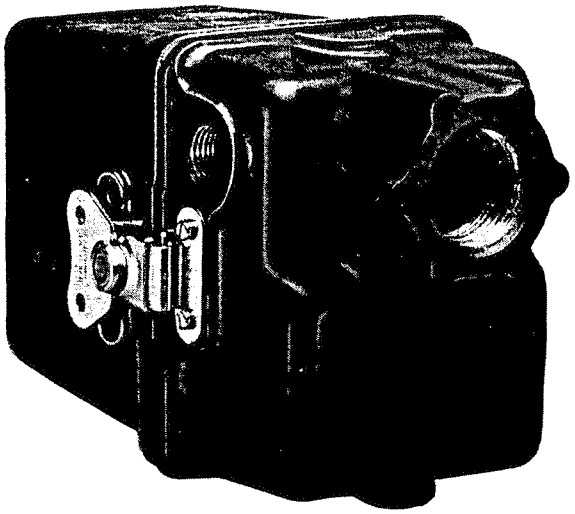


ALL FUEL SCANNER C9507 Instructions

DESCRIPTION

The C9507 All Fuel Scanner is used in conjunction with Fireye Flame Safeguard Controllers to provide continuous monitoring of burner flames in industrial and utility boilers and furnaces. The scanner views the burner flame through a one inch inside diameter straight sight pipe.

The C9507 uses a UV sensor that responds to radiation in the range of 1850 to 2650 angstroms and an IR sensor that responds to radiation in the range of 5,000 to 10,000 angstroms, making it suitable for monitoring the flames of natural gas, no. 2 oil, no. 6 oil, pulverized coal and bark. The C9507 is a versatile flame scanner that is capable of sensing flames from a variety of burning fuels, eliminating the limitations of standard scanners that are more fuel specific.

The C9507 Scanner consists of sensors, a quartz lens, electronic circuitry for generating an output signal, and a testing feature for verifying that the scanner will respond to the absence of a flame.

The scanner chassis is mounted in a weatherproof cast aluminum enclosure made up of a base and a cover assembly. The cover assembly contains the working parts of the scanner, which includes the sensor and electronic circuitry to process the flame signals. The base casting has a one inch NPT (National Pipe Thread) tapping for mounting onto a threaded one inch API (American Petroleum Industry) standard sight pipe. The base also includes a $^{1}/_{2}$ inch NPSM (American National Standard straight pipe thread for free fitting mechanical joints) tapping for an electrical connector and a $^{3}/_{4}$ inch NPT tapping for connecting a purge/cooling air line.

The base casting and cover casting fit together guided by two 5/16 inch diameter alignment pins and are secured with spring-loaded half-turn fasteners. A five contact spring-mounted plug electrically connects the base and cover assemblies. A silicone rubber gasket seals the scanner housing at the housing separation plane, assuring a weatherproof enclosure.

FEATURES

- The C9507 is capable of detecting flames from a majority of burning fuels used in today's boilers and furnaces.
- Scanner testing (self-checking) feature allows verification of scanner operation by periodically interrupting the incoming flame radiation.
- Automatic gain control compensates for varying firing rates to decrease the risk of unwanted actuation caused by radiation from adjacent burners.
- Plug-in electronics package can be removed and replaced in seconds without disturbing wiring.
- Low impedance signal transmission from scanner to controller provides maximum transient immunity.
- Gasketed weatherproof enclosure allows outdoor installation.

OPERATION

Flame Detection and Signal Processing

The C9507 incorporates sensors that detect both ultraviolet (1850 to 2650 angstroms) and infrared radiation (5,000 to 10,000 angstroms), which is produced by burning gas, oil, coal, waste and other solid fuel flames. Switching between the UV and IR sensors is done at the controller (R9005P or 9105P).

The circuitry described below processes the detected signal in order to increase flame discrimination, minimize the effects of airborne matter blocking the scanner view and compensates for size, distance and variations of the flame.

Since hot refractory can emit significant levels of infrared (IR) radiation, making flame discrimination difficult, electronic circuitry in the C9507 is designed to send a flame signal to the controller only when the radiation being detected is "flickering." Flicker is caused by the turbulent mixing of fuel with air during the combustion process.

An IR gain potentiometer is used to set the C9507 for the flicker of the fuel/air mixture being burned. Because both radiation and a specific flicker frequency are required for the scanner to produce a flame signal output, a high degree of reliability is achieved.

An automatic gain control (AGC) circuit, which is able to sense large variances in radiation intensity levels, is another important feature of the C9507. This circuitry automatically compensates for varying firing rates and decreases the possibility of unwanted actuation of controller outputs caused by the flame of an adjacent burner.

The AGC circuit decreases the amplifier gain of the scanner when the radiation intensity level increases, thereby maintaining a relatively constant flame signal. The AGC circuit can be set "on" or "off," depending on the application and the level of extraneous radiation.

A HI/LO gain switch that represents fixed values is used for applications where IR radiation is emitted but the signal reaching the scanner is attenuated. For example, when coal is being burned, the coal dust can obscure some of the signal reaching the scanner so the HI/LO switch would be set on "HI" to compensate. When oil is being burned, there is not as much attenuation of signal, so the HI/LO switch would be set for "LO" gain.

The C9507 Scanner also has a UV gain potentiometer that is used to adjust ultraviolet (UV) radiation signals to a level that is usable for the controller to process. The amount of UV radiation reaching the scanner can vary greatly with the distance, sighting and size of the flame.

As a result, the flame signal can also vary greatly. In order for the flame controller to properly process the UV flame signal, it must fall within certain parameters. The UV gain adjustment does this, making the system as reliable with a small flame as with a large flame, regardless of distance and sighting.

SCANNER TESTING (SELF-CHECK)

Scanner testing is initiated by a test signal from the controller that causes a mechanical light blocking chopper in the scanner to block the flame radiation from reaching the sensors for one out of every 10 seconds. The system must respond to this absence of a flame signal or the controller will indicate a fault condition.

SPECIFICATIONS

OPERATING VOLTAGE —The flame scanner operates on 14 vdc, which is internally regulated from the 28 vdc supply in the supervising flame controller.

WIRING — Five non-shielded wires, 18 gauge minimum rated at 600 volts, with insulation rated at 220°F (105°C). The scanner can be mounted up to 1000 feet (300 meters) from the controller.

An optional 5 pin military connector is available.

MECHANICAL — $^3/_4$ inch NPT purge air, $^1/_2$ inch NPSM tap for electrical fitting, 1 inch NPT to sight pipe.

TEMPERATURE — - 4°F to +200° (-20°C to 93°C) measured at mounting hub. Housing ambient air should not exceed 160°F (71°C).

PURGE AIR REQUIRED — 10 standard cubic feet per minute at 13 inches water column over furnace pressure.

RESPONSE RANGE — UV: 1,850 to 2,650 angstroms. IR: 5,000 to 10,000 angstroms.

SHIPPING WEIGHT — 7 pounds (3.18 kilograms).

DIMENSIONS — See Figure 1.

INSTALLATION

FLAME SCANNER MOUNTING

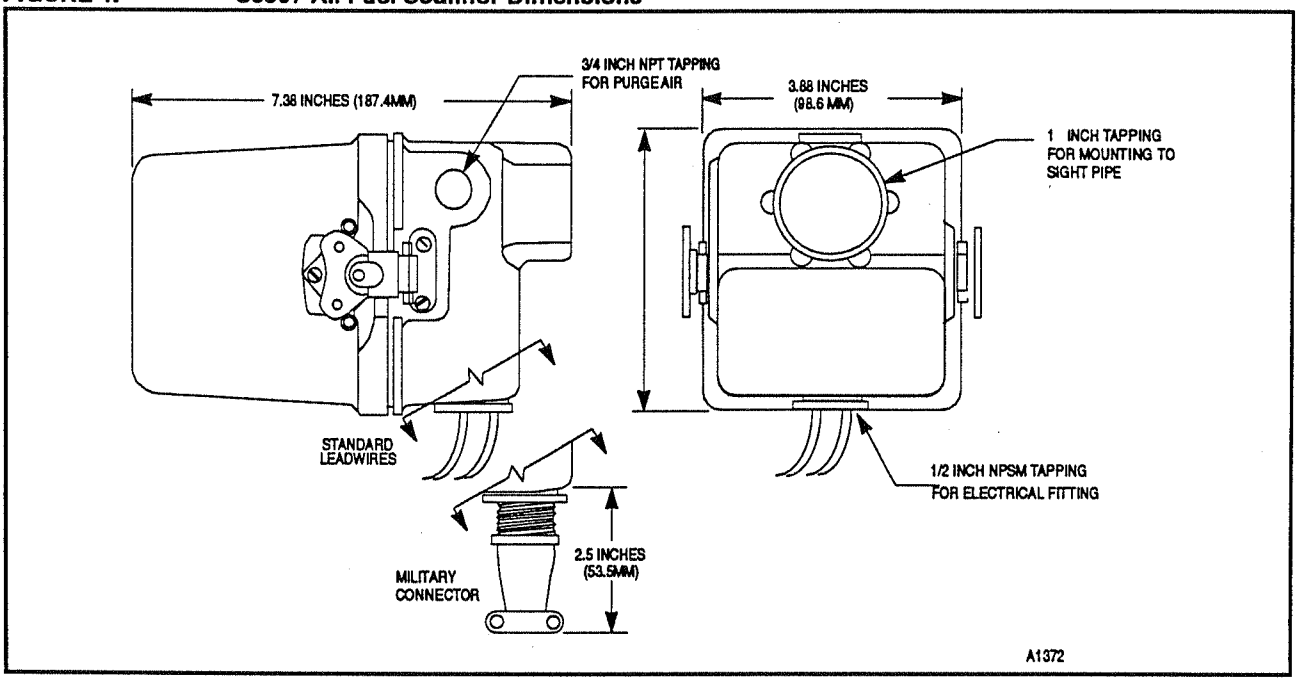
1. Choose a sighting location where the scanner will have an unobstructed view of the flame under all firing conditions. The greatest amount of UV radiation is produced in the area immediately ahead of the burner. The greatest amount of infrared (IR) radiation is produced in the later (cooler) stages of combustion.

   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 sight pipe should be inclined slightly downward, so that unburned particles or condensed moisture will not fall or drain onto the scanner.
2. Prepare a hole in the burner front or windbox wall to mount the sight pipe at the angle of approach selected. Select a length of 1 inch standard pipe (with NPT thread on one end) no longer than is necessary to place the scanner housing in an unobstructed and accessible area. If a sight pipe longer than 12 to 18 inches is required, the sight pipe should be of larger diameter (2 inch pipe, for example) with the reduction to 1 inch occurring as close to the scanner as practical, so the field of view will not be reduced to a narrow angle.
3. Thread the scanner base assembly onto the sight pipe until tight, making certain that, in the final position, the wiring connector points down.
4. Project the sight pipe through the hole in the firewall surface and tack weld the pipe to the boiler front plate at the selected location and angle of sight.
5. In many instances it will be convenient to use a swivel mount (model number Q2625A) that is threaded onto the sight pipe. This arrangement allows angular adjustment within a cone of approximately 20 degrees.

6A. Install an electrical fitting in the housing base tapping and encase the extension leadwires in 1/2 inch flexible metal conduit or other flexible conduit that meets local standards. Terminate the assembly at a junction box and splice the leadwires to conductors extending to the flame control module. For any wiring runs on or near hot surfaces, use an appropriate fitting and liquid tight conduit arranged to pitch downward from the scanner. The scanner wiring scheme is shown in Tables 1 and 2. Table 1 identifies the color of the PVC cable wiring scheme. The hypalon cable has either the color code shown in Table 1 or Table 2. Check the wire colors of the cable and match them with one of the two tables.

FIGURE 1. C9507 All Fuel Scanner Dimensions



6B. When the optional military connector is purchased, an 18 gauge 5 conductor cable with a 5 pin plug assembly must be used to connect the scanner to the controller. Fireye offers a kit to facilitate this connection. Table 1 shows the pin connections.

7. The introduction of cooling and/or purging air will be required. A positive flow of air down the sight pipe can eliminate the necessity for frequent lens cleaning and prevent transmission losses caused by products of combustion in the sight path. The purge air source must be oil free and dry and it should provide 600 standard cubic feet per hour at 13 inches water column over furnace pressure. Unless the purge line includes a flexible connecting portion, it cannot be attached until the permanent scanner position has been determined.

Table 1: PVC and Hypalon Cable Color Codes, Pin Connections

SCANNER LEADWIRE	FUNCTION	CONNECTOR DATA	
		WIRE COLOR	PIN NO.
Gray	Signal Output	Blue	B
Violet	+28VDC from Controller	Orange	A
Yellow	From chopper drive	Yellow	C
Brown	Ground	Black	E
Red	+520 VDC	Red	D

Table 2: **Hypalon Color Code**

PIN	CABLE COLOR	FUNCTION
A	Orange	+28VDC
B	Green	Signal
C	White	Chopper
D	Red	+520 VDC
E	Black	Ground

SIGHTING ADJUSTMENT

An inadequate signal can be the result of improper sighting or poor combustion. If the sight pipe was only tack welded, as instructed, or if it is on a swivel mount, vary the angle to achieve the highest voltage signal reading.

If the scanner is used to monitor both pilot and main flames, adequate signal from each flame should be verified with the other flame off. If a good signal can be acquired from both flames only at two different sighting angles, either the sight pipe should be relocated to a more appropriate area or the use of two scanners should be considered.

In multiple burner furnaces where individual flame discrimination is required, it is possible that a strong signal is received from an interfering flame as well as from the flame of interest. The best way to correct this condition is to restrict the size of the viewing orifice on the scanner so that the signal intensity from both flames is reduced. Assuming that the monitored flame, which has an optimized sighting angle, will provide a greater signal than an adjacent flame, a reduction of signal strength (by restricting the viewing orifice) will permit the differences in signal level from the two flames to be recognized.

IMPORTANT: The electric spark used to ignite a pilot flame is an emitter of ultraviolet and infrared radiation. To ensure that the sighting arrangement does not permit the detection of direct or reflected spark energy, a flame signal reading of no more than 1 volt should exist with fuel source shut off and spark energized. Re-align the scanner or optically shield the igniter, if necessary, to avoid spark detection. As an additional precaution, it is a common and recommended practice to de-energize the ignition transformer before the energizing of main fuel valves.

IMPORTANT: A scanner should not respond to a pilot flame that is too small to reliably ignite the main burner. This can be checked by reducing the pilot flame size to the smallest that can be detected (sensitivity set to maximum) and then determining that such reduced flame will readily ignite the main burner fuel.

CAUTION: If ignition of main flame does not occur at once or is slower than usual, shut off fuel immediately, readjust the scanner to sight further out, and repeat the above test.

If the pilot flame signal is relatively strong, the viewing orifice should be restricted to inhibit detection of a pilot flame. The sensitivity control should not be used to attenuate the signal in this instance unless some means is provided to guard against the setting being changed.

IMPORTANT: When satisfactory sighting has been achieved, the sight pipe should be permanently welded in place to maintain the selected position. If a swivel mount is used, tack weld it to prevent further movement.

With the sight pipe in a fixed position, a permanent purge air line connection can be made to the scanner base.

FINAL CALIBRATION

A voltage applied to the controller is used to select either the UV or the IR sensor. With Gain 1 selected at the controller (no voltage applied at terminal P1-2 of the R9005P Controller or terminal 15 of the R9105P Controller) the UV sensor is activated. With Gain 2 selected (line voltage applied at terminal P1-2 of the R9005P Controller or terminal 15 of the R9105P Controller) the IR sensor is activated.

The final adjustments-should be made only after the scanner is properly sighted. The settings on the scanner before beginning the final adjustments should be: UV Gain set at minimum (0), IR Gain set at minimum (0), AGC switch turned "ON" for oil burning or "OFF" for coal burning, HI/LO Gain switch set on "LO" for oil burning or "HI" for coal burning. Proceed to the scanner adjustments below that correspond to the fuel being burned.

If more than one type of fuel will be burned, perform adjustments for each with that fuel burning.

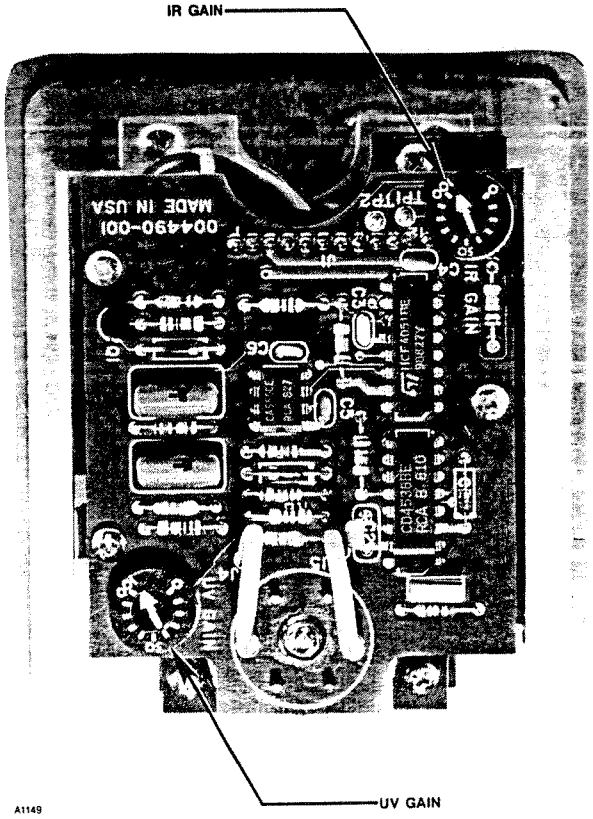
To adjust the C9507, remove the rear cover of the scanner housing and locate the potentiometers and switches shown in Figures 2 and 3. Use a thin standard blade screwdriver to adjust the UV Gain and IR Gain potentiometers.

Before proceeding, ignite the burner that is to be monitored. Place the controller faceplate toggle switch to the METER position.

UV GAIN (Gas and Light Oil Burning)

Ensure that the correct Gain channel is selected at the controller. Set the controller Gain potentiometer to maximum. Adjust the C9507 UV Gain potentiometer to get a reading over 10 vdc on the controller meter. Reduce the controller Gain setting until the controller meter reads between 7 and 8 vdc.

FIGURE 2. **Scanner Gain Potentiometer Locations on Electronic Module (Scanner Cover Removed)**



IR GAIN (Coal and Heavy Oil Burning)

Ensure that the Gain 2 channel is selected at the controller. Adjust the Gain 2 potentiometer on the controller faceplate for a meter reading of 7 to 8 volts. If the required signal readings cannot be obtained using the gain adjustment on the controller, the C9507 IR Gain potentiometer can also be adjusted to obtain the required readings. Adjust the potentiometer upward just until the faceplate meter indicates the highest signal (as close to 10 volts as possible). Do not over-adjust as this results in loss of discrimination. Stop turning the potentiometer as soon as the high point is reached. Return to the controller and set the Gain potentiometer there for a 7 to 8 volt signal reading.

HI/LO GAIN SWITCH (Coal and Heavy Oil Burning)

For coal fires, set the switch to "HI." For oil fires, set the switch to "LO."

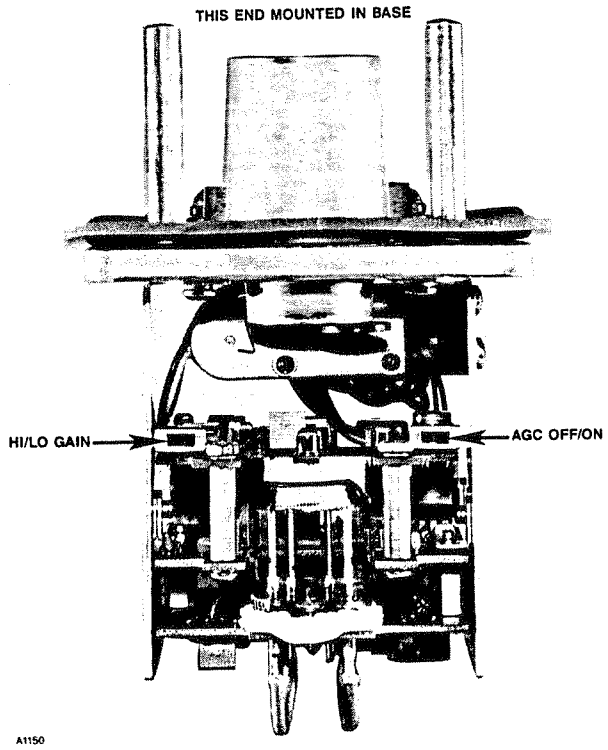
AGC SWITCH (Coal Burning)

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 can cause the AGC to lower the flame signal below acceptable limits. In such cases, the AGC should be switched off.

AGC SWITCH (Coal Burning)

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 can cause the AGC to lower the flame signal below acceptable limits. In such cases, the AGC should be switched off.

FIGURE 3. **Scanner Switch Locations on Electronic Module (Scanner Cover Removed)**



HOW TO ORDER

C9507N		C9507N Scanner Description
	4001	8 ft. lead wires
	4012	Military Connector
Example: To order a C9507N scanner with a military connector ORDER: C9507N4012		
To order scanner electronics assembly only, ORDER: DE601-113 for both models.		
To order scanner base only ORDER: DE601-104F for C9507N4001 Model. DE601-104D for C9507N4012 Model.		

ACCESSORIES

- 5 pin military connector kit for use with PVDC, cable part number DE601-006.
- 5 pin military connector kit for use with Hypalon cable, part number DE601-006A.
- Connector receptacle with 8 foot leadwires, part number DE601-08.
- Swivel mounting assembly, Q2625.

DEVICE REPAIR AND RETURN

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

Return all equipment transportation prepaid to the Minneapolis location.

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated it its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for one year from the date of shipment of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature which may arise in connection with such product or part.

FIREYE®
3 Manchester Road
Derry, New Hampshire 03038

65-8048
JUNE 1993

Division, Detector Electronics Corporation