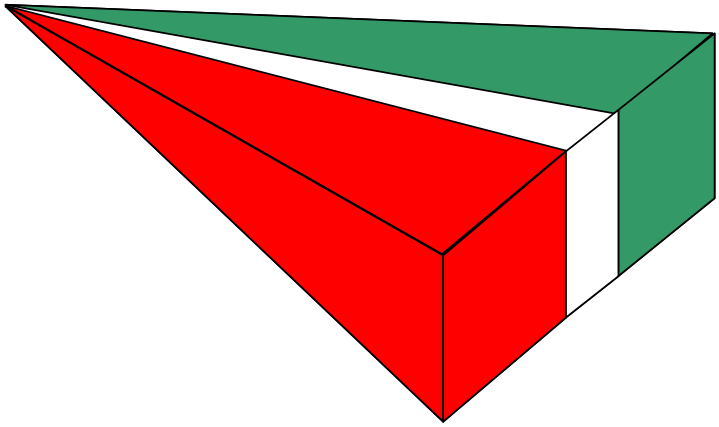
VEGA INDUSTRIES LIMITED

PEL 6 Marine Sector Light

Installation and Instruction Manual



PEL-6 Sector Light Product Manual	
Available colour range	Red, White, Green
Subtense	3.5°, 5.0°, 7.5°, 10°, 15°, 20°
This manual applies from serial #:	
Calc version:	Calc2001
Manual version:	1.1.1
Date released:	21 October 2008
Status:	Released by IG

Manual quick reference

Description of Change	Date manual released	Manual version	Software version	PEL Serial number
Re-issue of manual -updated formatting	April - 08	1.1	Calc2001	
Warranty clause added	October 2008	1.1.1		

WARNING!

DO NOT CONNECT TO ANY POWER SUPPLY BEFORE READING THE MOUNTING AND INSTALLATION INSTRUCTIONS

PEL 6 POWER SUPPLY REQUIREMENTS

Nominal Input voltage 24 Volts DC

Nominal Current 12 Amps

Product Warranty
Vega warrants that all products supplied are free from labour and material defects, and will repair or replace (at its option) the whole or any part of the products found to be faulty. The standard warranty is valid for 12 months from the date of dispatch. Vega is not to be liable for any charge beyond the point of delivery, including installation, alignment or testing. To claim under warranty the product must be returned to the Vega factory in New Zealand at the users expense.

Patent Notice
The PEL Marine Sector Light has been developed from a prototype developed by the Physics and Engineering Laboratory of the New Zealand Department of Scientific and Industrial Research. The design concept is fully protected by world-wide patents held by the New Zealand Government.

AUTHORIZED DISTRIBUTOR

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E2M7K2

1.0 General Description.

1.1 Introduction

The standard light source of the PEL Sector Light is the 250 watt long-life Thorn M36 tungsten-halogen (TH) lamp. A highly efficient and patented optical condenser system collects most of the available light energy into an intense beam which is emitted through a precision projection system. The beam is optically separated into accurately controlled sectors.

These sectors are recognisable by colour alone (normally red, white and green), or by alternation between two colours of adjacent sectors (when optical coding device is fitted). Functionally the PEL Sector Light consists of the following integrated sections:

1.2 Lamps Used in PEL Sector Lights

The PEL-6 Sector Light optical system was designed specifically to utilise the special features of the 2000-hour 250 Watt tungsten halogen lamp designated (M36) which was originally developed in the UK by Thorn. To our knowledge in 1978 this was the only lamp available with this label (M36). The original lamps had Ø1.0 mm pins on a 6.35mm pitch, a Light Centre Length of 33 mm and Max Overall Length of 55mm. In the early 1980's this pin diameter was increased to Ø1.25 mm.

In the last few years other lamps from other manufacturers designated 'M36' have appeared on the market. Most of these do not compare with the original 'M36' lamp and in fact are extremely suspect in design. They can degrade the optical performance of the PEL-6 Sector Light, and also cause damage because they are prone to exploding. Such explosions can fracture the first (spherical) condenser lens, damage the primary mirror with shards of flying glass, and coat the optics with a thin film of ash and soot, mainly tungsten oxide. The first condenser lens can also be cracked by excessive heat - some non-genuine M36 lamps run at higher temperatures than the original, and the increased resistance of poorly-adjusted or corroded lampchanger collets can add to the heat load.

Vega now understands that Thorn has sold its plant and lamp designs to GE from whom Vega now sources lamps. The lamps now sold into Australasia by Thorn, designated 'M36' are of Japanese origin, have a shorter LCL and must not be used in PEL-6 Sector Lights. They have a much shorter life, easily over-heat and are prone to exploding.

If a Tungsten Halogen lamp is operated at a voltage higher than its rated voltage then its expected life deteriorates rapidly as the operating voltage increases. The envelope temperature of a TH lamp is in excess of 500° F at rated voltage, so any increases in voltage will increase the chance of a lamp exploding. If the Spherical Condenser lens is cracked then boundary resolution is destroyed.

Summary

Use only M36 lamps manufactured by GE. Do not run lamps in excess of 24 Volts when controlled by CALC-88 controllers. CALC-92, CALC-2000 and CALC-2001 controllers have pulse-width modulation (PWM) applied to the output to the lamp to ensure that the RMS voltage does not exceed the nominal value. Size and check the grip tension on the lamp

collets every time lamps are replaced. Ensure the pin size of the lamp is Ø1.25mm

1.21 Power Supplies for PEL Sector Lights

There is a potential problem when using power supplies with a high internal inductance to drive low-voltage lighted navigation aids. The problem is that when a lamp is switched off (either at dawn or when it is being periodically flashed), or when a lamp fails at the end of its life, very large transient voltages can be generated. These voltages - of the order or 100-200 Volts - can cause damage to electronic lamp controllers (eg CALC-2001 and CALC-20) which operate at typically 12 or 24 Volts.

The reason for the high inductance in the power supply is that an inductive element (typically a “choke”) is often used in conjunction with a capacitor to form an “LC” circuit which smoothes the pulsed DC after rectification. Unfortunately, such inductors also store large amounts of energy during normal operation, and it is the rapid discharge of this energy which is responsible for the voltage spike when sudden changes are made to the current flowing.

A further hazard is that when such power supplies are initially installed, typically as a continuous battery charger into a bank of batteries, the batteries are in good condition and undamaged. In this situation the batteries may well have sufficient capacity to absorb voltage spikes and prevent them being passed on to the electronics in the light. However, as the batteries deteriorate with time, their condition possibly aggravated by poor maintenance or damage, their capacity to absorb such spikes reduces and more frequent damage to electronics can result.

1.3 Lamp System

The tungsten-halogen lamp is slightly displaced in the vertical plane from the centre of curvature of a concave spherical mirror. This mirror gathers the light emitted from the rear of the lamp and forms a real image of the lamp filament adjacent to the actual filament. The mirror is a spherical, optically worked concave glass surface onto which aluminium has been evaporated under vacuum. On anamorphic (wide-angle) lights the displacement may be horizontal rather than vertical to give a wider light source.

1.4 Aspheric Condenser System

The condenser system is arranged to collect as much light as is practicable from the filament and its image generated by the mirror, and to form this light into a narrow beam of high intensity light. In doing so, an enlarged image of the filament (and its mirror image) is formed between the two projector lenses. This is the source of light which the mariner actually sees.

1.5 Colour Filter Assembly (and Optional Oscillating Boundary Device)

The colour filter assembly is a set of optically-worked filters located in the illumination plane of the condenser system and at the focus of the projection lens. The width of the individual filters is accurately scaled to provide the required sector subtenses.

The “oscillating boundary” device mechanically reciprocates the filter assembly to provide additional defined sectors. These are characterised by an alternation between the colours of the solid sectors on either side of the alternating sector.

1.6 Intensity Reduction Filter

This is a neutral density filter which is mechanically inserted into the beam to reduce the intensity of the emitted light for night operations.

1.7 Projection System

The sharp boundaries of the PEL Sector Light are produced by a two-component positive projection lens in models with a subtense greater than 10° and a singlet projection lens in the case of the 5° and 3.5° models. This system forms an enlarged image of the coding device (coloured filters) at a considerable distance from its focus. Sector positions are determined solely by the relative positions of coding device and projection lens, and are independent of lamp filament position, errors in which can affect only the beam intensity of the lamp.

1.8 Aperture Stop

The boundary definition is further enhanced by an aperture stop situated between the two projection lens components. The aperture stop reduces the amount of light which is scattered outside the beam angle, and also enables a long-life filament lamp such as the M36 to be used without incurring any loss of boundary definition.

1.9 Air Cooling System

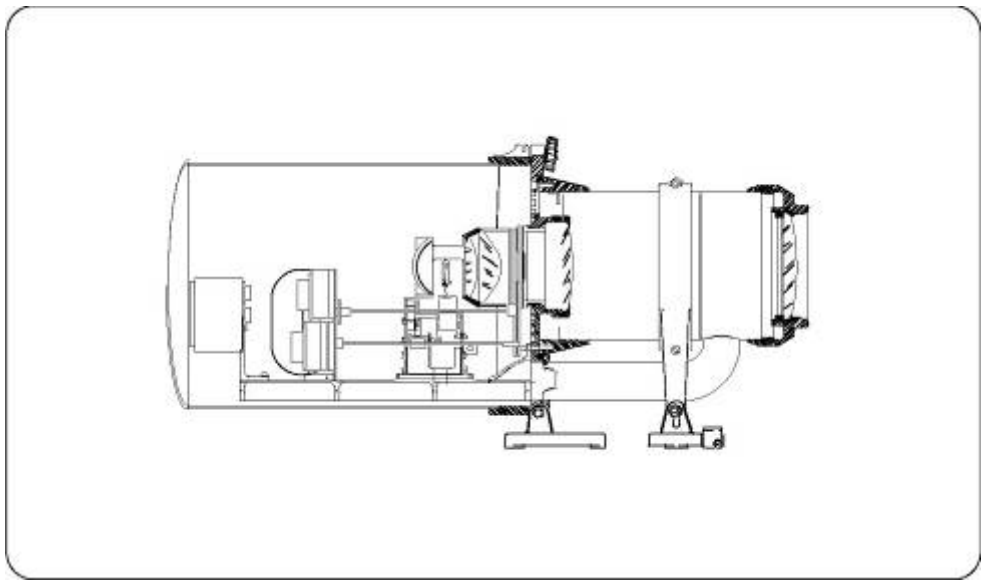
Because the PEL Sector Light is a sealed unit, a slow speed internal fan is used to move the air through a fixed circuit enabling the inside temperature to be held at an acceptably low level.

1.10 Electric Motors

There are up to three motors in this Sector Light - a DC Brushless type used in the cooling fan, and stepper motors to drive the neutral density filter and optional oscillating boundary device. Stepper motors are employed where speed control and good reliability in high temperature situations are essential.

1.11 Electronic Controller

The total electronic monitoring and control system, including inverter supplies, is controlled by a micro-processor in a module called the CALC-2001. This is a sealed unit contained within the Light. Up to two sealed converters can be mounted directly to this module.



2.0 Mounting and Installation

2.1 Acceptance Inspection

Before connecting the sector light to any power supply, the following steps should be carried out:

2.1.1 After removing the unit from the packing case, an inspection should be carried out to check that no damage has occurred during transit.

2.1.2 Review this manual and become familiar with the general layout of components.

2.1.3 Remove Rear Cover. NOTE: If cover is not totally removed, support underside of rear cover otherwise damage to CALC-2001 may result.

2.1.4 Remove packing around Suspension Springs of oscillating boundary mechanism (if installed). NOTE: Packing will be on both sides.

2.1.5 Remove packing around brilliancy control mechanism.

2.2 Exclusion of Moisture - THIS IS VERY IMPORTANT

2.2.1 PEL Sector Lights run at high internal temperatures. One of the common problems associated with this type of system is condensation, which is introduced when the light is opened for service or replacement of lamps.

2.2.2 Where it is impracticable to house the light, properly pre-dried packs of silica gel should be placed in convenient places around the lampchanger area of the light. PEL Sector Lights are tested to hold 6 psi internal pressure, and it is extremely rare for the ingress of moisture to be associated with the failure of a seal. When servicing, ensure that the can-fastening knobs are properly tightened to evenly compress the O-Ring seal.

2.3 Physical Mounting

2.3.1 The sector light can now be mounted and aligned. The PEL light has two mounting bases. Care must be taken to ensure that the mating surface is flat and no distortion is introduced to the light itself when mounting.

2.3.2 In order to achieve the high degree of accuracy of which the PEL Sector Light is capable, it is essential that the mounting location is not capable of being torsionally deflected more than 0.2 mm per metre in azimuth under wind loading and other forces likely to be encountered.

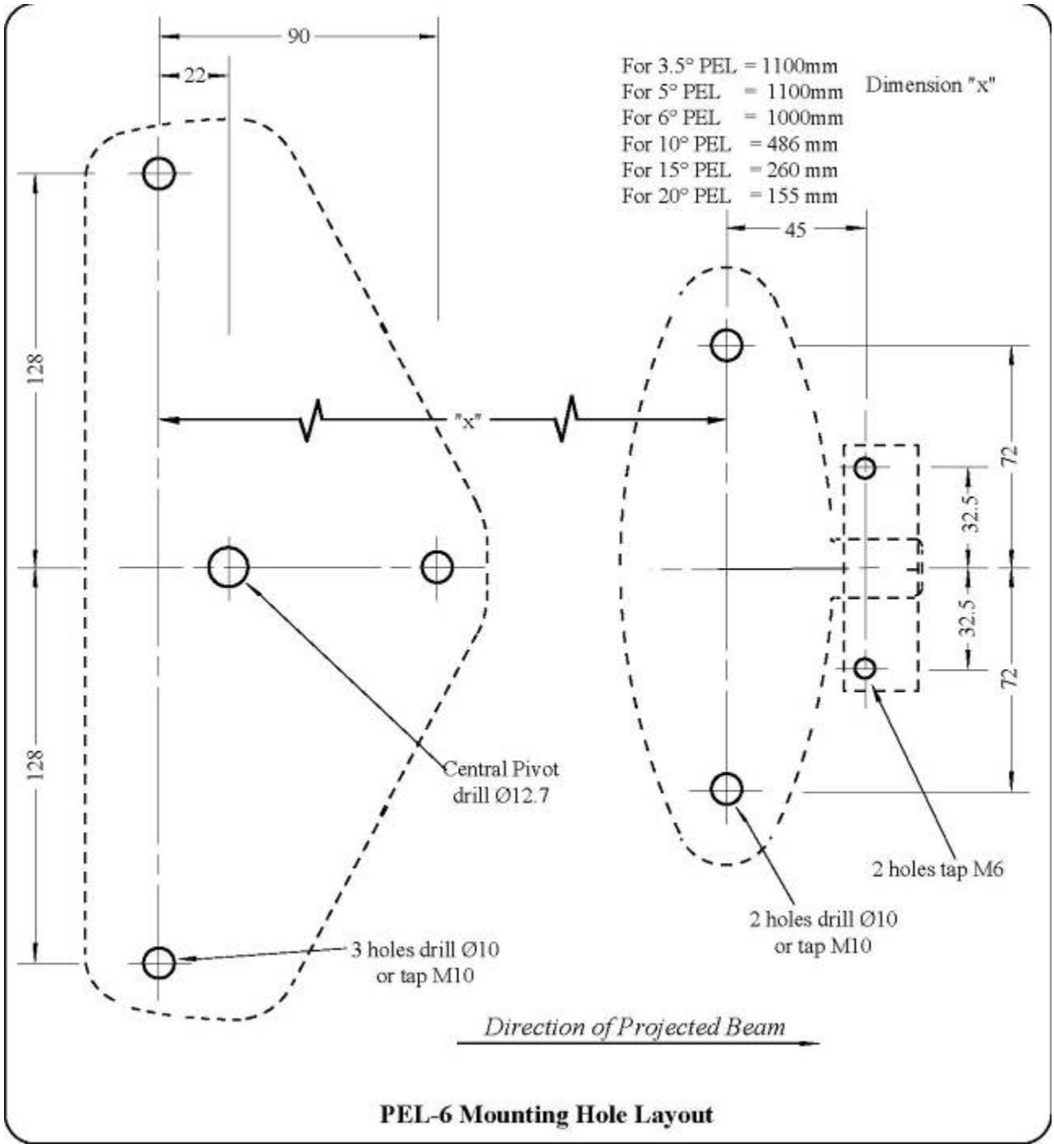
2.3.3 Mounting holes should be drilled to the dimensions shown below. Note that the two bases are spaced differently for different sizes of sector light.

2.3.4 The “rear” base incorporates a recess for a 12.6 mm Ø (0.5 inch Ø) pin, on which the light can be pivoted during the alignment phase. To permit extremely fine adjustment of azimuth angle the “front” mount incorporates a pair of trimming screws.

2.4 Alignment of Sector Light

2.4.1 Adjust the angle of elevation of the beam so that the vertical centre is at the average height of a ship's bridge at the maximum range at which the light is used. Align the sector pattern in azimuth using an observer located on the boundary between two adjacent sectors.

2.4.2 Sector positions should be checked by survey, and the location of the sector boundaries should be verified from the waterway before commissioning.



PEL-6 Mounting Hole Layout

2.5 Masking Stray Light

2.5.1 In an optical projection system at least 0.5% of the light will be scattered by the last lens surface, and even more if the lens is not completely clean. In the case of a very powerful sector light there can be enough stray light for an observer outside the beam to think he or she is inside the beam. This problem may arise with PEL-6 Sector Lights of 5° subtense or less, and is possible with 10° lights at full brilliance at night against a black background.

2.5.2 PEL-3 Series Lights of small subtense angle are masked with a barrel extension. With the larger aperture of a PEL-6 (Mark VI) PEL Sector Light this is impractical. The problem can be largely alleviated by placing a pair of vertical plates some distance in front of the lens (like blinkers on a horse) to mask the lens from an observer outside the beam.3.0 Electrical Supply and Circuitry

3.1 Input Power Connections (WARNING)

3.1.1 The PEL Sector Light is supplied fully wired and ready for use. This Sector Light must be connected to a 24V DC supply which is sufficiently smoothed (eg has a large enough capacitor across the output of the supply which is the input to the light) to ensure no high voltage spikes can damage the microprocessor-based control system.

3.1.2 Prior to switching on any power, please ensure that the power supply is 24 Volts DC and that Brown = Positive, and Blue = Negative. The absolute maximum voltage must not exceed 28 V DC. It is normal to energize from a battery bank with “battery-charger float.”

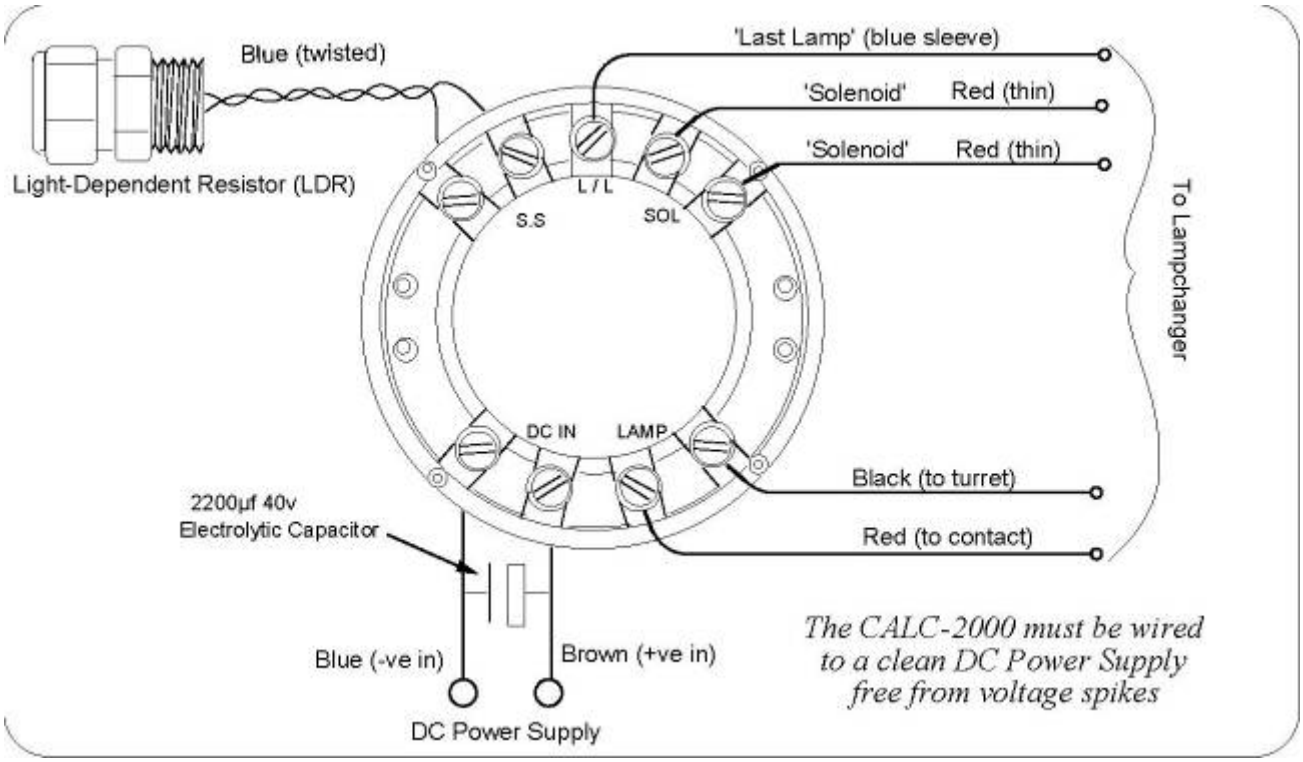
INPUT CONNECTIONS: BROWN = positive 24V DC
BLUE = negative 24V DC

3.1.3 The voltage at the lamp terminals should normally be at the nominal voltage of the lamps installed when a lamp of the correct wattage is installed and switched on. Excessive voltage will reduce lamp life but low voltage will reduce light output while extending lamp life. Low voltage is therefore acceptable, or even desirable in some cases. Special limitations apply to tungsten-halogen lamps.

3.1.4 Vega PF and TH lampchangers can be operated on either AC or DC, 12 or 24 volts depending on the lamp requirements. The DC polarity is of no consequence and the frame of the lampchanger is insulated from the electrical system.

3.2 CALC (Electronic Controller) Connections

3.2.1 The CALC-2001 unit electronically controls all the functions performed by the Sector Light. This includes intensity changes for day/night operation, the imposition of flash characters if required, and drives for stepping motors.



3.3 Stepping Motor Inverters

3.3.1 The mechanically-inserted Intensity Reduction filter is driven into position by a stepping motor, which is powered from an inverter attached to the CALC-2001. This stepping motor acts through a Vega 56.25:1 reduction gearbox with built-in constant-velocity coupling to smooth out the steps from the motor. Two micro-switches, ‘A’ and ‘B’, are used to define the ‘park’ position of the Intensity Reduction filter.

3.3.2 The optional Oscillating Boundary device (where fitted) is driven by a similar stepping motor acting through a 7.5:1 Vega reduction gearbox with built-in constant-velocity coupling.

4.0 Lampchanger Operation

A special Vega Lampchanger is required for the PEL Sector Light to carry the high currents drawn by the lamps, to provide the special collet-mounting system, and to fit within the tight confines of the optical condenser system.

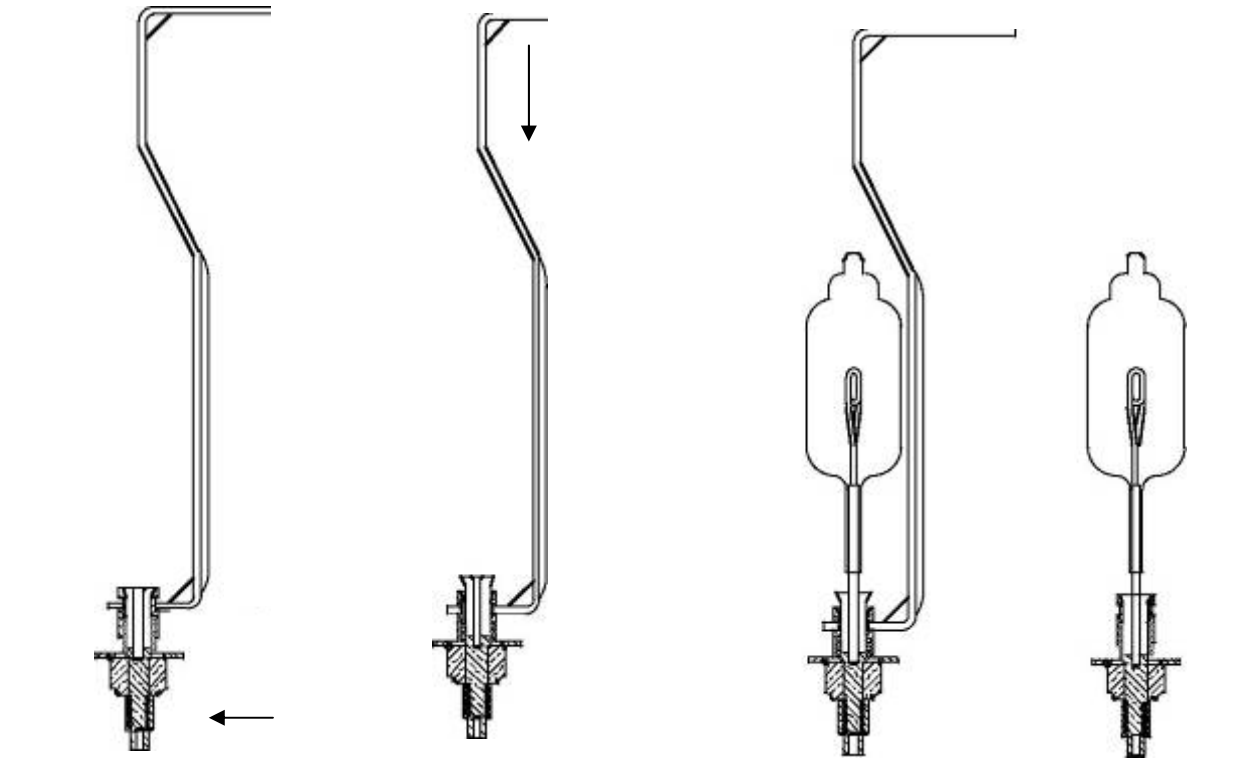
4.1 Fitting of Lamps

4.1.1 The following instructions apply to M-series 50, 100 and 250 watt lamps as fitted to the PEL-6 Sector Light. These lamps have a bi-pin base and must be fitted carefully into a twin-collet lamp-holder.

4.1.2 The mounting system does not provide automatic focusing - refer to section 4.2 for positioning the lamp correctly on the lampchanger, and section 4.2 for lampchanger alignment. Both these procedures must be followed correctly to ensure that each lamp is in its proper focus.

4.1.3 The VLC-153A lampchanger is fitted with spring-loaded collets to ensure reliable gripping of the lamp pins. No special adjustment of the collets is required prior to fitting lamps.

4.1.4 A special collet-opening tool is attached to the lampchanger with a small knurled bolt, Undo the bolt and remove the tool. Use as shown below to open both collets at once, then slip the lap in place.



Slip tool over both collets at the same time

Press down on tool to open collet jaws

Fit lamp while jaws are open

Remove collet tool, lamp is locked into

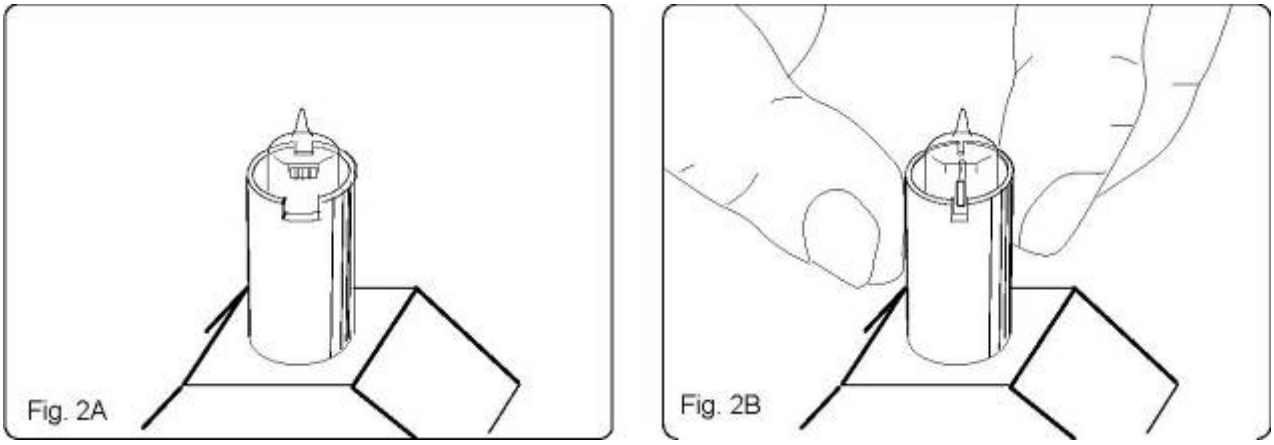
4.2 Lamp Alignment on Lampchanger

4.2.1 Each TH lamp must be correctly aligned in the lampchanger during fitting. Note that TH lamps are not to be handled with the fingers. This shortens the lamp life considerably, as oils on the fingers react with the quartz material of the lamp envelope. It is acceptable to use the the lamp wrapping material as an insulator when fitting and adjusting TH lamps.

4.2.2 The filament position must be correctly adjusted for each lamp fitted. Lamp adjustment must be performed prior to any adjustment of the lampchanger. Use gentle pressure to move each lamp into its correct position.

4.2.3 When fitting the lamps, **all collets must grip the lamp pins firmly.** If there is not a very firm contact between collets and lamp pins the collets will heat up, and in extreme cases burn away.

4.2.4 To adjust the lamp filament position, place the slotted tube over the lamp as shown. Line up and sight through the pairs of wide and narrow slots in turn. When the lamp is correctly installed, the filament will exactly fill the slots in both directions. Refer to Figures 2A and 2B below. This alignment is repeated for each lamp on the lampchanger.



Filament Position Alignment

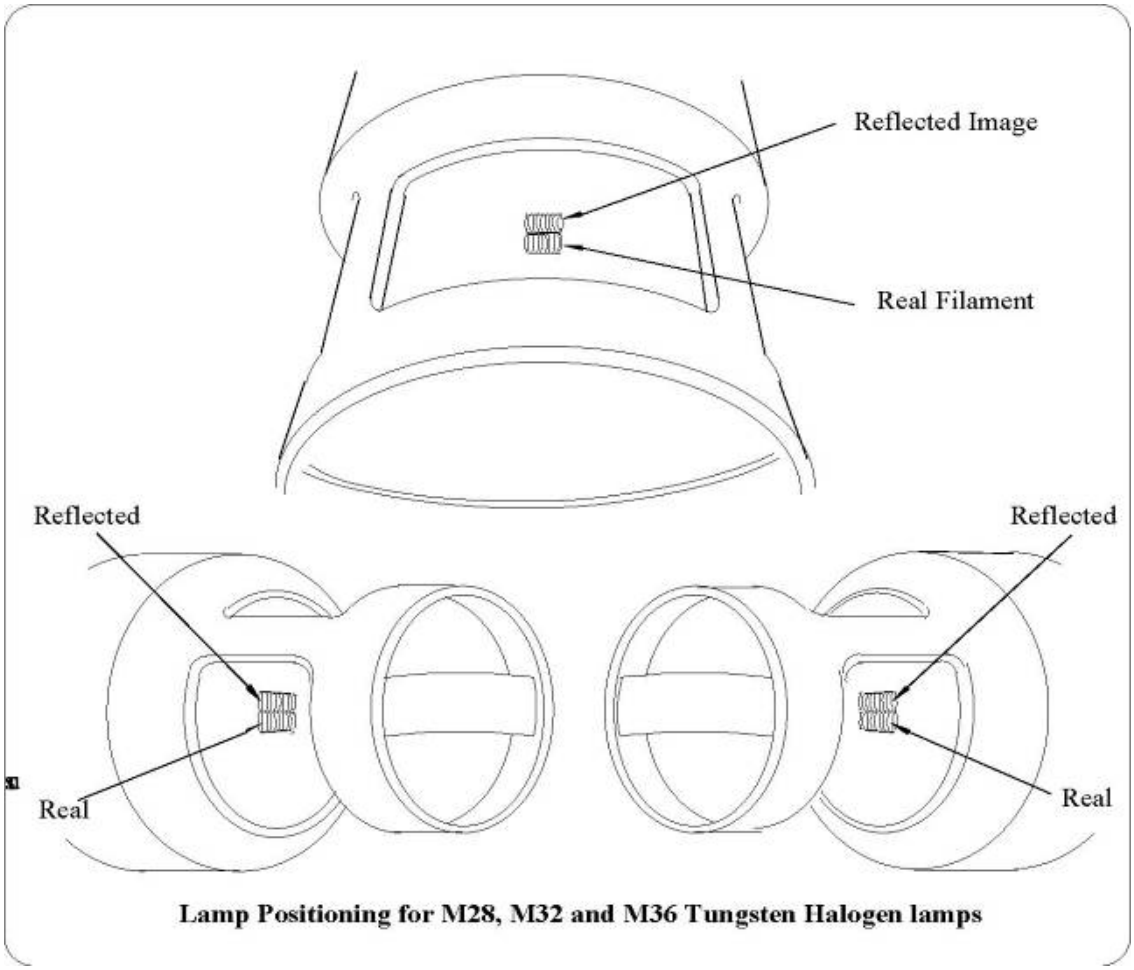
4.3 Lamp Changer Alignment

4.3.1 The following instructions apply to Vega TH 50/100 watt (VLC-151) and TH 250 watt (VLC-152 and VLC-152A) Lampchangers as fitted to the PEL-6 Sector Light.

4.3.2 Correct lamp positioning is important to obtain maximum intensity from the PEL Sector Light. The concave mirror which is located directly behind the lamp is required to produce an inverted, real image of the lamp filament directly above the actual lamp filament. The lampchanger must be adjusted to bring each lamp into a position where this occurs.

4.3.3 The upper (reflected) image must be directly above and adjacent to the lower (real) image, nearly touching it and in the same plane. The view from above is sometimes

distorted by irregular lamp envelope contours, but views from each side permit accurate positioning.



Lamp Positioning for M28, M32 and M36 Tungsten Halogen lamps

4.3.4 The lampchanger base is held down by two 4mm laterally located fixing screws, C and D. Two 3mm screws (A and B - see diagram) on the longitudinal axis provide for vertical height adjustment and also permit minor fore-and-aft adjustment of the filament position. If the lampchanger has been disturbed for any reason, re-adjustment of the filament position in relation to the optical axis of the condenser will be necessary.

4.3.5 Fit a lamp into one of the six sockets. Follow the procedure above to accurately position the filament of this lamp in relation to the turret and hence the other lamps as they are installed.

4.3.6 Set the first lamp at the top of the changer and apply reduced voltage to the changer supply terminals - about 1/3 of the nominal supply voltage.

4.3.7 Examine the filament image reflections in the condenser lens (through welding goggles), from the three views depicted in the filament image positioning diagram in Section 4.1 above.

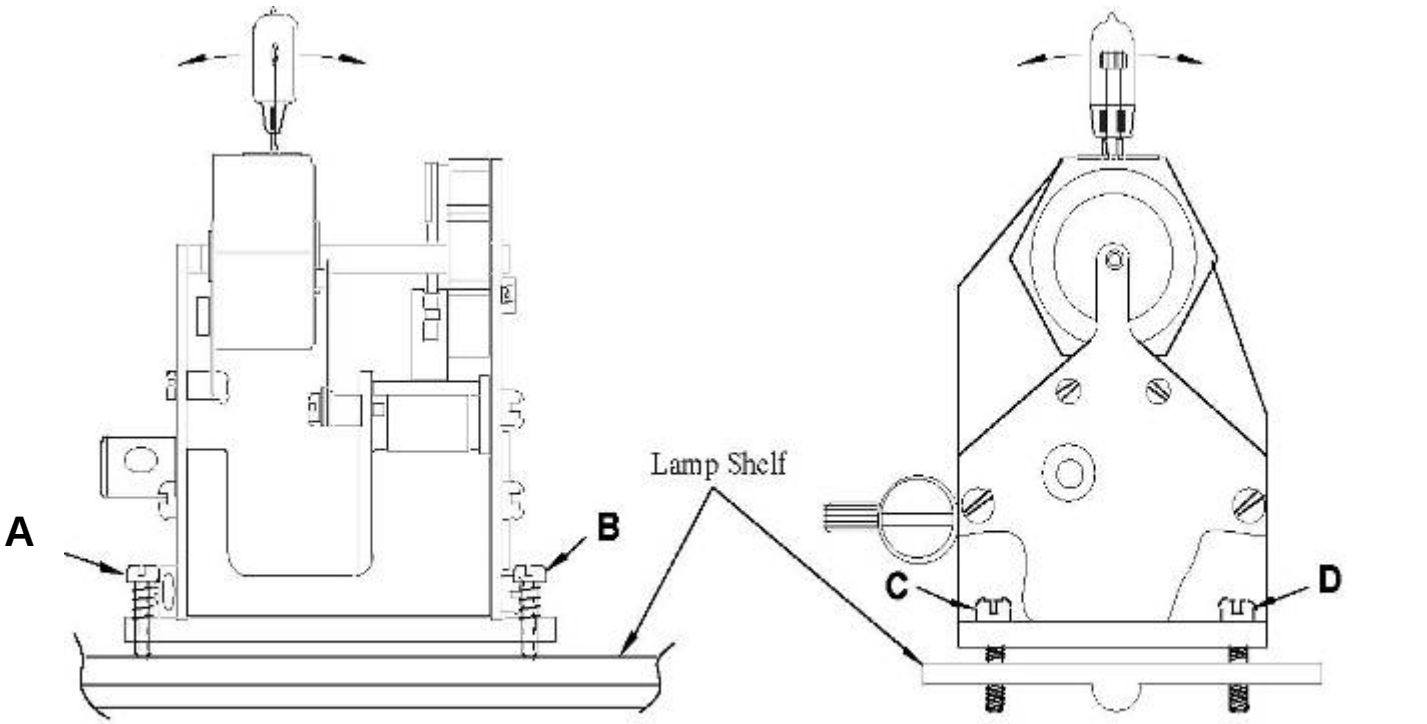
4.3.8 Have the hold-down screws entered into the lampchanger shelf threads but free to permit the base to be raised to the correct height and tilted laterally and fore-and-aft. Hold the base down by hand if necessary during the following operations.

4.3.9 Adjust the height (screws A,B) keeping the base approximately level until the direct image is below the reflected image - just meeting it with no gap and no overlap. It will be found that adjustment of the screws affects the fore-and-aft relationship of the two images, as well as the height. When the images lie in the same plane as shown, this adjustment is correct.

4.3.10 Use a long slim screwdriver to lightly tighten the hold down screws, adjusting them to bring the height screws into firm contact with the lampchanger shelf. It will be found that relative adjustment of these screws affects the lateral relationship of the two images which should now be made to conform to the positioning diagram.

4.3.11 Now re-check all aspects of the image relationship - height, fore-and-aft and laterally. Tightening any of the four screws will now fix the changer firmly. Careful selection of the screw or screws tightened will serve to correct any minor errors in the image pattern.

4.3.14 Make sure that the lampchanger is positively held down and not liable to shift in service. Do not tighten the screws to the extent that they distort the base of the lampchanger.



Screws A and B adjust height and fore-and-aft FILAMENT position

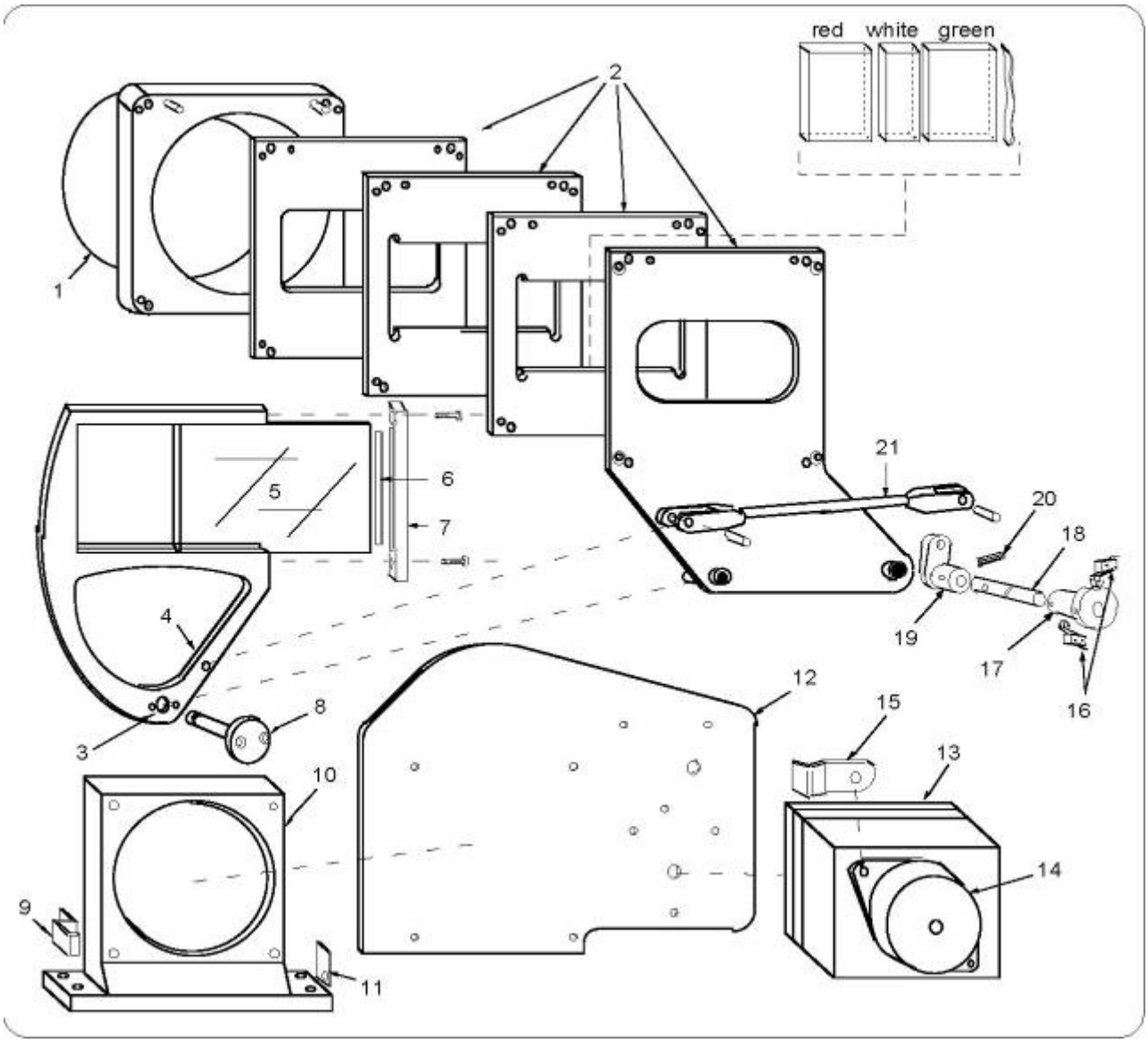
Screws C and D hold changer down and adjust lateral position of FILAMENT

5.0 Intensity Reduction Mechanism

5.1 General Description

The out-put intensity of the PEL-6 Sector Light is controlled automatically for day and night requirements. A Light Dependent Resistor (LDR) senses the light level in order to drive a relay which in turn sets the direction of a stepper motor. The motor in turn drives a nickel-coated duran filter into the beam between the condenser and filter systems. The travel of the motor is limit controlled through two micro-switches, which park the Neutral Density (ND) Filter in either the day or night positions. For a 5° light, the filter transmission is normally set at 5%; for a 10° light it is set at 25%. For other sizes the transmission is proportion to these values to take into account the maximum intensity required at night. The ND filter can be manufactured to suit a customer's requirements for any percentage value of transmittance.

5.2 Exploded View



5.3 Parts Listing: Intensity Reduction Filter Assembly

5.3.1 Parts Illustrated in Diagram

Key Number	*Part Number*	*Description*
1	6-289-001	Focusing Ring
2	6-289-002	Filter Plate Assembly
3	6-289-003	Pivot Sector Plate
4	6-289-004	Intensity Filter Frame
5	6-289-005	Intensity Filter
6	6-289-006	Intensity Filter Spring
7	6-289-007	Intensity Filter Retaining Plate
8	6-289-008	Intensity Filter Pivot
9	6-289-009	Cable Retaining Clips
10	6-289-010	Fan Housing
11	6-289-011	Cable Retainer
12	6-289-012	Heat Shield
13	6-289-013	Torsional Damping Gearbox 56:1 reduction
14	6-289-014	Filter Drive Motor
15	6-289-015	Motor Cable Retainer
16	6-289-016	Microswitch ‘A’ and ‘B’
17	6-289-017	Drive Cam
18	6-289-018	Drive Shaft
19	6-289-019	Crank Arm
20	6-289-020	Shear Pin
21	6-289-021	Con Rod

5.3.1 Parts Not Illustrated in Diagram

6-289-022	Condenser Housing
6-289-023	Lampchanger
6-289-024	Fan
6-289-025	Fan Connecting Cable
6-289-026	Intensity Filter Connecting Cable
6-289-027	CALC-2000
6-289-028	L.D.R. Retaining Clip
6-289-029	Focusing Locking Screw

6.0 Air Cooling System

The PEL Sector Light utilizes its total surface area to dissipate the heat generated by the 250 watt lamp. A standard 3" computer fan is used to circulate air internally through a fixed circuit, ensuring maximum heat dissipation. It would be advisable to replace this fan at least every TWO years to ensure maximum reliability.

7.0 Oscillating Boundary Device (optional extra)

7.1 General Description

A filter plate holding the glass filters (typically Red, White and Green) oscillates laterally to produce up to seven separate sectors, three of which are steady colours. In the other four sectors the colour either alternates between the colours in the adjacent sectors, or flashes. As a viewer moves away from the optical axis of the light from within the colour/white boundary sector, the duration of the colour flash increases and the duration of the white decreases. In the flashing sectors, the eclipse time increases as the viewer moves away from the axis.

7.2 Mechanical Arrangement

The filter assembly is suspended on phosphor bronze flexible straps and is oscillated laterally in a sinusoidal manner using a rotating crank and connecting rod. A gear box reduces the motor speed to give a period of oscillation of three seconds. The gearbox incorporates a flywheel and flexible motor coupling to eliminate torsional vibration and extend gear life.

7.3 Servicing the Oscillating Boundary Device

The central position and travel limits of the filter assembly are indicated by a pointer registering with scribed marks. If the mechanism is disturbed for servicing, the filters must be centralised on these marks at re-assembly to avoid a sector position change. The connecting rod is adjustable by half turns.

All moving parts should be lubricated every 12 months. The gearboxes are lubricated with BP ZSOO Semi-Fliud Grease, or ENERGREASE FG OO.EP. To replenish the lubricant in the gearbox remove the gearbox from the light, unscrew the end plate and lifted it off. The groove around the side of the large gear should be judiciously filled with grease then the gearbox reassembled. The four small bearing races in the gearbox are shielded but not sealed, and are lubricated by the grease in the gearbox. The rubber damper at the drive dog should be examined for wear (and preferably replaced). In any case apply two drops of glycerine to the rubber to lubricate it.

The motors are fitted with self-aligning sintered-bronze bearings, and one drop of light mineral oil (sewing machine grade) should be applied to the bearing at each end of the motor. At the same time apply two drops of light mineral oil to each motor shaft bearing.

7.4 Dismantling the Oscillating Boundary Device and Colour Filters

The following procedure should be adopted if at any time the moving assembly has to be removed from the condenser/filter system, keeping glassware clean.

7.4.1 Locate the complete light on a clean, well lit workshop bench and completely remove the rear cover. Remove all lamps.

7.4.2 Loosen the big-end fixing screw, and gently slide the split boss off the ball-race. Avoid bending or straining the light coupling rod at all times.

7.4.3 Loosen the four grub screws on the drive sleeve and intensity cam.

7.4.4 Unscrew the four 4mm screws holding the condenser assembly and withdraw it off the two locating pins, leaving the 6-plate filter assembly on the pins.

7.4.5 Carefully remove the filter plates, intensity frame and drive-rod as one unit off the locating pins. Remove intensity frame and rods. Withdraw brilliancy control assembly.

7.4.6 Use two of the 4mm screws to hold the plates together and withdraw the filter assembly complete, taking care not to damage the push rod.

7.4.7 Lie the filter assembly on its back (large plate) and remove the top fixed plate. Release the lower spring strap screws. Note the relieved inner surface of the pads under the screw heads, for reassembly. Separate the 4-plate moving assembly from the springs.

7.4.8 Remove one or both of the lower attachment fittings only if required to release the upper plate of the 4-plate coloured filter assembly.

7.4.9 Release the 6 x 3mm countersunk screws holding the side plates and lift off the top plate only. Use two only 3 mm screws to locate the lower plates while the filter glasses are being removed or refitted.

7.4.10 Release the filter plate retention spring, being careful not to chip the edges of the filter glasses in the process.

7.4.11 Remove the three or more filter glasses.

7.5 Reassembly of the Oscillating Boundary Device and Colour Filters

Reassembly is generally the reverse of the disassembly process, but the following points should be noted:

7.5.1 Clean the filter plates carefully with methylated spirits and wipe off with cotton wool or facial tissue. Do not subsequently finger the glass.

7.5.2 Make sure that the polished mating glass edges of the colour filters are entirely clean and free from fluff or grit, as intimate contact is essential.

7.5.3 The mating edges are sharp and fragile and care must be taken not to chip them or apply pressure to them until the glass is lying flat in its holder.

7.5.4 Inspect the filters to ensure they are absolutely clean. Blow off any dust on the surface because these specks appear greatly magnified in the projected beam. If stronger measures are necessary gently swab the surface with a wad of clean cotton wool damped with isopropyl alcohol or high-grade methylated spirits, making sure not to trap any particles in the filter edges. Great care must be taken doing this.

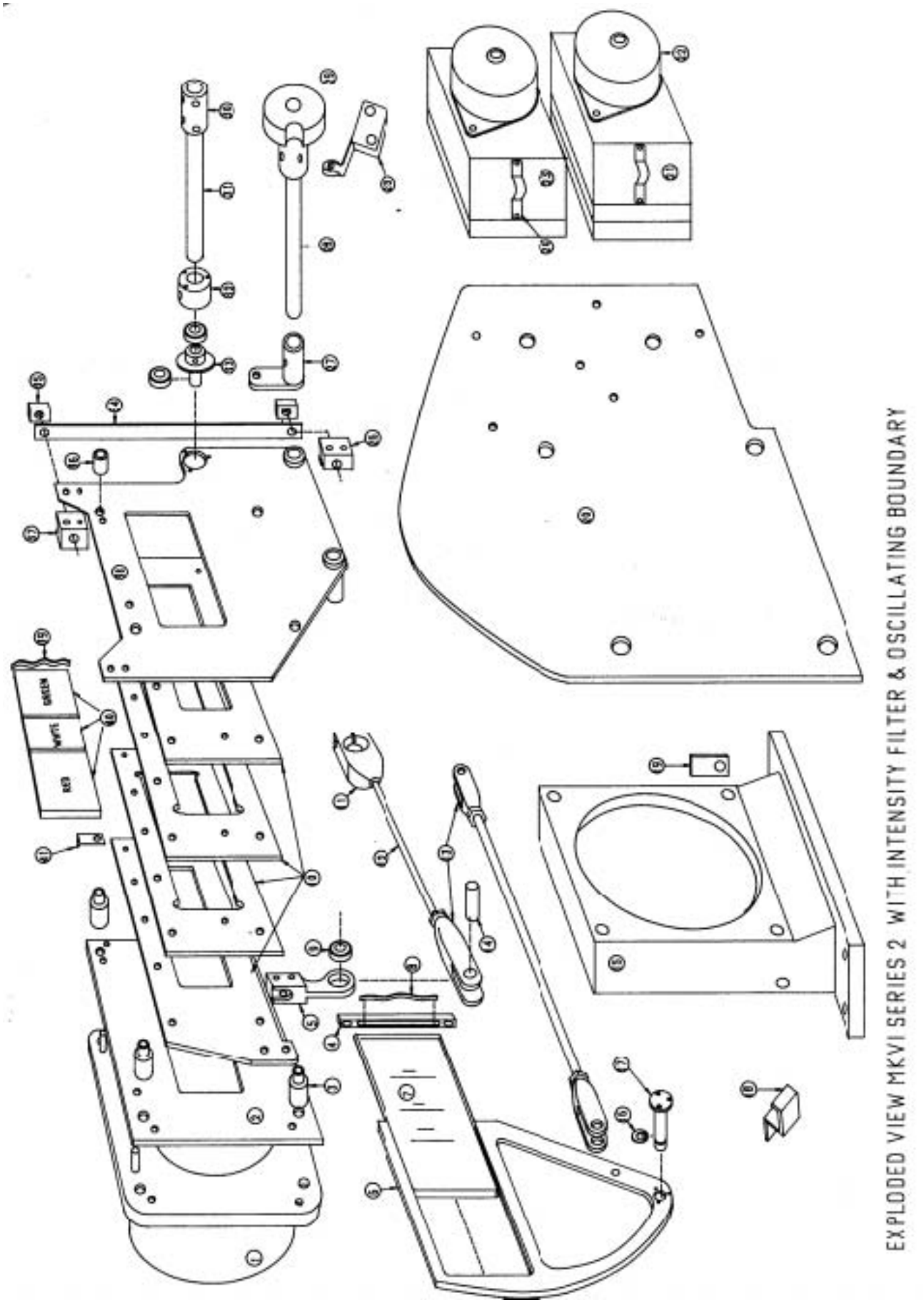
7.5.5 When reassembly is completed, ensure that the oscillating components swing

freely and generally parallel to the fixed plates. Loosen the suspension strap screws to aid this, and retighten while the plate is held in its proper relationship.

7.5.6 Make sure that the connecting rod lies parallel to the oscillating plane. When clamping the big end onto the ballrace ensure that correct alignment is achieved.

7.5.7 Before wiring to the inverter board check that the unit does not interfere with the front or rear plate when oscillating. Turn the crank arm to check the clearances. Adjustment can be made by loosening the suspension-strap screws, holding the suspension strap to the correct position, and retightening.

7.6 Exploded View



7.7 Parts Listing: Intensity Reduction Filter and Oscillating Boundary Device

Key Number	*Part Number*	*Description*
1	6-290-001	Focusing Ring
2	6-290-002	Oscillating Boundary Front Mounting Plate
3	6-290-003	Oscillating Boundary Spacer
4	6-290-004	Intensity Filter Retaining Plate
5	6-290-005	Suspension Pivot
6	6-290-006	Intensity Filter Frame
7	6-290-007	Intensity Filter
8	6-290-008	Intensity Filter Spring
9	6-290-009	4 x 9 x 4 Ball Race
10	6-290-010	Oscillating Boundary Moving Filter Assembly
11	6-290-011	Clamp End Intensity Filter Crank Arm
12	6-290-012	Filter Connecting Rod Shaft
13	6-290-013	U Pivot
14	6-290-014	4mm Pin
15	6-290-015	Fan Housing
16	6-290-016	Circlip
17	6-290-017	Intensity Filter Pivot
18	6-290-018	Cable Retaining Clips
19	6-290-019	Cable Retainer
20	6-290-020	Heat Shrink
21	6-290-021	Torsional Damping Gearbox 56 to 1 reduction
22	6-290-022	4-phase Stepper Motor
23	6-290-023	Torsional Damping Gearbox 7.5 to 1 reduction
24	6-290-024	Cable Retainer
25	6-290-025	Microswitch ‘A’ and ‘B’
26	6-290-026	Suspension Strap Mounting Lower
27	6-290-027	Intensity Filter Crank Arm
28	6-290-028	Intensity Filter Drive Shaft
29	6-290-029	Drive Cam
30	6-290-030	Connector Tube
31	6-290-031	Oscillating Boundary Drive Shaft
32	6-290-032	Bearing Housing
33	6-290-033	Oscillating Boundary Crank Arm
34	6-290-034	Suspension Strap
35	6-290-035	Retainer
36	6-290-036	Condenser Spacer
37	6-290-037	Suspension Strap Top Connection Block
38	6-290-038	Oscillating Boundary Rear Mounting Plate
39	6-290-039	Filter Retaining Spring
40	6-290-040	\Filter 41 6-290-041 Pointer

8.0 Maintenance Procedures

8.1 Objective Lens

Clean the external surface of the objective lens at intervals of 90 days. This period may need to be shortened if reduced definition of the sector boundaries or overall intensity reduction is reported. The degree of salt incrustation on the lens is dependent on the weather, wind direction, etc. The interval between cleaning must therefore be determined after experience. The lens should be cleaned with plenty of fresh water with a little household detergent to dissolve the salt, and then dried off, using a special lens-cleaning cloth, which must be clean and free from grit, as the lens is easily scratched.

8.2 Oscillating Boundary

The motor bearings, gearbox and driving mechanism have been lubricated at assembly. Re-lubricate annually all seven ballraces and the motor spindle bushes. The motor and gearbox are readily dismantled for this purpose. At the same time, the gear lubricant should be replaced and the rubber drive membrane examined for wear or perishing. Refer to Page 16 for more details.

THE REGULAR MAINTENANCE IS TO INCLUDE YEARLY REPLACEMENT OF THE RUBBER DRIVE IN THE OSCILLATING BOUNDARY AND EVERY FIVE YEARS FOR THE INTENSITY DRIVE.

8.3 Internal Optical Surfaces

Exercise care in the treatment of optical surfaces, as most optical glasses are easily scratched, being much softer than spectacle and window glasses. In addition, most internal optical surfaces are coated with a relatively soft anti-reflection coating to improve light transmission through the instrument. These surfaces are easily scratched and marked, and such marking will adversely affect the performance of the light. Generally, it is a lesser evil to put up with a modest amount of dust and grime, than to leave permanent marks from excessive zeal in cleaning. The use of a blower or light camel hair brush is usually adequate for the removal of excessive dust deposits.

Where stronger measures are necessary, *GENTLY* swab the surface with a wad of clean wool, wound around a soft stick and dampened with a weak solution of detergent in clean water. Avoid a rubbing action. Rinse with several changes of clean water and leave to drain and dry or swab dry with clean cotton wool.

8.4 Aluminised Mirror

If soiled, blow the dirt off or agitate face down in warm water to which a little detergent has been added. Similarly agitate in several changes of clean water and set aside to drain and dry.

8.5 Filter Glasses

Generally treat filters as for optical surfaces. Take care, however, to blow off as much dust on insertion as possible, since these specks appear greatly magnified in the projected beam. If the filters are at any time dismantled, ensure that the butting faces of the filters are free of dust on assembly as high point pressures could otherwise occur with possible damage to the filter edges. The filter edges are rather fragile and should be

treated with great care.

8.6 Seals

The seal between the rear cover and main frame must be replaced if it becomes hard or perished. It should be lubricated on fitting, and removed and re-lubricated annually. Leakage will allow moisture to enter the light, causing misting of the optical surfaces and a degradation in performance.

9.0 Trouble Shooting List

9.1 Loss of Intensity or Change in Intensity Profile

Possible Cause	*Remedy*
Dirty optical surfaces	Clean with warm soapy water, dry with tissue
Water between lenses	Dry with clean tissue paper, replace O-ring seal
Condenser mirror corroded or dull	Replace mirror

9.2 Poor Sector Resolution

Possible Cause	*Remedy*
Dirty optical surfaces	Clean with warm soapy water, dry with tissue
Cracked condenser lens	Replace lens
Scratched or weathered objective lens	Replace lens

9.3 Oscillating Boundary Fails to Oscillate

Possible Cause	*Remedy*
Connecting rod ball race frozen or worn out	Caused by lack of lubrication - replace bearing
Broken rubber on constant-velocity coupling	Replace drive rubber
No power to stepping motor	Check 12 volt input to inverter

9.4 Lamp Inoperative / Lampchanger Faults

Possible Cause	*Remedy*
On last lamp position, with failed lamp	Replace all lamps and reset lampchanger
Contact and blade not making contact	Remove and reset, clean contacts
Turrent not indexing properly	Re-tension or replace main spring
Lamp-carrying collets corroded or burnt	Replace collets (TH changer only)
Solar switch failure	Disconnect solar cell and short across connectors - if light operates replace solar cell

9.5 Electronic Controls

Possible Cause	*Remedy*
Faulty circuit board on early models	Test individual circuits, replace faulty board
CALC-2001 malfunction on current models	Refer to CALC-2001 installation manual