

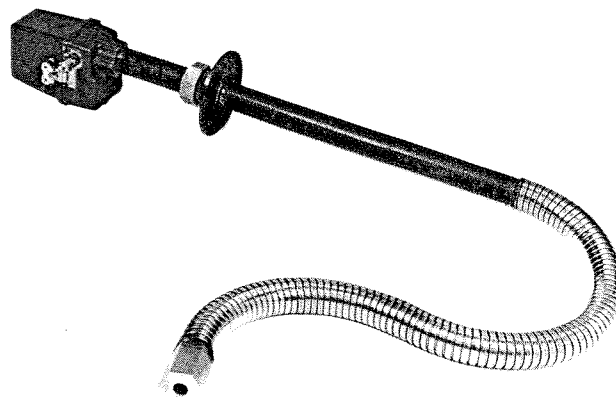
DESCRIPTION

The Detector Electronics C9503M and C9504M Fiber Optic Flame Scanners provide an effective means of flame monitoring in a tilting bucket, tangentially fired boiler or in any application where a scanner cannot be mounted in a direct line of sight from the flame to be monitored. The C9503M and C9504M Scanners are used in conjunction with Detector Electronics' R9001, R9005, R9100, R9101 and R9105 Flame Controllers, and are electronically interchangeable with the C9501M and C9502M Scanners.

A flexible fiber optic light guide between the scanner lens and the electronic package allows the lens to move with the flame source, monitoring it at all points in its arc of travel. The C9503M Scanner responds to the frequencies of light emitted by coal and oil flames. The C9504M Scanner is designed specifically for gas flames.

FEATURES

- Fiber optic link means increased flexibility of installation, allowing flame scanning in areas where conventional scanners cannot be mounted.
- Automatic gain control instantly compensates for varying firing rates to decrease the risk of false trips caused by a low flame signal and increase the flame discrimination capability of the scanner.
- Flexible stainless steel fiber optic carrier enables placement of outer carrier termination anywhere on the fuel burner.
- Adjustable compression fitting allows continuous adjustment of outer carrier position over a wide range, and allows varying amounts of slack in the flexible carrier.
- Centering block provides continuous flow of purge air even when scanner electronic package is removed, prevents rotation or dislodging of the inner carrier and aligns fiber optic termination with scanner electronic package.
- Scanner sighting can be adjusted with lens offsets of 0°, 5°, 9° and 14° to provide precise scanner alignment with burner flame at any angle of outer carrier installation. Scanner viewing angle can be adjusted from outside the windbox after the outer carrier termination has been permanently installed.



PRINCIPLE OF OPERATION

The C9503M and C9504M Flame Scanners include:

1. A photocell that reacts to specific radiation bandwidths generated by burner flames.
2. Electronic circuitry to process and transmit an output signal.
3. A mechanical "light chopper" that blocks the photocell from light at preset intervals, testing its response.
4. A flexible fiber optic light guide that transmits the burner's radiation from the burner to the photocell.
5. Four interchangeable lens assemblies, each with a different viewing angle, to compensate for inaccuracies in scanner lens mounting.
6. Inner and outer carrier assemblies to guide and protect the optic fiber.

The scanner electronic circuitry is mounted in a weather-proof cast aluminum enclosure. A base casting and a cover casting are secured together with spring-loaded half-turn fasteners. The base also includes a 1/2 inch NPSM tapping for an electrical connector and a 3/4 inch NPT tapping for connection to a purge air line.

The base casting is tapped for mounting onto an outer carrier pipe. The outer carrier is composed of both rigid and flexible sections and is available in various lengths

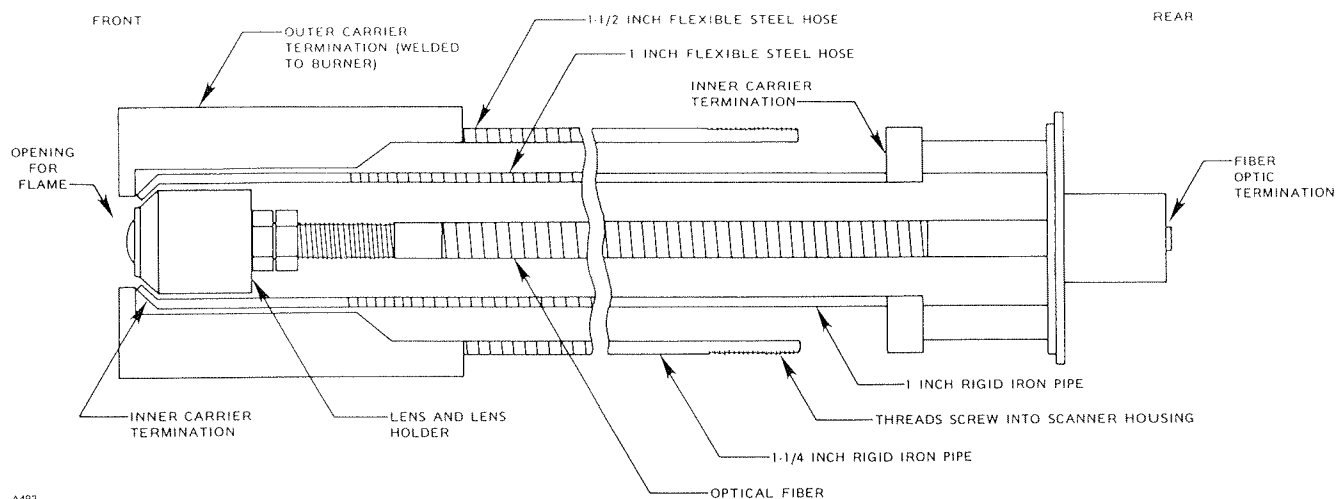


Figure 1—C9503M, C9504M Flame Scanner Construction

from 6 to 10 feet. The flexible section of the outer carrier is terminated with a hexagonal no. 304 stainless steel fitting, for welding to the burner.

An inner carrier fits within the outer carrier pipe. This inner carrier is also composed of a flexible and a rigid section. It holds the metal sheathed optical fiber that transmits the flame's radiation to the photocell within the cast housing. The front end of the inner carrier holds a lens assembly, which focuses the flame on the light fiber. Figure 1 shows the construction of the fiber optic flame scanner's inner and outer carrier. Four interchangeable lens mountings are available, each with a different offset angle from the light fiber's axis. The different offset angles allow selection of the optimum angle of view for flame monitoring. The offset angle of each of the four different lens mountings is distinguished by the number of slots in the rim around the lens (see Figure 2). The slotted rim can be viewed from the end of the inner carrier to determine which lens is installed without total disassembly of the fiber optic link. Figures 3 and 4 show the effect of lens offset on the field of view.

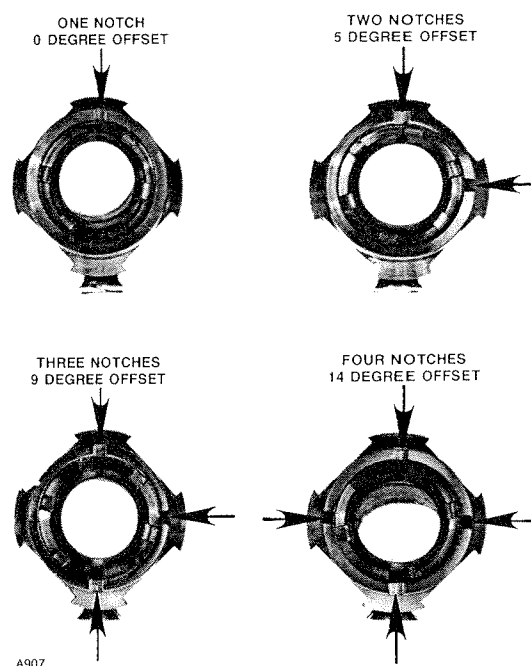


Figure 2—Offset Lenses

SPECIFICATIONS

ELECTRICAL —

28 vdc operating voltage (from controller).

Choice of 8 foot or 40 foot nonshielded 18 awg leadwires (five), insulation rated at 220°F (105°C), 600 vdc breakdown, oil-resistant.

A military connector without leadwires is also available.

MECHANICAL —

3/4 inch NPT purge air inlet (threaded).

1/2 inch NPSM tap for electrical fitting.

1-1/4 inch NPT tap for mounting to outer carrier.

PURGE AIR REQUIREMENT —

600 standard cubic feet per hour (scfh) at 13 inches water column over furnace pressure.

OPTICAL —

Field of vision: 8°.

Spectral sensitivity: 5,000 to 10,000 angstroms for the C9503M, 4,000 to 6,500 angstroms for the C9504M.

TEMPERATURE RANGE —

−4°F to +200°F (−20°C to +93°C) measured at mounting hub, housing ambient air not exceeding 160°F (71°C). Maximum allowable windbox temperature with 600 scfh of purge air is 800°F (427°C).

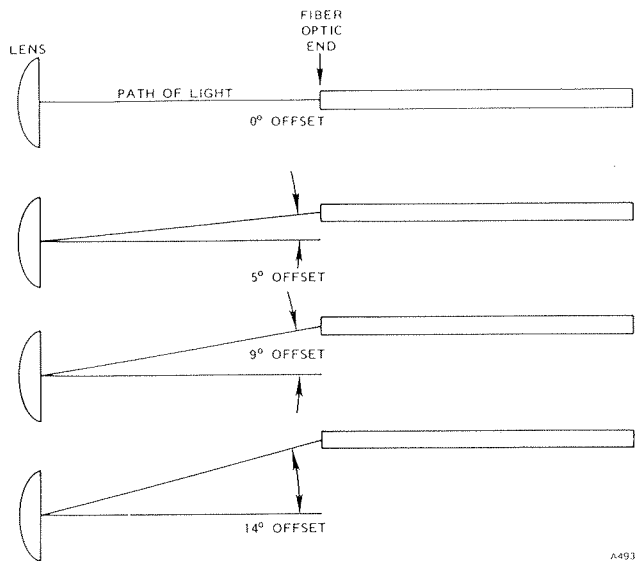


Figure 3—Light Path, Varying Lens Offsets

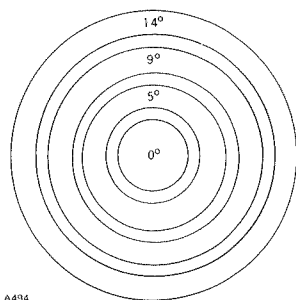


Figure 4—Field of View (When Rotated) - C9503M, C9504M Lens Assemblies

DIMENSIONS —
See Figure 5.

SHIPPING WEIGHT —
25 lb (11.3 kg).

FLAME SCANNER MOUNTING

1. Choose a sighting location on the burner where the hexagonal scanner termination will have an unobstructed view of the flame under all firing conditions. A scanner monitoring a pilot flame must sight at a point where pilot and main flames intersect to ensure that a detectable pilot flame will reliably ignite the main flame.

In multiple burner furnaces, choose a sighting angle with the best possible view of the flame of interest and the poorest view of other flames in the furnace. The hexagonal carrier termination should be angled slightly downward, if possible, so that unburned particles or condensed moisture will not fall or drain into the scanner. Figure 6 is an illustration of scanner installation.

2. Disassemble flame scanner parts. Figure 7 illustrates the components of the fiber optic link. Unclamp the rear part of the casting and pull inner carrier completely out of outer carrier. Unscrew the front part of the casting from the outer carrier. Remove compression fitting from around the outer carrier. Actual welding and fitting of the scanner requires only the outer carrier and the compression fitting.

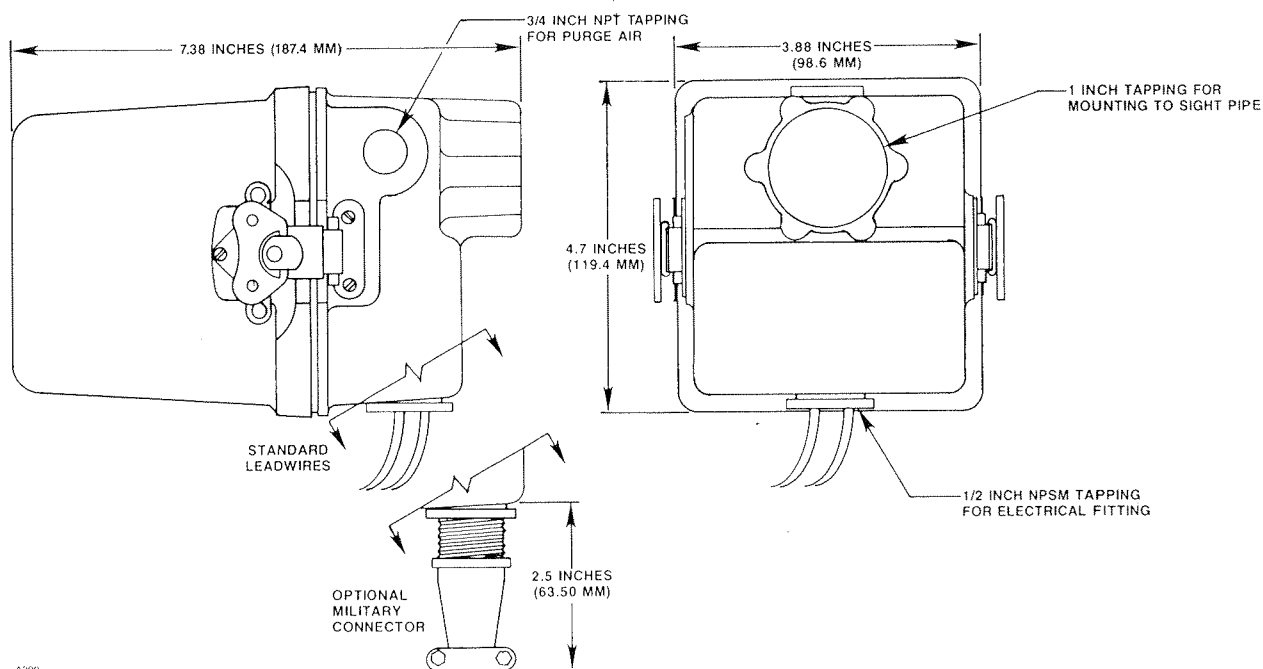


Figure 5—Dimensions C9503/C9504

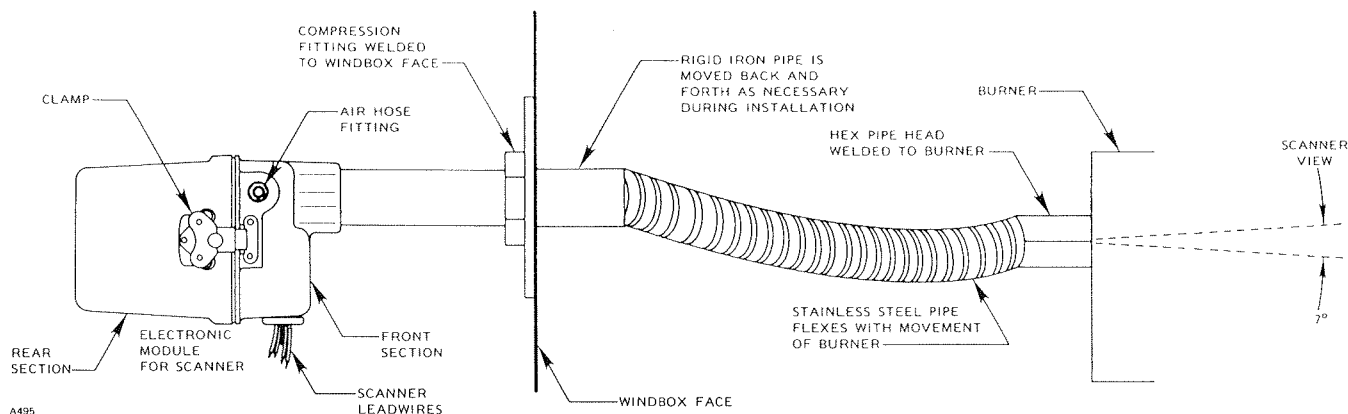


Figure 6—Example of Installation, Fiber Optic Flame Scanner

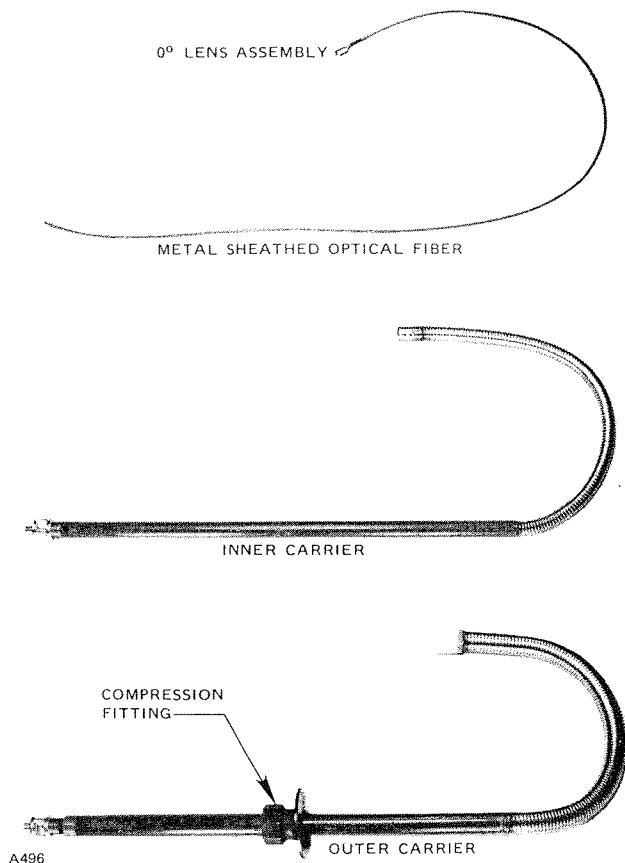


Figure 7—Components of Fiber Optic Link

6. From the outside, slide the compression fitting over the outer carrier and down to the windbox, with its larger diameter toward the windbox.
7. Weld or bolt the compression fitting around its circumference to the windbox.
8. Adjust the length of the outer carrier within the windbox for the proper amount of slack when the burner is moving. This can be done in one of two ways:
 - a. With the burner in a horizontal position (at mid-point in its arc of travel), pull the outer carrier tight, then push four to six inches back into the windbox or,
 - b. Activate the burner's tilting mechanism, without firing the burner. When the carrier is pulled into the windbox as far as it will go, that is the position at which it should be locked.
9. Once the outer carrier is positioned correctly, tighten the compression fitting around the outer carrier by turning the large hexagonal nut on the compression fitting clockwise.
10. Screw the front casting of the scanner to the end of the outer carrier. Install an electrical fitting in the housing base tapping and encase the extension leadwires in 1/2 inch flexible metal conduit or other flexible conductors meeting local standards. Terminate the assembly at a junction box and splice the leadwires to conductors extending to the flame controller. For any wiring runs on or near hot surfaces, use wire rated at 221°F (105°C) or higher. The scanner wiring scheme is shown in Table 1. For a watertight connection, use an appropriate fitting and liquid tight conduit arranged to pitch downward from the scanner.
11. Fasten the purge air hose to the air hose fitting on the housing (Figure 6). The purge air source must
3. Weld the hexagonal termination of the outer carrier to the burner in the position desired.
4. Prepare a hole in the windbox wall for the outer carrier. The hole need not be exact in size, but should not be much larger than 1.66 inches in diameter (the diameter of the outer carrier). Hole diameter must not exceed 4 inches.
5. Slide the outer carrier through the windbox hole from the inside (burner side).

Table 1—Wire Connections to Scanner

Wire Color	Function
Gray	Signal output
Violet	+28 Vdc from controller
Yellow	From chopper drive
Brown	Ground

be oil-free and dry. Recommended flow of 600 standard cubic feet per hour (scfh) will yield a pressure differential of 13 inches water column over the length of the scanner assembly. Figure 8 illustrates the relationship between air flow and pressure difference along the scanner assembly.

12. Slide the inner carrier, lens end first, into the outer carrier. Leave the rear part of the casting off the scanner to allow sighting.

SIGHTING THE SCANNER

The C9503M and C9504M Scanners have a lens mounted at the end of the inner carrier, to focus the burner's radiation on the light fiber. An offset in the lens positioning within its carrier provides a corresponding offset in the lens' field of view. Since the hexagonal termination of the outer carrier is welded to the tilting burner before sighting is done, a chance exists that the carrier, as furnished with the standard 0° offset lens, will not sight

the burner flame. It is for this reason that three other lens assemblies are available: 5°, 9° and 14° offset.

The C9503M and C9504M Scanners are supplied with the 0° offset lens installed. Scanner sighting is performed with the burner on, as follows:

1. With the inner and outer carriers installed as specified in the "Flame Scanner Mounting" section, and with the rear casting of the scanner removed, activate the burner to be viewed.
2. Observe the light coming from the end of the light fiber within the front part of the casting. If a strong, relatively bright pulsating light is present, scanner sighting is complete, and the rear casting of the scanner can be re-installed.

If little or no light is observed at the end of the light fiber, use of one of the offset lenses is indicated. Lens removal and installation proceeds as follows:

1. Pull the inner carrier in its entirety from the mounted outer carrier.
2. Remove the two lens retainer screws from the front termination of the inner carrier as shown in Figure 9. This frees the lens assembly.
3. Loosen the two setscrews holding the fiber optic in place at the rear termination plate, until the optical

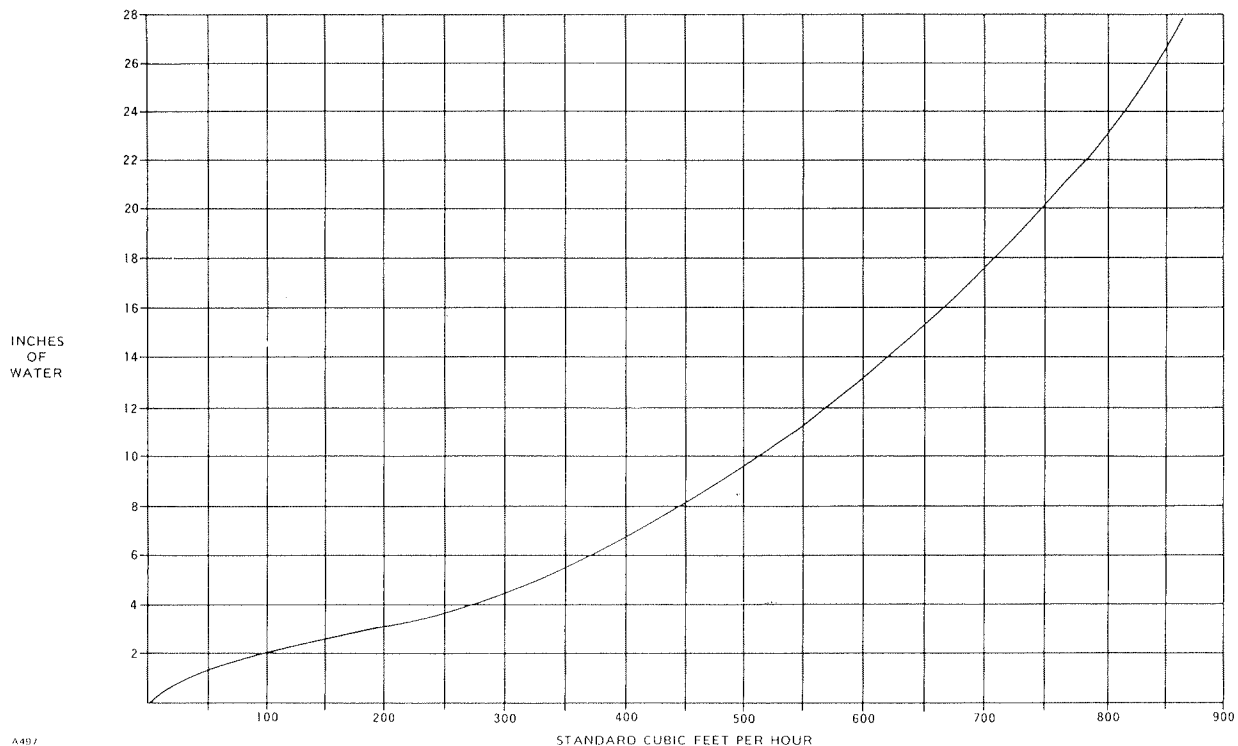


Figure 8—Air Flow Versus Pressure Difference

SCREWS HOLDING
LENS ASSEMBLY (2)



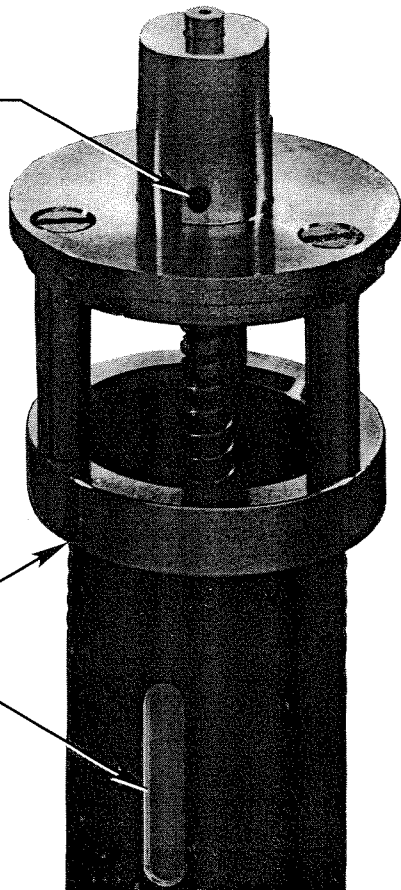
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Figure 9—Front Termination, Inner Carrier

fiber can move freely within its holder. Unscrew the entire three-legged termination assembly from the inner carrier and set it aside. See Figure 10.

4. Gently pull the metal-sheathed optical fiber from the inner carrier. The lens assembly will be the last part to emerge from the carrier. Do not use excessive force, or the optical fiber may be damaged or destroyed.

SETSCREW HOLDING
FIBER OPTIC (1 OF 2)

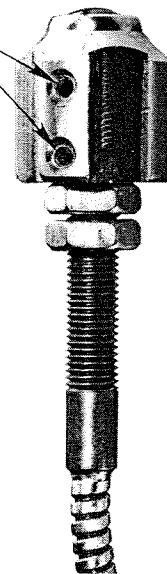


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Figure 10—Rear Termination, Inner Carrier

5. Using an open-end or an adjustable wrench, hold the retaining nut at the base of the lens assembly. Using a pliers to grip the lens assembly, unscrew it from the end of the optical fiber. See Figure 11.
6. Check to make sure the lock nut, which contacts the lens assembly, is 5/16 inch down from the end of the fiber to obtain the correct focal point for the lens and fiber. See Figure 12.
7. Screw the 5 degree offset lens assembly onto the optical fiber, seating it against the upper lock nut.
8. Secure the lens and focal point setting by making sure the lower lock nut is tight against the upper one.
9. Insert the optical fiber back into the inner carrier. Secure the lens assembly within the inner carrier's front termination using the two screws removed in step 2. Screw the rear termination assembly back into place on the inner carrier pipe. Insert the optical fiber into its orifice in the rear termination assembly and tighten the two setscrews loosened in step 3.
10. Slide the inner carrier back into the (mounted) outer carrier and front casting of the flame scanner.
11. Using a wrench on the rear of the inner carrier's fiber optic termination, rotate the inner carrier through 360 degrees of travel, until a strong pulsating light is seen at the termination. If there is a poor flame signal registered at the controller, if there is only a slight difference in signal between flame on and flame off, or if the scanner is picking up signals from adjacent burner flames, remove the inner carrier again, install the 9 degree offset lens and repeat the aiming pro-

SCREW HOLES (2)



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Figure 11—Lens Assembly at End of Optical Fiber



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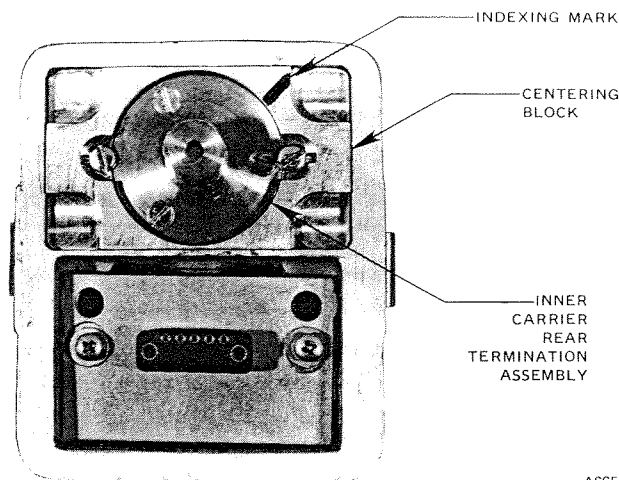
Figure 12—Optical Fiber Without Lens Assembly

cess. If these sighting criteria are still not met, remove the inner carrier again, install the 14 degree offset lens and repeat the aiming process.

12. Once the scanner has been sighted, pull the inner carrier out far enough to note the position of the index mark on the carrier directly in front of the termination assembly (Figure 10). Using a permanent marker, mark this position on the centering block inside the front half of the scanner. See Figure 13.
13. Once the correct rotational position of the inner carrier has been marked, slide it back into the assembly. Turn the two retaining screws down onto the rear termination plate to hold it in place.

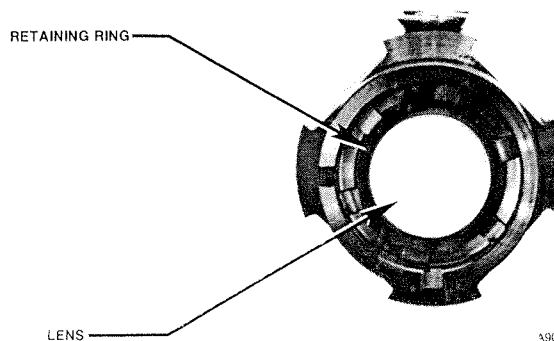
If the lens is defective, becomes scratched or is otherwise obscured, it must be replaced. To remove and re-install the lens (refer to Figure 14):

1. Using a small pliers or screwdriver, pry the lens retaining ring out of the lens assembly.
2. Remove the defective lens.
3. Place the new lens in the assembly.
4. Carefully place the retaining ring back into position without damaging the lens.



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Figure 13—Front Half of Scanner Module (Inside)



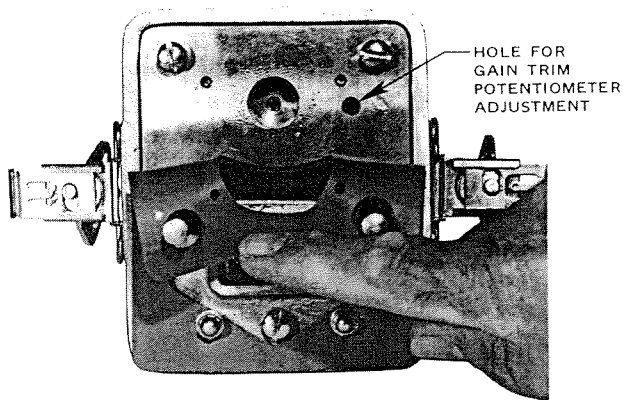
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Figure 14—Lens Replacement

FINAL CALIBRATION

Scanner gain is normally adjusted at the controller. If adjusting gain at the controller proves insufficient, the C9503M and C9504M Fiber Optic Flame Scanners have individual sensitivity adjustments that enable fine-tuning of each individual scanner in a system.

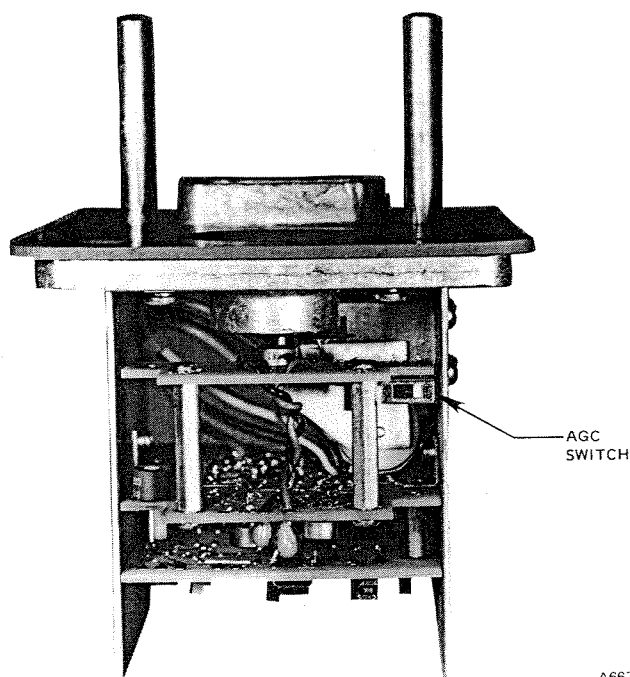
A trimmer potentiometer mounted within the scanner's electronic package permits sensitivity adjustment from 0 to 100 percent. The sensitivity trim potentiometer is accessible only when the two halves of the scanner are separated. To adjust scanner sensitivity, pull the rubber gasket back from the rear portion of the scanner housing until the hole on the right side of the central opening is exposed. See Figure 15. Insert a thin standard blade screwdriver into the hole and turn it gently until it slides into the trim potentiometer's slot. The trim is a four turn potentiometer with no end stops. Turning the potentiometer more than four turns either way means that the adjustment will idle at one or the other end of its range. Turning the potentiometer to the left (counterclockwise) reduces the sensitivity. The scanners are sent from the factory with the adjustment set at 50 percent sensitivity (two turns from the end). For more specific system calibration information, refer to the instructions supplied with the controller.



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Figure 15—Inside of Rear Scanner Housing

The C9503M and C9504M Scanners have an automatic gain control (AGC) on-off switch as standard equipment. The AGC circuit automatically raises or attenuates the scanner signal to compensate for variations in flame intensity. Scanners are shipped with the AGC switched on. An especially hot, bright coal flame may cause the AGC to lower the flame signal below acceptable limits. In such an instance the AGC should be switched off. To gain access to the switch, unscrew the three machine screws (two above, one below) holding the electronic module inside the rear housing. Pull the electronic module out, holding it by the alignment posts. The AGC switch is found on the top of the electronic package, near one edge of the module as shown in Figure 16.



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Figure 16—Scanner Electronic Module with Housing Removed

DEVICE REPAIR AND RETURN

Prior to returning devices or components, contact the nearest local Detector Electronics office so that an RMI (Return Material Identification) number can be assigned. A written statement describing the malfunction must accompany the return device or component to expedite finding the cause of the failure, thereby reducing the time and cost of the repair to the customer.

Return equipment transportation prepaid to the Minneapolis location:

Office locations

Detector Electronics Corporation

6901 West 110th Street
Minneapolis, Minnesota 55438 USA
Telephone (612) 941-5665
Telex 29-0562 DETRONICS BLTN or 6879043 DETEL UW
Cable Detronics

Detector Electronics Corporation

3000 Wilcrest
Suite 145
Houston, Texas 77042 USA
Telephone (713) 782-2172

Detector Electronics Canada Ltd.

Bay 106
3505 - 29th Street Northeast
Calgary, Alberta T1Y 5W4
CANADA
Telephone (403) 291-0535
Telex 03-821301

Detector Electronics International

Vossepap 24
7822 BB Emmen
HOLLAND
Telephone 5910 14913
Telex 30112

Detector Electronics UK, Ltd.

51/53 The Pantiles
Royal Tunbridge Wells
Kent TN2 5TE
ENGLAND
Telephone 0892-42919
Telex 957532

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Detector Electronics Europe S.r.l.
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20146 Milano
ITALY
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Telex 312625

Detronics A/S
Spireaveien 6
0580 Oslo
NORWAY
Telephone 2651 000
Telex 76082

ORDERING INFORMATION

When ordering specify the model:

For coal, oil flames — C9503M Fiber Optic Flame Scanner.

For gas flames — C9504M Fiber Optic Flame Scanner.

For assistance in ordering a burner management system to fit your application please contact:

Detector Electronics Corporation
Sales and Application Engineering
6901 West 110th Street
Minneapolis, Minnesota 55438 USA

REPLACEMENT PARTS

DE601-110	Electronic assembly and rear housing for the C9503M
DE601-111	Electronic assembly and rear housing for the C9504M
DE601-112	Front base casting with 8 foot lead-wires for the C9503M and C9504M
DE601-112A	Front base casting for C9503M and C9504M with military connector

DE601-16	Circular stainless steel fiber optic termination
DE601-18	Cast metal compression fitting with graphite gasket
DE601-20A	0° lens offset
DE601-20B	5° lens offset
DE601-20C	9° lens offset
DE601-20D	14° lens offset
003324-001	Lens for offset assemblies
101814-001	Retainer ring for offset assemblies
003263-001	Inner carrier assembly, 72 inches
003263-002	Inner carrier assembly, 85 inches
003263-003	Inner carrier assembly, 120 inches
003263-004	Inner carrier assembly, 100 inches
003265-001	Outer carrier assembly, 72 inches
003265-002	Outer carrier assembly, 85 inches
003265-003	Outer carrier assembly, 120 inches
003265-004	Outer carrier assembly, 100 inches
101806-001	Metal sheathed optical fiber, 72 inches
101806-002	Metal sheathed optical fiber, 85 inches
101806-003	Metal sheathed optical fiber, 120 inches
101806-004	Metal sheathed optical fiber, 100 inches

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