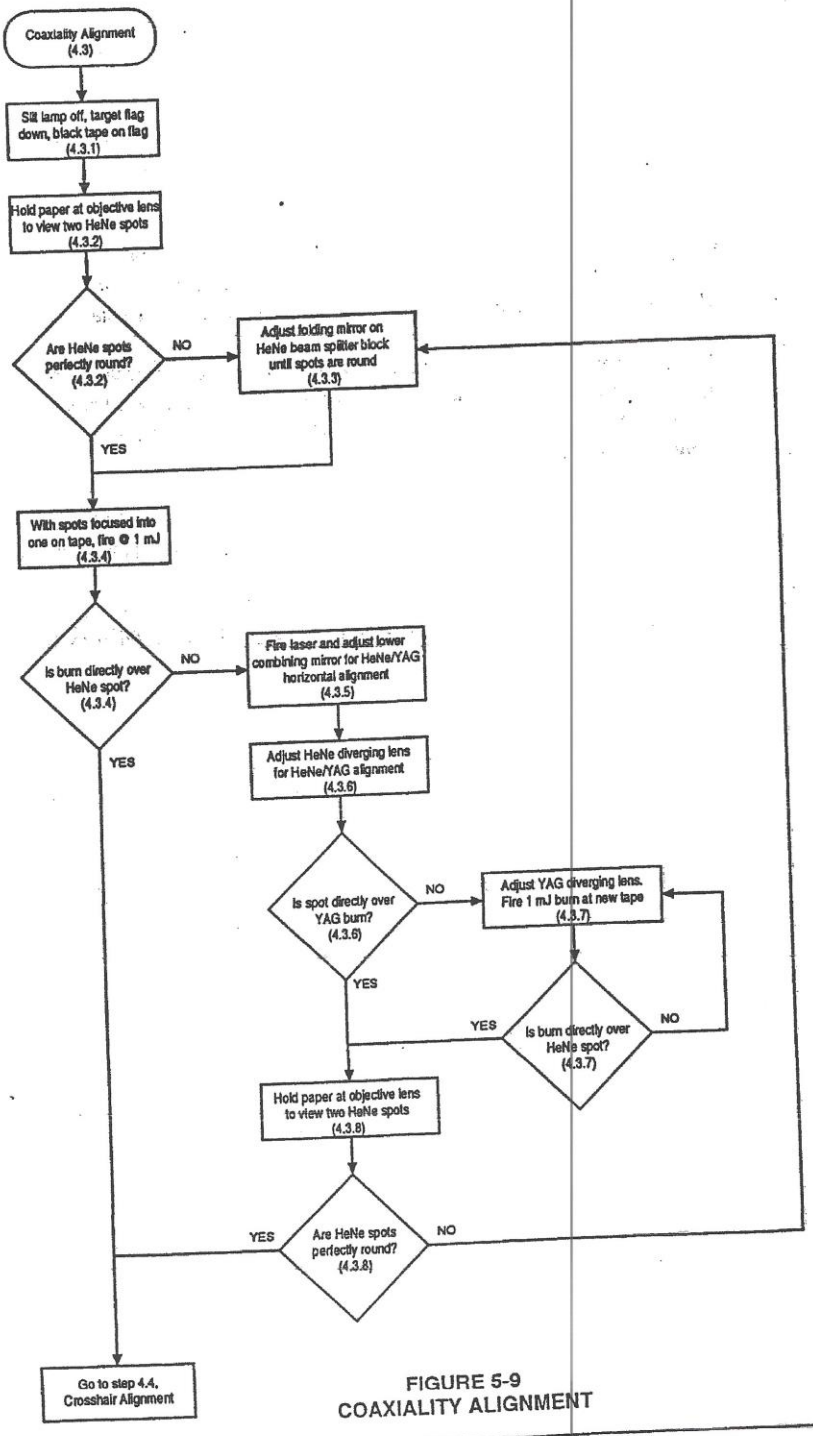


FIGURE 5-9
COAXIALITY ALIGNMENT

4.4 CROSSHAIR ALIGNMENT

The interlock bypass jumper, installed on Interconnect PCB at J11 pins 1-4 during laser plate alignment, must remain connected during this crosshair alignment.

4.4.1 Look through eyepieces and note position of HeNe spot. If spot is centered between crosshairs, go to step 4.5, HeNe/YAG Offset Alignment. If not centered, go to next step.

4.4.2 Turn system OFF and remove Display Interface PCB (do not disconnect J18). Remove plate covering elliptical mirror. If system is equipped with a micro manipulator, go to next step. If system is NOT equipped with a micro manipulator, go to step 4.4.4.

4.4.3 Turn system ON. Adjust nuts on shaft under elliptical mirror up or down to move HeNe beam vertically. Loosen two allen bolts under mirror cavity and adjust setscrews on left and right sides of cavity to move HeNe beam horizontally. When HeNe beam is centered, tighten two allen bolts and go to step 4.4.5.

4.4.4 Turn system ON. There are three allen bolts and setscrews used to lock & adjust the elliptical mirror. Loosen, adjust, and tighten one allen bolt/setscrew at a time until HeNe beam is centered.

4.4.5 Turn system OFF. Replace plate covering elliptical mirror. Replace Display Interface PCB.

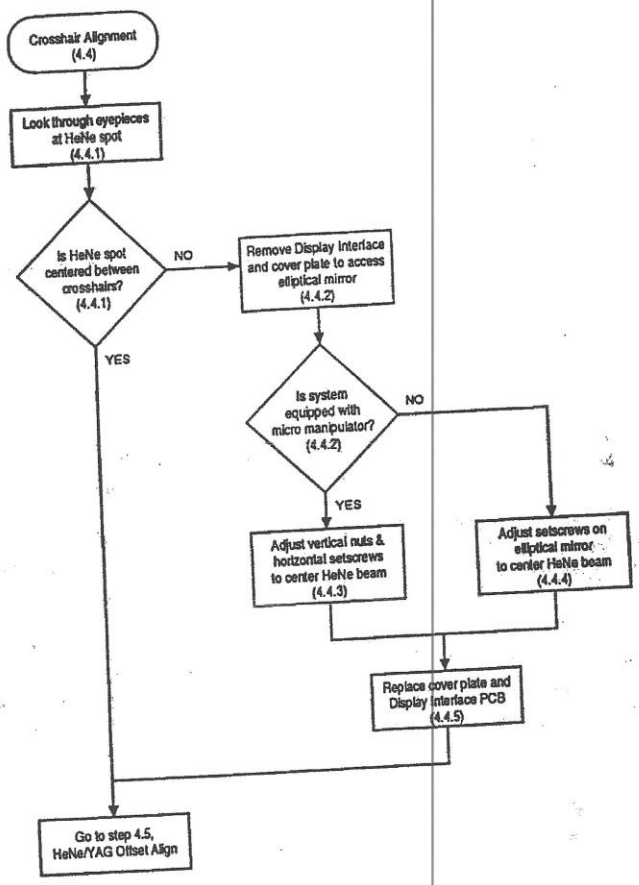


FIGURE 5-10
CROSSHAIR ALIGNMENT

4.5 HeNe/YAG OFFSET ALIGNMENT

The HeNe/YAG offset alignment procedure should be performed after completion of Laser Plate, Optics Plate, Coaxiality, and Crosshair alignment procedures. This ensures HeNe aiming beam and Nd:YAG treatment beam are properly aligned with each other and with the slit lamp optics. This procedure offsets the YAG beam focus point 150 microns posterior to (behind) the HeNe aiming beam focus point, allowing the surgeon to focus the YAG treatment on the posterior capsule rather than on the intraocular lens (IOL). Always advise surgeon after adjusting offset.

The interlock bypass jumper, installed on Interconnect PCB at J11 pins 1-4 during laser plate alignment, must remain connected during this HeNe/YAG offset alignment.

4.5.1 Attach offset tool to top of objective lens and secure with mounting bolt. Place black vinyl tape on test surface.

4.5.2 Turn left and right eyepiece adjustment rings fully CCW.

4.5.3 Viewing through right eyepiece, rotate adjustment ring CW until crosshair in field of view becomes clear and focused.

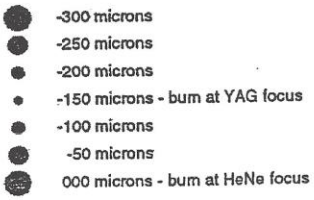
4.5.4 Viewing through right eyepiece, adjust horizontal micrometer until tape is in focus.

4.5.5 Viewing through left eyepiece, rotate adjustment ring CW until tape is in focus.

4.5.6 Adjust HeNe attenuator knob until HeNe spot(s) are clearly visible. If HeNe is focused at one spot, go to step 4.5.8. If HeNe makes two spots on black tape, go to next step.

4.5.7 Focus HeNe spots into one spot by moving HeNe diverging lens up or down. Lowering the diverging lens moves the HeNe focus closer to the objective lens; raising the diverging lens moves the HeNe focus farther from the objective lens. Repeat step 4.5.6.

4.5.8 Make a note of horizontal micrometer value, set displayed energy to 1.0 mJ, and fire laser. Turn vertical micrometer CCW 150 microns to allow space for the next shot, adjust horizontal micrometer CCW 50 microns, and fire laser again. Repeat this procedure five more times until you have seven burns in a vertical row.



4.5.9 Inspect burn pattern. If middle burn is smallest of the seven burns (150 microns posterior to HeNe focal point), and top three burns/bottom three burns are same size, HeNe/YAG offset is correct; go to step 4.6, Slit Lamp Focus. If burns are not as described, go to next step.

4.5.10 If smallest burn is above the middle burn, move YAG diverging lens right to move focus closer to objective lens, and repeat step 4.5.8. If smallest burn is below middle burn, move YAG diverging lens left to move focus farther from objective lens, and repeat step 4.5.8.

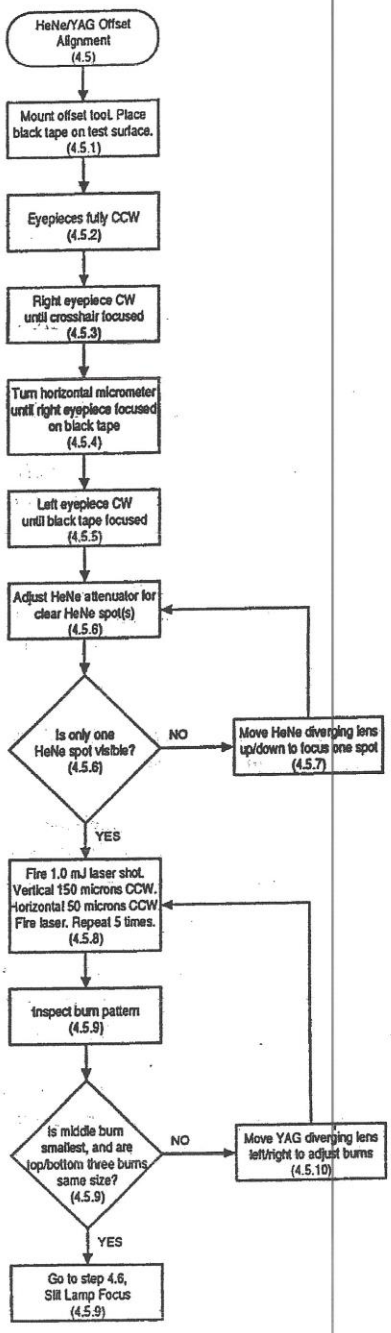


FIGURE 5-11
HENE/YAG OFFSET ALIGNMENT

4.6 SLIT LAMP FOCUS

4.6.1 Attach offset tool to top of objective lens and secure with mounting bolt. Place black vinyl tape on test surface.

4.6.2 Turn left and right eyepiece adjustment rings fully CCW.

4.6.3 Viewing through right eyepiece, rotate adjustment ring CW until crosshair in field of view becomes clear and focused.

4.6.4 Viewing through right eyepiece, adjust horizontal micrometer until tape on test surface is in focus.

4.6.5 Viewing through left eyepiece, rotate adjustment ring CW until tape is in focus.

4.6.6 Adjust HeNe attenuator knob until HeNe spot(s) are clearly visible. If HeNe is focused at one spot, go to next step. If HeNe makes two spots on black tape, go to step 4.5, HeNe YAG Offset Alignment.

4.6.7 Turn slit lamp illuminator ON and close the horizontal adjustment (vertical slit) to a width of approximately 1 mm. Move the slit lamp tower to mid position and set the horizontal slit lever into its center detente position. If vertical slit is centered in cross hairs, go to step 4.6.9; if not, go to next step.

4.6.8 Loosen two screws on horizontal adjustment knob plate and move until the vertical slit is centered in cross hairs, then tighten screws.

4.6.9 Swing the slit lamp tower from 30 degrees on one side to 30 degrees on the other side while viewing through the oculars. The slit should not move more than 1/2 the slit width in either direction from center. If within 1/2 slit width, go to step 4.6.11; if not, go to next step.

4.6.10 While adjusting horizontal micrometer, swing the illuminator from 30 degrees on one side to 30 degrees on the other side until slit no longer moves left or right. Unscrew objective lens and add or remove steel spacer rings until HeNe is focused at one spot.

4.6.11 Open the horizontal adjustment and close the vertical adjustment (horizontal slit) to approximately 1 mm. The horizontal slit should be centered in cross hairs within 1/2 the slit width. If within 1/2 slit width, procedure is completed; if not, go to next step.

4.6.12 Viewing through oculars, adjust screw on top of tower until horizontal slit is centered on cross hairs. Procedure is completed.

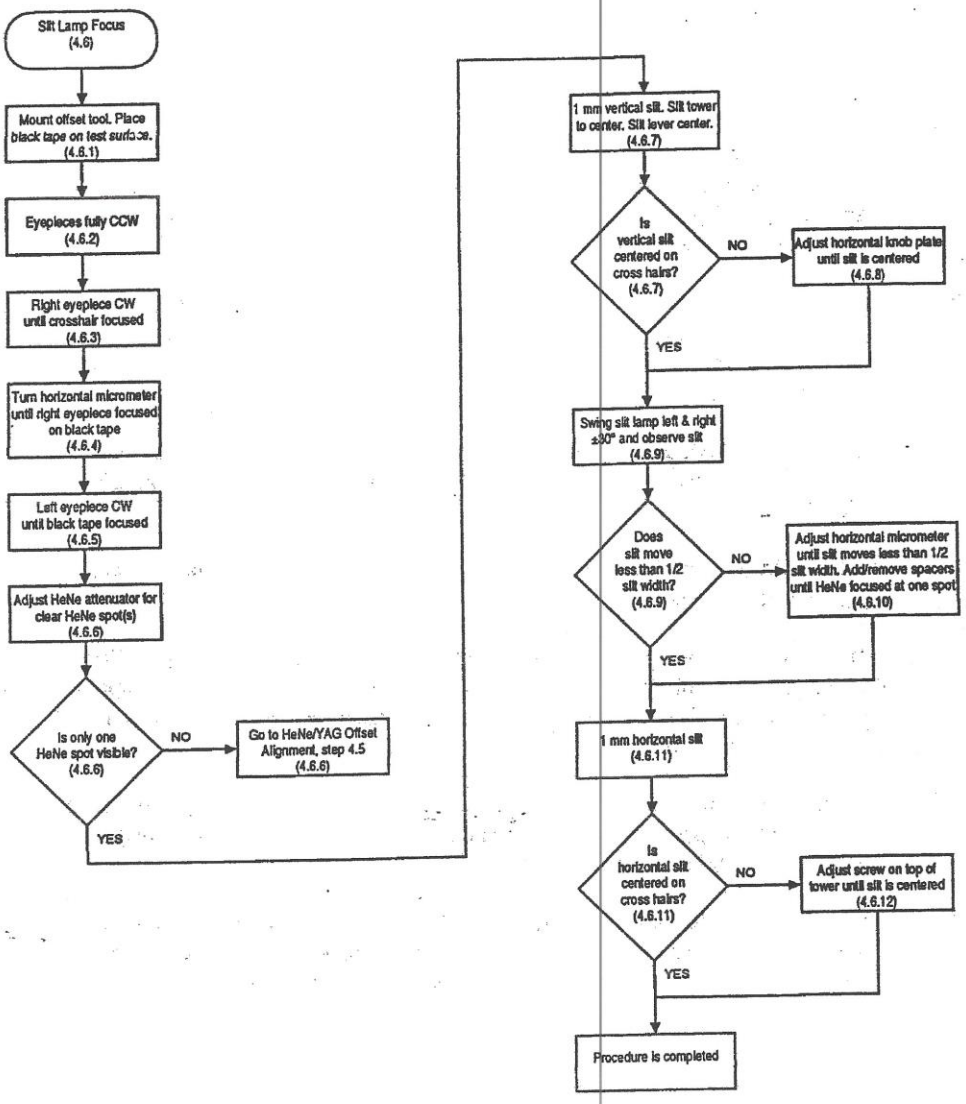


FIGURE 5-12
SLIT LAMP FOCUS

5.0 REPLACE LASER PLATE

The laser system electronic maintenance procedures and laser plate alignment should be performed prior to changing the laser plate; this ensures the problem is the laser plate and not something else.

This procedure is written for optics plates with removable laser plates. Single-piece optics plates do not contain a separate laser plate, and this procedure is not applicable.

5.1 Turn SYSTEM POWER keyswitch OFF. Disconnect two wires from Q-switch and two flash lamp wires from optics plate.

5.2 Remove three allen bolts securing laser plate to optics plate and remove laser plate from system. Place new laser plate on optics plate and secure, but do not tighten, three allen bolts. Ensure that no wires are trapped or crimped behind laser plate.

5.3 Connect two wires to Q-switch as directed on data sheet supplied with new laser plate to ensure proper polarization (a normal laser plate requires the brown wire to be on the top, and the white or red wire to be on the bottom. A reverse laser plate requires the opposite orientation). Connect two flash lamp wires to optics plate.

5.4 Remove EPROMs Z22 & Z23 from CPU PCB. Install test EPROM at location Z22. Install interlock bypass jumper on Interconnect PCB at J11 pins 1-4. Turn SYSTEM POWER keyswitch ON.

5.5 Adjust charging module potentiometer to voltage referenced on data sheet supplied with new laser plate.

5.6 With laser plate bolts secure but not tight, place burn paper, enclosed in cellophane, between output coupler and folding mirror, and fire laser. If laser burns a spot on paper, go to next step. If laser does not burn a spot on paper, call your technical support representative for assistance.

5.7 Gently tighten three allen bolts to secure laser plate to optics plate and fire laser. If laser burns a spot on paper, go to step 4.0 and perform laser plate and optics plate maintenance. If burn spot is not visible, go to next step.

5.8 Readjust laser plate allen bolts and fire laser. If laser burns a spot on paper, go to step 4.0 and perform laser plate and optics plate maintenance. If laser does not burn a spot on paper, call your technical support representative for assistance.

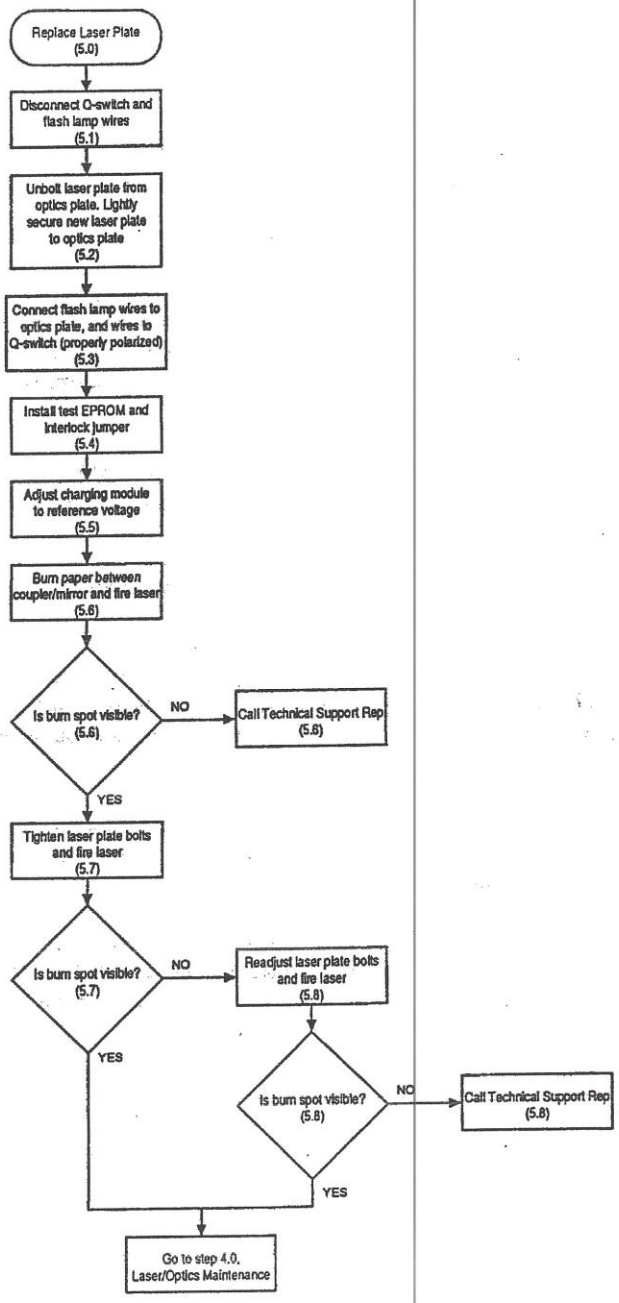


FIGURE 5-13
LASER PLATE REPLACEMENT PROCEDURE

6.0 REPLACE OPTICS PLATE

6.1 Turn SYSTEM POWER keyswitch OFF. Release Display Interface PCB from optics plate by removing four standoff bolts.

6.2 Disconnect all cables between optics plate and Display Interface PCB. Disconnect flash lamp cables and ground wire from back side of optics plate.

6.3 Remove four bolts that secure optics plate to binocular tower and remove optics plate. Place new optics plate on binocular tower and secure, but do not tighten, four bolts. Ensure that no wires are trapped or crimped behind optics plate.

6.4 Connect flash lamp cables and ground wire to back side of optics plate. Connect all cables between optics plate and Display Interface PCB. Secure Display Interface PCB to optics plate with four standoff bolts.

6.5 Remove EPROMs Z22 & Z23 from CPU PCB. Install test EPROM at location Z22. Install interlock bypass jumper on Interconnect PCB at J11 pins 1-4. Turn SYSTEM POWER keyswitch ON.

6.6 Adjust charging module potentiometer to voltage referenced on data sheet supplied with new optics plate.

6.7 With optics plate bolts secure but not tight, place burn paper, enclosed in cellophane, between output coupler and folding mirror, and fire laser. If laser burns a spot on paper, go to next step. If laser does not burn a spot on paper, call your technical support representative for assistance.

6.8 Gently tighten four allen bolts to secure optics plate to binocular tower and fire laser. If laser burns a spot on paper, go to step 4.0 and perform laser plate and optics plate maintenance. If burn spot is not visible, go to next step.

6.9 Readjust laser plate allen bolts and fire laser. If laser burns a spot on paper, go to step 4.0 and perform laser plate and optics plate maintenance. If laser does not burn a spot on paper, call your technical support representative for assistance.

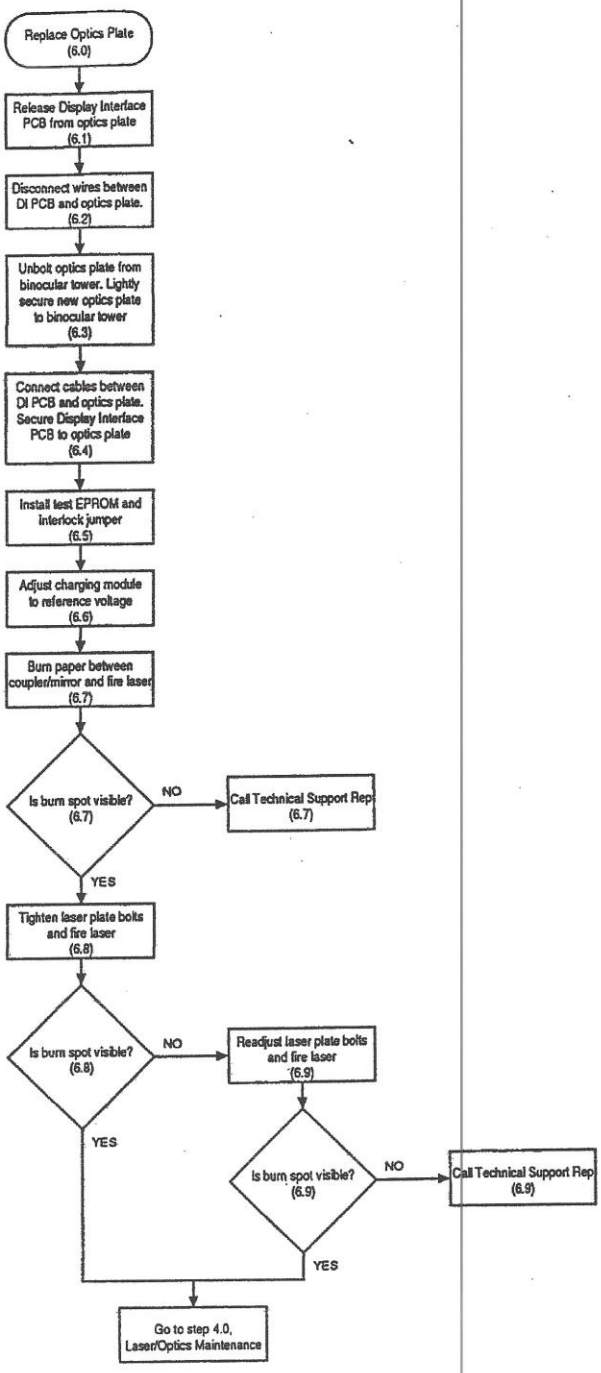


FIGURE 5-14
OPTICS PLATE REPLACEMENT PROCEDURE

7.0 CPU PCB JUMPER POSITIONS

CPU boards made by Cubic, Inc., require different jumper positions depending on system and software. Identify the type of system being checked: 2500 Standard, 2500 Low Energy, or 2300 Standard (there is no 2300 Low Energy system). Identify the type of EPROM being used at Z22 and Z23 on CPU PCB: 2532 or 2732. After determining system type and EPROM, use the following table to determine jumper positions on CPU PCB.

2532 EPROMs at Z22 and Z23:

SYSTEM	W1	W2	W3	W4	W5
2500 standard	2-3	4-5	2-3	2-3	1-2
2500 low energy	1-2	2-3	2-3	2-3	1-2
2300 standard	2-3	4-5	2-3	2-3	1-2

2732 EPROMs at Z22 and Z23:

SYSTEM	W1	W2	W3	W4	W5
2500 standard	2-3	4-5	1-2	1-2	1-2
2500 low energy	1-2	2-3	1-2	1-2	1-2
2300 standard	2-3	4-5	1-2	1-2	1-2

TABLE 5-2
CPU PCB JUMPER POSITIONS

CHAPTER 6

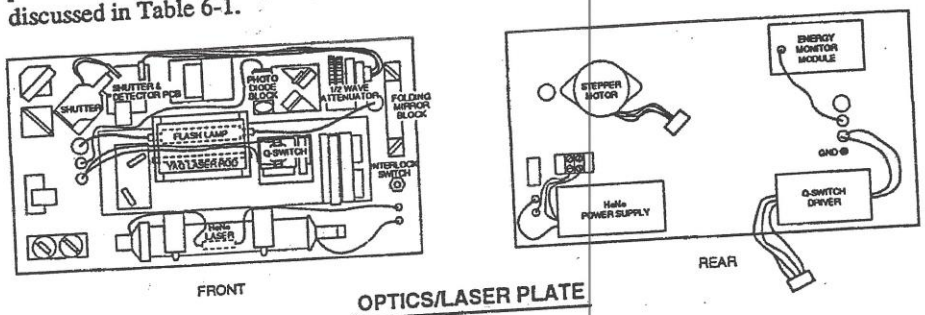
TROUBLESHOOTING

CHAPTER SIX

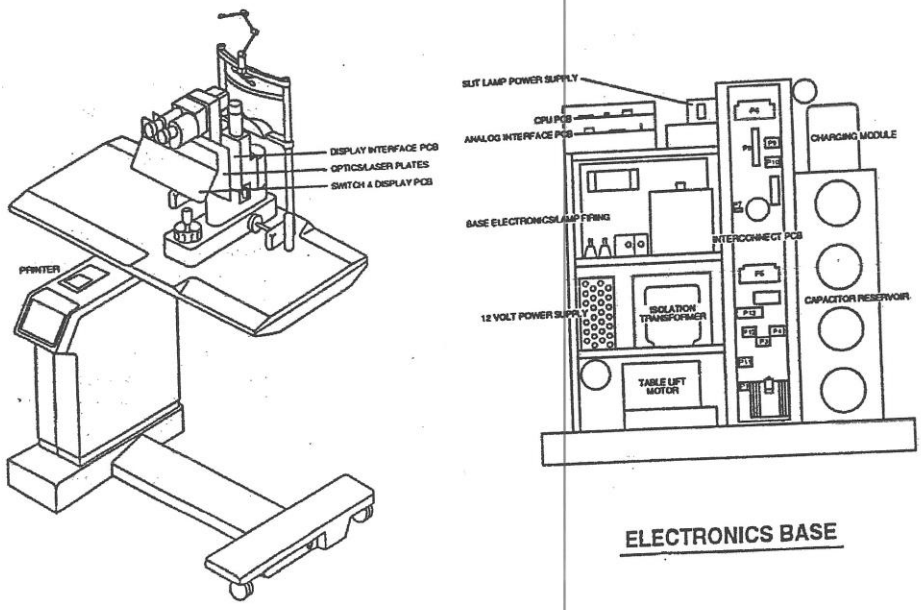
TROUBLESHOOTING

1.0 INTRODUCTION AND TROUBLESHOOTING CHART

The troubleshooting chart, Table 6-1, is an aid to locate failed or malfunctioning parts or components, but it is not meant to replace standard troubleshooting procedures. Safety precautions demand that input power be disconnected from the equipment prior to connecting or disconnecting meter leads, internal wiring, or connectors. Care should be taken when troubleshooting to prevent the introduction of additional problems. Figure 6-1 shows locations of components discussed in Table 6-1.



OPTICS/LASER PLATE



2300/2500 Nd:YAG LASER

ELECTRONICS BASE

FIGURE 6-1
COMPONENT LOCATIONS

TABLE 6-1
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Nothing happens when keyswitch is turned ON.	No AC voltage supplied to system.	a) Verify power cord plugged into wall. b) Verify power cord plugged into system. c) Check condition of system main fuse. If bad, replace with fuse of same type and value. d) Verify power outlet circuit breaker is ON. e) Connect system to good power outlet. f) Check K2 relay. g) Check mains transformer T4.
Unit fails to complete self test.	a) YAG power switch is not ON.	Turn YAG power switch ON. Turn keyswitch ON.
	b) A safety interlock is open.	a) Check YAG power switch indicator lamp. If indicator not illuminated with switch ON, an open interlock suspected. If indicator illuminates, interlock status OK. b) Check remote interlock connector on system base. Jumper plug or remote switch must be connected. c) Check fit of base and optical head covers. Interlock switches prevent system operation if covers not flush.
	c) System processor unable to complete self test routine.	Press system RESET switch to reset microprocessor.

TABLE 6-1
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
	d) Footswitch not connected, or not connected properly.	Verify footswitch connector plugged into receptacle. Push connector firmly to ensure it is fully seated.
	e) System processor locked up (bad memory chip).	a) Reset system. b) Replace CPU PCB.
	f) Cables W26 or W28 bad.	Re-seat or replace as necessary.
	g) Analog PCB bad.	Re-seat or replace as necessary.
	h) Laser power fuse blown (charging module, 4 amp).	Verify condition of power fuse. If bad, replace with fuse of same value and type.
Upper panel controls have no effect.	System processor unable to execute control commands.	a) Reset system. b) Check cable W27. c) Check U7 on Display Interface PCB. d) Reseat/replace Analog PCB, CPU PCB, Switch and Display PCB.
ERROR indicator illuminated.	a) System has detected an error condition. An error code displays in the SHOT/BURST window.	a) Reset system. b) Turn system power OFF for one minute, then turn power ON.
	b) ERROR 0: Indicates attenuator is in wrong position.	a) Perform attenuator assembly setup procedure. b) Replace Analog PCB. c) Smooth out gears. d) Replace servo pot.
	c) ERROR 1-6: Indicates servo pot bad or out of calibration.	a) Perform servo pot calibration procedure. b) Replace servo pot.

TABLE 6-1
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
	d) ERROR 7: Indicates low voltage supply out of tolerance.	Adjust, repair, or replace 12 volt power supply.
	e) ERROR 8: Indicates laser power supply out of tolerance.	a) Check laser power supply. b) Check ADC on Analog PCB.
	f) ERROR 9: Indicates laser safety shutter in wrong position.	a) Check safety shutter. b) Check 6522 on CPU PCB.
	g) ERROR C : Indicates memory error during power-up sequence.	Replace RAM, EPROM, or CPU PCB.
	h) ERROR E : Indicates power-up energy value ≤2.0 mJ. (2500 only)	a) Reset system. b) Perform Optics Plate Alignment procedure.
	i) ERROR F : Indicates test fire value 20% higher than predicted display value, or is ≤0.1 mJ. (2500 only)	a) Test fire system. b) Perform Optics Plate Alignment procedure.
Printer sounds as if operating, paper advances, but is blank.	Paper threaded through printer upside down.	Correct paper path.
Printer does not print.	a) Bad printer.	Check printer test pattern (turn system ON while holding down paper feed button).
	b) Bad cable connection.	Reseat/repair cable connection.
	c) Bad CPU PCB.	Check 6522 I/O ports, RAM chip.
No aiming beam.	a) Aiming beam intensity OFF.	Adjust intensity control.
	b) Slit illuminator in center position, obstructing aiming beam path.	Reposition slit illuminator to clear objective lens.
	c) HeNe supply failed.	Repair/replace HeNe power supply.
	d) HeNe laser failed.	Replace HeNe laser.

TABLE 6-1
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
No slit lamp illumination.	a) Slit illumination switch OFF.	Turn switch ON.
	b) Horizontal or vertical slit controls completely closed.	Adjust slit controls.
	c) Filter selector wheel set between filter positions.	Adjust filter selector wheel.
	d) Slit lamp bulb failed.	Replace bulb.
	e) Lamp housing connector not making contact.	Repair/replace connector.
	f) Loose wires.	a) Remove top cover from illuminator tower and check terminal block.
		b) Check wires at bulb receptacle.
	g) Blown power supply.	a) Check bridge rectifier on slit lamp power supply.
		b) Check SCR on power supply.
Fan works, but no lights illuminate.	a) 12 volt power supply failed.	Repair/replace power supply.
	b) Cable W17 bad.	Reseat, repair, or replace cable.
No front panel display.	a) Cable W27 bad.	Reseat, repair, or replace cable.
	b) Cable W21 bad (on Display Interface PCB).	Reseat, repair, or replace cable.
	c) Cable W32 bad.	Reseat, repair, or replace cable.
No table lift, up or down.	a) 12 volt power supply bad.	Repair or replace supply.
	b) Motor belt bad.	Inspect/replace belt.
	c) K3 or K4 on AC panel bad.	Inspect/replace relays.

TABLE 6-1
TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
System fires, but display reads only 0.0 to 0.1.	a) Bad footswitch.	Repair or replace footswitch.
	b) Bad Q:switch driver.	Inspect/replace Q-switch driver.
	c) Bad lamp fire assembly.	a) Repair or replace lamp fire assembly.
		b) Inspect/replace K1.
	d) No reservoir voltage.	Check/repair charging module.
	e) Burned optics.	Check, clean, or replace high reflector and output coupler.
	f) Bad Analog Interface PCB.	Check timing, align, repair, or replace.
Low energy.	a) Misalignment of laser plate.	Check/align laser plate.
	b) Misalignment of optics plate.	Check/align optics plate.
	c) Dirty or burned optics.	a) Clean with compressed air.
		b) Inspect, clean, or replace high reflector.
Fluctuating energy.	a) Misalignment of laser plate.	Check/align laser plate.
	b) Misalignment of optics plate.	Check/align optics plate.
	c) Misalignment of electronics.	Check/align laser system electronics.
	d) Bad flash lamp.	Check/replace bulb.
	e) Burned optics.	Inspect/replace optics.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	f) ERROR 9: Indicates that the laser safety shutter is in the wrong position.	Service may be needed. Turn the power off for one minute, then turn back on.
	g) ERROR ⊏ : Indicates that an error occurred reading RAM or ROM.	Hardware problem. Call the factory for service.
	h) ERROR ⊆ : Low output power detected during self test.	Service may be needed. Depress the SYSTEM RESET button to retry.
	i) ERROR ⊱ : Laser misfire.	Service may be needed. Test fire at least eight times or until the error disappears or there is no significant change in the measured energy.
Printer sounds as if operating; paper advances, but is blank.	Paper threaded through printer upside down.	Check paper path.
No aiming beam.	a) Aiming beam intensity control turned off.	Adjust intensity control.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
		b) Check the remote interlock connector. The jumper plug supplied or an interlock switch must be connected.
		c) Check the integrity and fit of the base and optical head covers. Interlock switches will prevent system operation if covers are not in place and secured.
	c) System processor unable to complete self-test routine.	Depress SYSTEM RESET switch to reset microprocessor.
	d) Footswitch not connected or not connected properly. NOTE: If joystick firing is preferred, ensure that the footswitch is completely disconnected.	Verify that footswitch connector is plugged into receptacle on side of system base next to power cord. Even if footswitch appears to be connected, push the connector in firmly to ensure it is fully seated.
	e) Laser power fuse has blown.	Check the power fuse located on the system base. The fuse is the one closest to the operator. If fuse is blown, replace with one of same value and type.
Upper panel controls have no effect	System processor is unable to execute control commands	Depress SYSTEM RESET.

CAUTION

IF THE SYSTEM HAS BEEN IN OPERATION, THE ILLUMINATOR LAMP AND THE CONTACTS ON THE LAMP COVER WILL BE HOT. WAIT AT LEAST FIVE MINUTES FOR THE LAMP AND COVER TO COOL BEFORE PROCEEDING WITH LAMP REPLACEMENT.

2. Refer to pages 25 and 26 of the Nikon Slit Lamp Instruction Manual that was provided with the instrument and follow the procedure given there for changing the illuminator lamp.

Yag Opthalmic Laser System

(entire manual)

D-5 zenor diode
IN 5232B

St. Joseph's Hospital

6-25-87

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KNOX TRIN

Error messages 2500 LE

1. stuck at max value (top pcb broken off?)
2. does not reach max. value (no 5vdc)
3. pot reading unstable (loose mount)
4. expected value not obtained after 200 steps (should be 3.9v DC)
5. attenuator pot out of range (bad reading from lok_r pot)
6. voltage reading @ low pos position of of tollerence. (pot not linear)

10. stepper pot out of range