

GR-526/510
Vehicle Monitoring System
OPERATORS MANUAL
(PART NO. 93516-3)
REV 2.2
Software Version 2V16
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GR-526/510 Vehicle Radiation Monitor

Software Version - 2V16

OPERATORS MANUAL - Rev 2.2

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EXPLORANIUM
RADIATION DETECTION SYSTEMS

GR-526/510 OPERATORS MANUAL

for

DYNAMIC VEHICLE RADIATION MONITORING

Software Version - 2V16

USERS ARE HEREBY NOTIFIED THAT THIS MANUAL CONTAINS TECHNICAL INFORMATION OF A PROPRIETARY NATURE. THIS INFORMATION IS NECESSARY FOR TECHNICALLY KNOWLEDGEABLE USERS TO UNDERSTAND SYSTEM OPERATION AND TO SATISFY THEMSELVES THAT THE SYSTEM IS PERFORMING CORRECTLY.

EXPLORANIUM ACCEPTS THAT IT IS THE RIGHT OF SUCH USERS TO BE PRIVY TO THIS INFORMATION. HOWEVER THIS DOCUMENTATION IS PROVIDED SOLELY FOR THE BENEFIT OF OWNERS OF THE GR-500 SERIES SYSTEM AND DISSEMINATION OF THE DETAILED TECHNICAL INFORMATION PROVIDED MAY BE CONSIDERED AS LEGALLY CONTRAVENING THE NORMAL SUPPLIER/CUSTOMER RELATIONSHIP.

UNAUTHORIZED RELEASE OF DETAILED TECHNICAL INFORMATION TO A THIRD PARTY WILL BE CONSIDERED AS A CONTRAVENTION OF USER AGREEMENTS.

1.0 GENERAL

1.1 INTRODUCTION

The GR-500 Series are the **state-of-the-art** radiation monitoring systems for Truck/Rail vehicles in the scrap metal processing and recycling industries. The GR-500 Series has been specifically designed to detect the presence of potentially shielded or un-shielded radioactive sources that are buried in scrap metal.

To prevent these expensive, and potentially dangerous accidents, EXPLORANIUM developed the GR-520 Radiation Detection System in 1988, which was the first system capable of detecting BURIED shielded sources. Current models include the high-sensitivity GR-510 and GR-526 systems, and the recently introduced AT-900 system. Exploranium has installed over 500 radiation detection systems in steel mills and scrap handling facilities in 17 countries including USA, Canada, Mexico, Germany, Sweden, Finland, Italy, Denmark, UK, Ireland and many countries in Asia.

It is impossible for ANY system to catch ALL potential incoming sources for a variety of technical reasons (see Appendix A). However the technology built into the GR-526/510 together with our previous experience PLUS some recent major technical breakthroughs, make the GR-526/510 THE technical limit in this specialised monitoring technology. The GR-526/510 will detect almost all potential "normal" sources that can be expected to be in the scrap stream and compensate for most logistic limitations commonly seen in scrap handling facilities.

The GR-526/510 offers the highest level of sensitivity, ease of use and system reliability of any scrap metal radiation monitor, through the following features:

- Very large Polyvinyl toluene (PVT) "plastic" detectors.
- Easy user interface via the large Graphics display plus printer output.
- One-button Alarm response for the user
- Continuous automatic system self-diagnosis with user notification
- Redundancy of key system components.
- Tele-Check with full performance data analysis/service support via built-in modem.
- Extensive Exploranium Service Centre support for customer questions.
- FREE software updates to continuously improve performance

1.2 GR-526/510 SYSTEM DESCRIPTION (General)

The GR-526/510 Radiation Detection System consists of a system console and two detector boxes (maximum = 8 detector boxes for special applications). The detectors are usually mounted at the entrance to a truck or rail scale. The system console can be mounted in the scale house or any other convenient indoor monitoring location.

Radioactive sources, both naturally occurring and man-made, emit Gamma-rays that are absorbed by the detectors and produce scintillations, small flashes of light, which are converted to pulses in the detector electronics. The system console collects and monitors the Gamma-ray information from the detectors and displays the data on the front panel Liquid Crystal Display (Console Display) in a "chart recorder" format.

If the system determines that a source of radioactivity is present, an audio alarm is sounded and detailed alarm information is displayed on the Console Display.

The GR-526/510 also performs continuous system diagnosis. If a component failure is detected, signals can be re-routed to take advantage of back-up systems designed into the GR-526/510. Any system faults that are detected, are displayed on the Console Display enabling Maintenance to be scheduled. The GR-526/510 will continue to operate even if some major components have failed, to give the user the MAXIMUM detection capability during this period.

The GR-526/510 system has been specially designed for ONE-BUTTON. The system is designed to monitor all internal components and to automatically alert the user to any system malfunctions. **ADVANCED SYSTEM DESIGN PERMITS THE SYSTEM TO OPERATE AT MAXIMUM PERFORMANCE LEVELS WITHOUT REQUIRING THE SCALE OPERATOR TO DO ANYTHING UNTIL AN ALARM OCCURS.**

1.3 IN CASE OF DIFFICULTY

In the event of a problem, customers can contact the Exploranium Service Centre closest to them

1) Exploranium-Canada

Address : 6108 Edwards Blvd., Mississauga, ON L5T 2V7, Canada

Telephone : (905) 670-7071

Fax : (905) 670-7072

Pager : (416) 614-4551

Service personnel : Dan Hoover
Fred Walker
John Crook

2) Exploranium-Europe-

ENVI-2000

Address : Vaclucova 1 A, Brno 638 00, Czech Republic

Telephone : [033] (420) 5-45-22-2020

Fax : [033] (420) 5-45-22-2024

Mobile : [033] (420) 602-702-075

Service personnel : Ivan Kaspárec
Jara Matejek

1.4 DOCUMENTATION

Various support documentation is available for the GR-526/510 system:

- 1) **SYSTEM SUMMARY CARD** - a 1 page (2 sided) laminated card that summarizes system operation, supplied with all systems. Part #93512
- 2) **GR-500 SERIES OPERATORS MANUAL – part #93516-3**
This manual covers basic system operation, alarm information, alarm responses, basic system maintenance and basic error analysis of system performance.
- 3) **GR-500 SERIES SYSTEM MANUAL – part #93516**
This is an in depth manual that covers system setup, parameter selection as well as normal system use.
- 4) **GR-500 SERIES MAINTENANCE MANUAL – part #93509**
This is a detailed manual specially for Maintenance Users may request a special Maintenance Manual for more in depth details of system operation primarily for maintenance personnel.

2.0 OPERATION

This section summarizes how the system works and gives some details of special operational parameters that may be selected during system setup. For a full description of each parameter - refer to Section 6.

For easy reference see the laminated 1 page (2 sides) **SYSTEM SUMMARY CARD**.

2.1 GR-526/510 CONSOLE PRIMARY FEATURES

Primary features are:

Bright graphics Console Display for the display of messages, alarms etc.

RED push-button marked **ALARM** - used during a Radiation alarm

YELLOW push-button marked **STATUS** - used for other user functions

Internal AUDIO buzzer referred to as **AUDIO BUZZER**

CLEAR, ENTER, RUN, STOP - special function keys used in Maintenance and System Set-Up - and a 10 key numeric keyboard - **0 - 9**

2 **ARROW** keys - for parameter selection

Internal **PRINTER** for hard copy of alarms (external Printer support if required)

Internal **MODEM** for Remote Maintenance access by telephone line

Special output for control of external **TRAFFIC LIGHTS**

Special data output (**RS-232**) permitting external data processing

Note that the system can be operated by **ANY** user by using **ONLY THE RED BUTTON**, as the other buttons are primarily for changing system parameters.

2.2 POWER SWITCH

The YELLOW power switch is located inside the system console and can be reached from the lower right-hand access door. Access to the power switch has deliberately been made difficult to minimize the chance of unauthorized personnel interfering with system operation.

2.3 STARTUP SCREEN

When power to the system is turned on, the following screen appears on the Console Display:

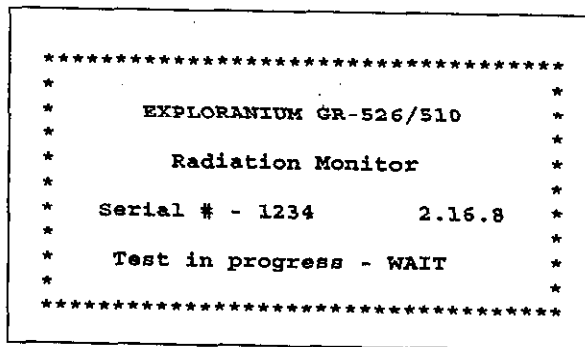


Fig. 1

This startup screen is displayed for a few seconds while all components of the system are automatically tested. If all parts of the system are working correctly, the Console Display will change to show the Monitoring Display (Fig 2).

The following message will be printed on the printer
RESXX - 02/14/96 - 14:23:00 -
 (date) (time)

XX represents a diagnostic code for performance analysis (See Appendix F for more details)

If any faults **ARE** detected, the errors are displayed - see Section 2.4 for details.

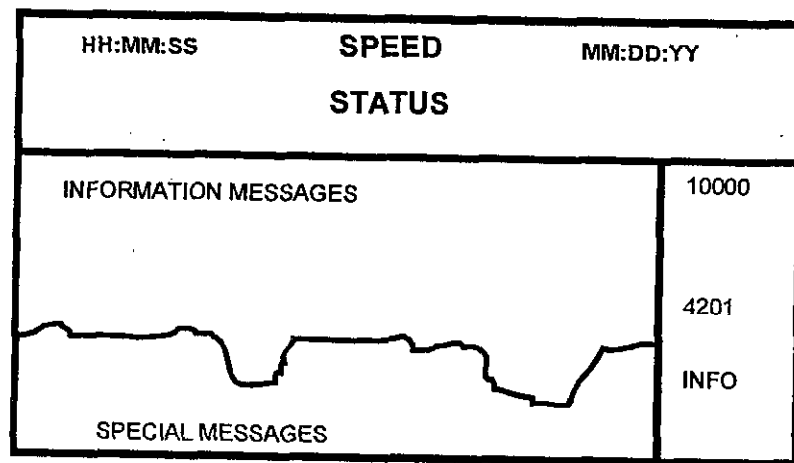


Figure 2

2.4 DISPLAY MESSAGES

The CONSOLE DISPLAY is used to alert the user to any problem with the system and to display system messages advising the user of the current status of system performance.

In the table below all messages are listed -

- STATUS** - shows the status of the STATUS (Yellow) button
- TRAFFIC** - shows the status of the Traffic Light output (if used)
- Audio** - shows the action of the internal audio buzzer
- User action** - shows the recommended user actions

Message	STATUS	TRAFFIC	Audio	User action	Comments
SYSTEM WARMUP - WAIT	Flash	YELLOW	None	None	10 second wait on system startup
SYSTEM READY	ON	GREEN	None	None	Ready to monitor
VEHICLE IN	ON	YELLOW	None	None	Vehicle passing
TELE-MAINTENANCE	ON	GREEN	None	None	Modem access occurring
3.7 MPH (or Km/h)	ON	Various	None	None	Speed of the vehicle
3.7, 5.2 MPH (or Km/h)	ON	Various	None	None	Vehicle speed IN and OUT
SPEED ERR	Slow Flash	YELLOW flash	Slow beep	Press STATUS	Super high speed vehicle
SpSpd	ON	Various	None	None	special mode
OS1 ERR (or OS2 ERR)	Fast Flash	Various	Fast beep	Call maintenance	Optical Sensor defective
OS1,2 ERR	Fast Flash	Various	Fast beep	Call maintenance	BOTH OS defective
OS3,4 ERR	Fast Flash	Various	Fast beep	Call Maintenance	OS3, 4 defective (if used)
Detector ERR A1, cntr 123	Fast Flash	Various	Fast beep	Call Maintenance	A detector is defective
COMM FAILURE A	Fast Flash	Various	Fast beep	Call Maintenance	Detector A Comm problem
COMM ERROR A	Fast Flash	Various	Fast beep	Call Maintenance	Detector A Comm problem
SYSTEM INOPERABLE	Fast Flash	RED	ON see Note #1	Stop vehicles call Maintenance	All detectors are defective - NO monitoring possible
??BACKGROUND UPDATE??	Fast flash	YELLOW flash	Fast beep	Remove vehicle and	Excess traffic

Message	STATUS	TRAFFIC	Audio	User action	Comments
				pass again	
SENSITIVITY TEST	ON	RED and flash RED	None	Test the system	Sensitivity test of system
TEST	ON	Various	None	TEST the system	Simple alarm test
PrALA	ON	Various	None	None	Alarms being printed
PrtAL	ON	Various	None	None	Summary alarms being printed
PrSTA	ON	Various	None	None	System parameters being printed
XaSPD	ON	Various	None	None	Alarms only by OS
SpSpd	ON	Various	None	None	Speed Alert suspended
Modem I/O error	Fast flash	YELLOW flash	Fast beep	Call Maintenance	Defective modem
Remote Monitoring	ON	Various	None	None	System being contacted by modem
Remote Vehicle Log	ON	Various	None	None	System being contacted by modem

Note 1: In this unusual condition the Audio is ON and may not be reset using the STATUS button. The user should switch the system OFF to prevent the audio. Maintenance may disconnect the audio temporarily while awaiting modem support from Exploranium.

2.5 ERRORS DURING INITIALIZATION

When the system goes through SYSTEM INITIALIZATION, a thorough check of all system parameters is made. When these tests are being carried out the screen shown in Fig. 1 is shown. At the conclusion of these tests, if **NO** errors are found the display changes to the Monitoring display. However if the tests determine that errors exist during these tests then the following sequence occurs:

- the console Audio Buzzer "fast-beeps" at a 3/sec rate
- the **STATUS** button flashes at a 3/sec rate + Yellow Traffic Light
- the errors are listed on the display for 10 seconds

After 10 seconds the display automatically goes into the Monitoring Mode (see Fig.2) and the errors are displayed - as listed above.

The Audio Buzzer "quick-beep" can only be stopped by pressing **STATUS**, at which time the user accepts responsibility for ensuring that all errors are corrected.

2.6 TRAFFIC LIGHT SYSTEM

The GR-526/510 is supplied with a TLC (Traffic Light Controller). Exploranium recommends that users install a complete Traffic Light system as it is very helpful in advising users and drivers of system operation. There are 4 control lines available and are usually connected to : **GREEN**, **YELLOW** and **RED** lights and an external **HORN**. The following is the detailed explanation of their operation and meaning.

GREEN steady	system operational, proceed
GREEN Flashing -	both primary Optical Sensors are defective, system still alive but sensitivity significantly reduced.
YELLOW steady	<u>EITHER</u> - vehicle is being monitored as it passes - <u>OR</u> system is not ready (user accessing alarms etc) so vehicle must WAIT
YELLOW SLOW Flashing -	Vehicle speed TOO HIGH
YELLOW FAST Flashing -	System errors (bad OS, or bad detectors)
RED steady	RADIATION ALARM <u>OR</u> - SYSTEM INOPERABLE
EXT. HORN steady -	RADIATION ALARM
EXT. HORN SLOW pulsing -	Speed Alert

2.7 SPEED ALERT

To prevent system sensitivity reductions caused by excessive vehicle speed, the system has a built-in SPEED control. The vehicle speed is shown on the Console Display in the "**SPEED**" location (see Fig. 2). The speed units of measure (mph, Km/h) are selected during Start-Up.

The maximum permissible SPEED of a vehicle passing through the detectors is selectable and is normally set to 3 mph (5 Km/h). Any vehicle passing at a speed above this limit causes a Speed Alert which gives an Audio alert (beeps) as well as Visual (YELLOW Traffic light flashes).

The user should realize that **reducing the vehicle speed from a maximum of 6 mph (10 Km/h) to a maximum of 3 mph (5 Km/h) - effectively increases system sensitivity by 40%**

2.8 CURRENT PARAMETERS - PRINTOUT

Enter Password <9 - 9 - 9 - 9 - ENTER> to give a printout of current system parameters as shown in Fig. 3.

```

CURRENT PARAMETERS      #3214
4/26/97                  12:34:19
C=30   B=2   N=5   V=10
O=N     1=30  2=15  3=9  MOD=2
ERR = 0  0  0  0   Ver: 2.16.8
D=4     O=7   D=N   C=1
S=D     L=3   U=U
Poff:   04/12/97  13:49:15
  
```

Figure 3

#3214 - is the Serial Number of the system

Date/Time - is the Date/Time of the printout

The following is a list of the parameter settings:

- C = 30 - Background Correction parameter - set to 30
- B = 2 - Background Parameter - set to 2
- N = 5 - Number parameter - set to 5
- V = 10 - Vehicle Parameter - set to 10
- O = N - Alarms ONLY by OS - set to NO
- 1 = 30 - LOW Alarm L1 - set to 30 - 50 for GR-510
- 2 = 15 - LOW Alarm L2 - set to 15
- 3 = 9 - HI - Alarm L3 - set to 9 - 4 for GR-510
- MOD=2 - Alarm Mode parameter - set to 2
- ERR=000 - Error Code (= current error messages see 6.8 below)
- Ver:2.16.8 - Software Version (display shows 16.8)
- D = 4 - # of detectors - set to 4
- O = 7 - # of OS - set to 7
- D = N - Dust Parameter - set to NO
- C = 1 - Discriminators = 1 = Normal mode = C mode + set at 10
- S = D - Speed Alert - set to D (Default)
- L = 3 - Speed Limit - set to 3
- U = U - Speed Units + Date Format - U = US Date + mph
(E = Euro date + Km/h, X = US Date + Km/h, Y = Euro Date + mph)
- Poff - Date/Time of last time system power was switched OFF

2.9 SYSTEM TEST

In order to help the user test the system on a regular basis special test capabilities are built into the GR-526/510. Refer to Appendix N for full details.

2.10 TELE-CHECK

The Exploranium Service Department computer can access the system on a regular basis to perform system performance analysis as required without interfering with system performance. In previous versions this access interrupted system monitoring so frequent contact was required to select a "quiet" time for data access - but this is not a problem now.

Exploranium offers optional extensive data analysis of system performance with weekly access and monthly data reports - contact Exploranium for more information and see Appendix M.

3.0 ALARM DISPLAYS AND PROCEDURES

3.1 IF AN ALARM OCCURS

If a **RADIATION ALARM** occurs, the Audio gives a loud continuous tone and the display changes to show the alarm (Fig 4) and the alarm is automatically printed (Fig 5) (unless this option is disabled). The Audio alarm will continue indefinitely until the red **ALARM** button is pressed.

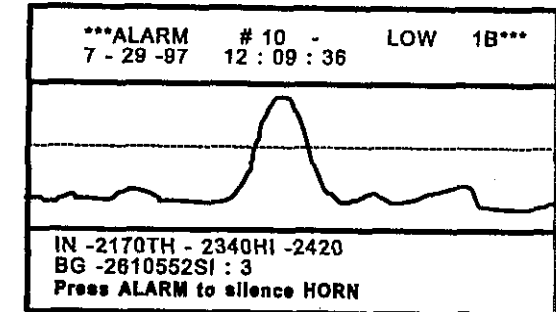


Figure 4

In the Alarm Display (Fig 4) various data are displayed:
ALARM #10 - a sequential alarm # for record keeping
LOW 1 - Alarm designation - refer to 3.4 below for more details

B - This refers to the detector that the primary (highest) alarm was detected on. (Other labels are **A, B, C, D, E, F** for different detectors, **X** = an alarm on A+B and **Y** = alarm on C+D, and **a, b, c, d, e, f** if a Test Alarm on a detector).

IN - 2170 Vehicle Background = 2170 cps
TH - 2340 Computed alarm threshold = 2340 cps
HI - 2420 Highest radiation count = 2420 cps
BG - 2610 Local Background = 2610 cps
55-2 Count analysis information.
SI:3 Vehicle speed = 3mph (or 3Km/h)

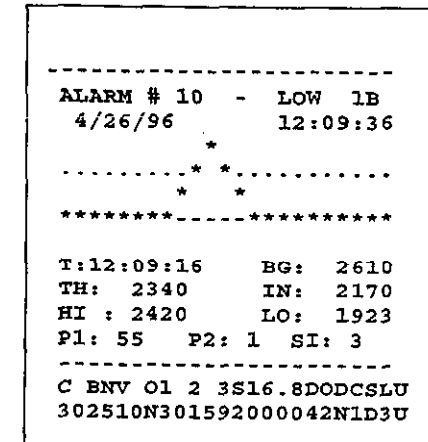


Fig. 5

With the Audio alarm stopped, pressing the red **ALARM** button again (a second time) will cancel the Alarm Display and the system will go back to the normal display screen. The user has 4 minutes from this point to view the alarm before the display reverts to the Monitoring Display.

3.2 DANGER (LEVEL 5) ALARM

LEVEL 5 is a special Alarm level that could denote hazardous material with a potential personnel exposure hazard. For this reason it has a special display (Fig 6) and printout (Fig 7).

If this screen appears, press **ALARM** to silence the audio, and the screen will replace the message "Press **ALARM** to silence **HORN**" with "proceed with caution".

Correct alarm procedures depends on the plant but normally the vehicle will have passed, so press **ALARM** again and the message "Press **ALARM** if ready" will appear and the **ALARM** light will flash. Pressing **ALARM** a third time returns the system to Monitoring.

SPECIAL PRINTOUT

A special alarm printout is used to clearly distinguish this alarm from normal alarms - Fig. 7.

```

>>>> LEVEL 5 ALARM <<<<
*****
*          *
*  VERY HIGH LEVEL ALARM!  *
*          *
*   PROBABLY                *
*  HAZARDOUS MATERIAL      *
*          *
*****
Press ALARM to silence HORN
  
```

Fig. 6

```

ALARM # 10 - DANGER
4/26/96      12:09:36

>> LEVEL 5 ALARM <<<
VERY HIGH LEVEL ALARM
PROBABLY
HAZARDOUS MATERIAL

T: 12:09:16   BG: 2610
TH: 300000   IN: 0
HI: 325000   LO: 18730
P1: 5        P2: 0    SO : 1

-----
C BNV O1 2 3S16.8 DODCSLU
302 510 N301592 00004 2 NID3U
  
```

Fig. 7

3.3 ALARM TIMING

LOW ALARM - (labelled L1/L2)

IF A VEHICLE IS PRESENT : The system has determined that the radiation levels from the vehicle that has just left the detectors, are above the alarm threshold. If **LOW 1A** this means that the source is closer to detector A etc.

IF NO VEHICLE PRESENT : Alarm LOW Alarm L2 can occur with no vehicle present and in this case was caused by whatever was near the detectors at that time.

HIGH ALARM - Immediate alarms. Radiation levels have risen VERY significantly (labelled H3/H4) above normal background. These alarms are sounded immediately and therefore may relate to the vehicle that is between the detectors at the moment the alarm sounds or has just passed.

3.4 ALARM LEVELS - detailed explanation

- LOW 1A** - this is the MOST SENSITIVE alarm on the system and is only activated when a vehicle is passing through the detectors. The "A" means that the primary alarm occurred on the A detector.
- LOW 2B** - this is the next highest-level alarm with an Alarm Threshold and can occur EVEN IF NO VEHICLE IS PRESENT, if the local radiation background level significantly changes. The "B" means that the primary alarm occurred on the B detector.

Other sub labels are C/D = if C/D detectors are used, X/Y = special combination detector alarms and Z = Danger alarm.

- HIGH 3** - this alarm signifies a very significant increase in local radiation level
- HIGH 4** - this alarm level signifies that the local radiation level has increased so high that the detectors are registering their maximum count levels. However this is not necessarily hazardous (see below)
- LEVEL 5** - This Alarm Level is triggered **WHEN ALL SELECTED DETECTORS EXHIBIT A HIGH "LEVEL 4" ALARM**. Thus a **LEVEL 5** alarm indicates that the source is **PROBABLY** a HIGHLY RADIOACTIVE source in the vehicle and this alarm should be treated with GREAT CAUTION and personnel exposure should be limited.

3.5 ALARM LEVELS AND EXPOSURE LIMITS

Potential radiation levels and employee safety are the main considerations when designing alarm procedures. Alarm levels provide an indication of the amount of radiation emanating from the source that has triggered the alarm.

Typical local background radiation levels are typically 5-10µR/h (0.05-0.1 µSv/h). The following examples assume that the local level IS 5 µR/h (0.05µSv), and that the system is set with the recommended parameters. **Note that the levels listed below are actually the Exposure Rate AT THE DETECTOR FACE** and should NOT be considered as an EXACT measure of radiation for safety or hazard evaluation. (The actual buried source, if exposed by dumping the vehicle, will have much higher levels **when not shielded by the scrap cover**).

LOW = 0.5 - 50µR/h (0.005 - 0.5 µSv/h)

HIGH = 50 - 150µR/h (0.5 - 1.5 µSv/h)

DANGER = ALL DETECTORS ABOVE 150 µR/h (1.5 µSv/h)

The GR-526/510 is designed to detect very small changes in radiation levels so all of the system's components and data analysis algorithms have been optimized to meet this design objective. Due to these design requirements, the system "saturates" at radiation levels above 150 µR/h (1.5 µSv/h).

As a result, **any radiation level above 300 $\mu\text{R}/\text{h}$ produces a HIGH radiation alarm on the detector.**

Thus a **NOT very dangerous 200 $\mu\text{R}/\text{h}$ (2 $\mu\text{Sv}/\text{h}$)** source positioned close to 1 detector would probably give ONLY a **HIGH** alarm. However a **very dangerous 400,000 $\mu\text{R}/\text{h}$ (4 mSv/h)** source would give a **LEVEL 5** alarm.

3.6 ALARM PROCEDURES

Exploranium strongly recommends that users of the GR-526/510, develop a plant operating procedure that specifies the actions to be taken in the event of an alarm. These procedures should be developed under the guidance of a certified Health Physicist and in co-operation with local and state authorities.

The basic recommendations made in this manual can be used as the starting point for a procedure - however restrictions pertaining to handling, storage and transportation of radioactive materials vary widely.

Exploranium is NOT certified to act as a Health Physics consultant to fully advise users on correct methods of handling and regulation compliance, so it is essential that each user develop procedures that suit their specific circumstances and conform to all applicable laws.

The following simple procedures are recommended for confirming alarms and vehicle handling. Procedures for the investigation of vehicle contents and radioactive material disposal will usually be required, but must be developed independently.

LOW ALARM PROCEDURES - Alarm Level L1 and L2

After silencing the audio alarm, inspect the Alarm display and note the approximate location of the source of radioactivity. (The left edge of the screen is the START of vehicle and the right side is the END).

If the Printer is enabled, the alarm will also be printed. Press the **ALARM** button to return to normal monitoring mode.

TRUCKS - have the truck circle around and wait at least 15 ft. back from the detectors.
TRAINS - move the suspect car back at least 2 cars from the detectors.

When the vehicle is again positioned prior to the detectors, have it proceed forward slowly (maximum 3 mph) and continuously (no stops), through the detectors to verify that the alarm is activated a second time.

Review the Console Display and again note the approximate location of the source. Repeat this test a third time. If the second and third tests confirm the initial alarm, isolate the vehicle and follow local procedures for investigating the source of the radioactivity.

HIGH ALARM PROCEDURE - Alarm Level H3 and H4

After silencing the audio alarm, inspect the Alarm display and note the approximate location of the source of radioactivity. (The left edge of the screen is the START of vehicle and the right side is the END). If the Printer is enabled, the alarm will also be printed.

Press the **ALARM** button to return to normal monitoring mode.

It is recommended that the **HIGH** alarm vehicle be moved at least 100 feet from the detectors to allow monitoring of other vehicles to continue without interference. Follow local procedures for investigating the source of the radioactivity.

DANGER (LEVEL 5) ALARM PROCEDURE

Proceed on the assumption that a potentially hazardous source is in the vehicle

- move personnel (and driver) at least 100 ft away from the vehicle
- strictly control access to the area
- allow access only to qualified personnel
- immediately advise the RSO to verify the alarm and implement correct procedures

4.0 VIEWING ALARM DATA IN MEMORY

The GR-526/510 will store up to 30 typical alarms in memory, however VERY LONG alarms can limit the number of alarms stored. An alarm access password is built into the system to allow an authorized user to review stored alarms. This password is different from the Maintenance password. (See section 5.28)

The alarm password is: **<ENTER - 1 - 4 - 9 - 2 - ENTER>**.
Once entered, the following screen appears.

***** A L A R M S *****				
#	Date	Time	Level	Size
1	4-26-96	17:11:21	L1a	123
2	10-18-94	17:18:11	H2B	96
cc 3	11-22-94	11:01:22	D5Z	48

Select alarm, press ENTER to view

Fig. 8

- cc** - is a cursor used to select an alarm by using the UP and DOWN arrow
- #** - is a sequential # starting at 1 to label the alarm. This number increases to 99 then RESETs to 1
- Date** - is the Date that the alarm occurred
- Time** - is the TIME that the alarm occurred
- Level** - is the Alarm LEVEL. There are various data here as follows :
L2A - L = LOW level alarm - **2** = LOW Alarm L2
A(B) = primarily on detector A(B), **a** = Test Alarm
- H3A - H** = HIGH level alarm - **3** = Alarm Level 3
A = primarily on detector A
- D5Z - D** = DANGER alarm - **5** = Alarm level 5
Z = ALL detectors
- Size** - the number of samples for each vehicle analysis. This parameter is usually only useful to Exploranium.

Pressing "1" while viewing this display will print a listing of the alarms in memory on the internal printer. The ARROW keys are used to select an alarm then pressing **<ENTER>**, displays the actual data from the Alarm as described in section 3.1. If **<1>** is pressed the alarm is printed in the format described in Section 3.2.

5.0 PARAMETER SETTINGS

System Parameters are set during installation, and under normal operating conditions do not require adjustments. **Modification to these parameters may result in seriously degrading system performance.** To restrict access to the system parameters, they are Password protected. The system parameters Password is set at installation, and is provided to the user at that time. If parameters need changing to suit local logistic problems or to enable/disable special system features, please discuss with Exploranium.

SPECIAL NOTE : ALL PARAMETERS WILL BE SET BY THE EXPLORANIUM ENGINEER AT SYSTEM START-UP. ANY CHANGE TO THESE PARAMETERS MAY DISABLE SYSTEM OPERATION. PLEASE CONTACT EXPLORANIUM BEFORE CHANGING ANY SETTING ON THE GR-526/510 SYSTEM

APPENDIX A - "NUISANCE" Alarms

From practical experience, as the acknowledged leader in vehicle monitoring technology with an installed base of more than 500 units, over the last 8 years a large variety of practical problems have been experienced. The GR-526/510 systems have been extensively modified over the years to "solve" most of these problems but it is impossible to prevent certain spurious alarms. These alarms are not **FALSE ALARMS** because they are REAL alarms as far as the system is concerned, however to the user they are NOT the big shielded source that is the REAL danger. However in most cases they have the same characteristics as a REAL alarm, so for this reason they are defined as NUISANCE alarms. Any monitoring system with enough sensitivity to detect deeply buried shielded sources will suffer from these NUISANCE alarms, as there is no technological way to prevent them occurring (however sophisticated data processing in the GR-526/510 limits many of these effects) - because such a system sees the REAL and NUISANCE alarms as the same. Thus any serious attempt to prevent these NUISANCE alarms will impair the systems ability to detect REAL alarms, so they must be lived with. As a guide to users the following types of NUISANCE alarms are common :

(a) CONTAMINATED PIPE

Contaminated Pipe - is usually steel pipe that has been used in the Oil or Potash industries and has a "scale" on the inside of the pipe that contains radioactive material - usually Radium or Thorium. This scale is usually of a low enough radiation level to be safe to handle, and if melted in the furnace would "disappear" WITH NO MEASURABLE EFFECT ON THE ENVIRONMENT or STEEL PLANT. Unfortunately this pipe typically has a RADIOACTIVE SIGNATURE that is often identical to a REAL shielded source. The MAJORITY of material detected by the GR-526/510 will usually be this pipe material BUT IF THIS IS NOT DETECTABLE, NEITHER IS A REAL SOURCE. Some users have agreed to sort a rejected vehicle load to isolate such pipe and some jurisdictions permit the melting of controlled amounts of this contaminated pipe. However the majority of users prefer to reject the load and "make it somebody else's problem", an understandable sentiment.

(b) "MEDICAL" ALARMS

Some plant personnel may receive special medical treatment involving radioactive tracers (Barium enema etc). For the next few days after this treatment they act as a radiation "source" to the GR-526/510 system. Even though such radiation is low level it can often be enough to set the alarms off. This particular type of alarm is very aggravating as it is so variable. For example if such a human "source" passed near the detectors WHEN A VEHICLE WAS PASSING, the system user would assume that the vehicle was the alarm.

If the vehicle is retested and NO alarm occurs the user could assume that a FALSE ALARM had been generated.

These "medical" alarms can only be isolated by common sense procedures such as restricting personnel near the system during retesting etc.

PARTIALLY LOADED VEHICLES

If a vehicle contains a variable density load of scrap then another type of NUISANCE alarm can occur. For emphasis, the following is an exaggerated example of this problem to permit the user to clearly understand this problem.

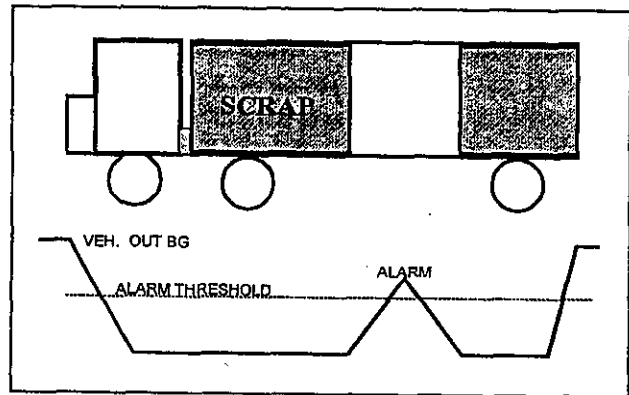


Figure 9

The GR-526/510 system will identify and suppress the vast majority of such "nuisance alarms" but very occasionally such "strange" alarms may occur.

(d) X-Ray GAUGING SERVICES

In the last few years we have seen many alarms caused by an X-ray crew who are crack testing steel and concrete pipes. This is a common service and involves shooting a high intensity narrow beam of radiation FOR A VERY SHORT PERIOD at the material and illuminating an X-ray plate looking for cracks.

Unfortunately if such a beam is bore-sighted at one of the GR-526/510 radiation detectors - even though such a source may be more than **ONE MILE** away the GR-526/510 CAN ALARM. These alarms can also occur WHEN NO VEHICLE IS PRESENT, unless parameters are adjusted to prevent this.

Normally such alarms are easy to identify as they are quite narrow (typically 1 second) and will of course NOT re-occur when the vehicle is re-tested (unless by an incredible coincidence). This problem is often solved by arranging with local X-ray service groups, that they will notify GR-526/510 users when they are in the vicinity!

(e) MISCELLANEOUS MATERIAL ALARMS

FIREBRICK used to line furnaces has a significant Thorium content and a vehicle loaded with firebrick will usually cause the system to alarm.

CALUMITE is a powder material made by grinding slag etc. This material contains trace amounts of Uranium, Potassium and Thorium and if a large volume is loaded into a vehicle will probably alarm the system.

CONCRETE - concrete usually contains trace amounts of Potassium and if in significant volume in a load can cause the system to alarm.

DUST - some users have reported alarms on hot baghouse dust. If the load is allowed to cool then the system will not alarm as they pass. This is a result of a short-lived isotope THORON which is derived from Thorium material.

Furnace Dust often contains low levels of URANIUM and THORIUM from various sources and if these levels are high enough an alarm can occur. Spectrometer sampling can be used to confirm this situation. Note new **Dust Parameter** to improve system response.

OTHER MATERIALS - that can cause alarms:

- s Alum (Aluminum sulfide)
- s Bonding Mortar
- s Bonding pour tile
- s Ceramics
- s Corrosive solids
- s Fiberboards
- s Fire brick
- s Fire clay
- s Fluidox 141
- s Industrial ceramics (such as nozzles and sleeves)
- s Insulation
- s Ladle brick
- s Oxytherm R1
- s Potassium Permanganate
- s Pyro block
- s Refractories
- s Liquid Petroleum Gas (often contains Radon)

NOTE - some of these materials can contain naturally occurring radioactive material but in volume may create enough of a "radioactive source" to cause a sensitive system to alarm. However it is CORRECT that the system should alarm as in these cases it IS radioactive material.

APPENDIX D - SPECIAL SYSTEM PASSWORDS

The system has a variety of reserved Passwords as listed below. If the user selects one of these as their Maintenance password, the system will not accept the data and a different Password must be selected.

1492 to access stored ALARM DATA - see Section 4

1590 reserved

2580 reserved

3214 to select special test mode - see Appendix N

4697 reserved

5555 reserved

7171 reserved

8741 reserved

9191 to access the HISTORY FILE - see Section 6.3

9999 to print CURRENT PARAMETERS - see Section 6.6

APPENDIX K - RECOMMENDED MAINTENANCE PROCEDURES

The following operational procedures are applicable to any Exploranium Radiation Monitoring system but Manual references are for Manual 2V16.

1. SET UP A SCALE LOG BOOK for each system (mark Serial #) and specify that the Scale Operator record (at a MINIMUM) the following data for EACH alarm and any system errors :

Date	Time	Alarm#	Alarm level	User actions	Signed
5/9	11:05	21	1A	Ran truck through again	
5/9	11:08	22	1A	Ran truck through again	
5/9	11:11	23	1A	3 alarms confirmed - Notified Mr. that truck rejected	
5/11	13:25	25	1b	Test Alarm - Maintenance	
5/12	14:22	Error		OS error, notified Maintenance	
etc					

Such a log permits :

- the Radiation Safety Officer (RSO) to have a record of all actions taken. Using a regular full Alarm printout (see below) they can ensure that ALL alarms were handled correctly - and investigate errors
- show that the user is responding correctly to system errors and notifying Maintenance as required
- show that someone (Maintenance?) Is carrying out regular Test alarms to ensure that the system is functioning correctly

2. SET UP A MAINTENANCE LOG BOOK for each system - mark each with the appropriate SERIAL #.

Enter in the LOG BOOK - the date of installation and after the installation is OK, printout Current Parameters (STANDARD) - see Manual Section 4.12 - and glue/tape into the book

It is highly recommended that as the various tests are carried out on the system, that sequential (dated) notes are kept in the logbook. Also regular Test Alarms - Parameter + History printouts etc. should be glued into this logbook thus providing an invaluable record of system performance and a reference guide to track persistent problems.

3. DAILY SYSTEM CHECK - MINIMUM actions by SCALE personnel

1	Inspect the display and ensure that the Yellow STATUS button is NOT flashing. If it IS flashing note the Errors on the display and call Maintenance
2	Inspect the display and ensure that Date and Time are correct - if Date/Time have changed significantly - notify Maintenance

4. WEEKLY SYSTEM CHECK - MINIMUM actions by MAINTENANCE

1	Check OS alignment - ensure that all OS Receivers have a "fast pulsing" light (2 flashes/sec - slower is bad) - mark in log as a record
2	Check that Date/Time are set correctly - a significant change could indicate that DEFAULT parameters have been loaded due to RAM error
3	Print out Current Parameters and compare to normal parameters printed in the LOG BOOK - glue in log as a record
4	Carry out a SENSITIVITY CHECK - as per Appendix N. Inspect and glue in logbook as a record

APPENDIX N - SYSTEM TESTING

GENERAL - Many users want to test their GR-526/510 systems on a regular basis. Exploranium strongly recommends this practice as a means of ensuring system performance is being maintained correctly. The following procedures are recommended for correct performance monitoring.

The basic testing method involves placing a Test Source on the face of the detector and then noting the change in count rate on the console. The system provides a data printout of the results that can be used to check system performance on a regular basis.

SYSTEM TESTING - (Minimum MONTHLY - recommend Daily or Weekly)

In this procedure a special test source is used in a fixed location on each detector. A 30 second reading is taken for each detector with and without the test source. This process is semi-automatic and requires only 1 person to carry out the test. At the conclusion of these tests the SOURCE data is corrected for background and the system printer is used to provide a hard copy. This test procedure should take only 2-3 minutes for a 2-detector system and provide very repeatable data for system performance analysis.

SPECIAL SOURCE MOUNTS

After various requests from users for a SIMPLE, REPEATABLE test, Exploranium has constructed a special "source holder" that must be glued in place at the required place on the detector face. These holders are made of steel and the supplied special Test Source has magnets in it so it will stay in place in the source holder. The reason for this holder is that for repeatable results, at least a 30 second sample must be made at each source location and it is extremely difficult to hold the source at a fixed location manually for this period of time.

New detectors are supplied with these source holders installed but older systems can be upgraded using the **SOURCE-HOLDER KIT** (PN 93610) available as an optional item from Exploranium and this kit includes:

- 2 - steel source holders (1/ detector)
- 1 - magnet equipped Test Source

NOTE : IF THIS TEST IS CARRIED OUT WITHOUT USING THE SOURCE HOLDERS FOR PRECISE POSITIONING - THE TEST WILL WORK CORRECTLY BUT THE DATA MAY NOT BE REPEATABLE FROM TEST TO TEST DUE TO CHANGES IN THE SOURCE POSITION.

SOURCE

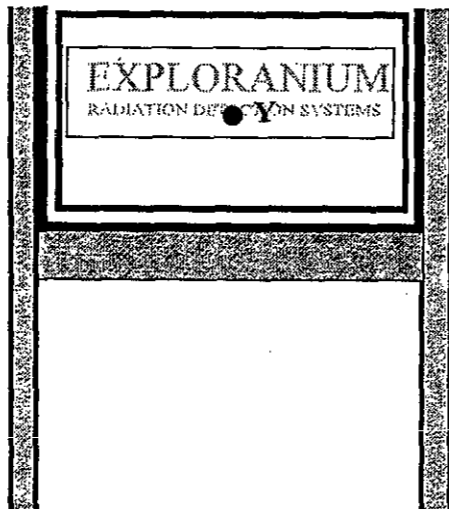
To get repeatable data it is very important that the SAME source be used for each test and that the source is placed the SAME way up every time. (The test source has a slightly different performance if placed face-up or face-down on the detector). Note the "magnet-equipped" Test Source is colour-marked to ensure it is not confused with the "normal" Test Source.

SOURCE POSITION

It is important that the test source be positioned on the detector at the same place each time. If the source position is very repeatable then the test data results can also be used to assess system performance over the long term.

The optimum Test Source location is shown at point Y in Fig. 10.

Each detector box actually has 2 detectors inside it and for best results the external source should be positioned to give approximately the same response from each detector. The GEOMETRIC centre of the detectors is usually the correct location but in some cases due to internal mechanical variations in the detector, this centre position is a poor choice. The recommended method is to temporarily attach the source mount and carry out the following Test Procedures, then inspect the results to determine if the selected location is OK. The best performance is if the Test Source signal (**SIG** in Fig. 11) is approximately equal on the 2 detectors in each box (+/- typically 10%). This is easily checked by repeating the procedure for various source holder locations, until the best location is determined. Once the correct location is found the source ring should be glued in place.

**TEST PROCEDURE**

1. Ensure that no vehicles will pass through the system in the 4-5 minutes normally required to test the system as this procedure disables system monitoring.
2. Ensure that there are no vehicles parked in front of the detectors and preferably none within 30 ft (10m). These test results are often used for comparative system analysis and so it is important not to distort the data by passing vehicles influencing local background results.
3. Enter Password **3214** (best method is **<Enter 3 2 1 4 Enter>** - slowly) :
NOTE : a 3 minute timer is started once this Password is entered, if 3 minutes pass **with no user action** this test procedure will automatically terminate to ensure that the system cannot be left in the test state.

ACTION : System is ready to start the Test
 DISPLAY **SENSITIVITY TEST** (at the top)
RUN = start STOP=exit
 TRAFFIC LIGHT : RED = **ON** - all others OFF

4. The user should ensure no vehicles are nearby and no one is walking between the detectors - then press **RUN**

ACTION : 30 second background average is being computed
 DISPLAY **Background meas**
xx (xx starts at 30 secs and counts down)
 TRAFFIC LIGHT : RED = **FLASH** - all others OFF

5. At the end of this time the audio will "beep" 3 times and :
 ACTION : System has stored background and is ready for source tests.
 DISPLAY **SENSITIVITY TEST** (at the top)
RUN = start STOP=exit
 TRAFFIC LIGHT : RED = **ON** - all others OFF
6. Locate the magnet test source - and press **RUN** :
 ACTION : System is waiting for a test source - user has 3 minutes to place the source on any detector
 DISPLAY **SENSITIVITY TEST** (at the top)
A B (also C,D etc. if installed)
 TRAFFIC LIGHT : RED = **ON** - all others OFF
7. The user must now take the special magnetic Test Source and place it on ANY detector in its special holder, **then stand back clear of the detectors**. The program can recognize which detector has the source in place and as soon as this identification is complete, the test of that detector begins.

As an example place it on the **B** detector first :

ACTION : **B** detector data is being analysed.
 DISPLAY **Source B**
xx (xx = 30 secs and counting down)
 TRAFFIC LIGHT : RED = **FLASH** - all others OFF

8. When the Traffic Light goes from **FLASHING** to **STEADY**, move the source to the next detector.

If NO Traffic Lights are installed - use a watch and wait 45 seconds after the source is firmly in place before retrieving it and moving it to the next detector.

NOTE : If somehow the source is removed by accident before the 30 second accumulation is complete, just place it back in place and the test will be restarted on that detector.

If you moved it to the **A** detector :

ACTION : **A** detector data is being analysed.
 DISPLAY **Source A**
xx (xx = 30 secs and counting down)
 TRAFFIC LIGHT : RED = **FLASH** - all others OFF

9. When all detectors have been tested the Traffic light will change briefly to RED.

Remove the source and return to the console.

NOTE : As each detector test is complete, it's label will be erased from the console display screen. If somehow the user did not test a detector - it will still be displayed on the screen and it can be immediately retested.

10. The system printer should produce a printout in a few seconds, then the Test is complete. During this time :
TRAFFIC LIGHT : YELLOW = **ON** all others OFF

11. When all is complete (a few seconds) :
TRAFFIC LIGHT : GREEN = ON all others OFF

12. The test printout appears as shown in Fig. 11. Users should use the SIG data only as this is the data from the SOURCE after BACKGROUND has been removed (SIG=Src-BACKGROUND).

The **SIG** data should be accurate typically better than +/-10% or better from test-to-test, but this depends on local conditions. When this testing system is first implemented Exploranium suggest that it be repeated 4 times in 1 week and the data discussed with Exploranium to select a reasonable estimate of probable repeatability.

SENSITIVITY TEST #9999		
3/26/97		12:09:13

Detector	BG	6122
A	Src	23848
	A1/A2	96
	SIG	17726
Detector	BG	5352
B	Src	18199
	B1/B2	97
	SIG	12847

Fig. 11

THE SYSTEM IS NOW READY FOR NORMAL OPERATION.

NOTES :

- Discuss the data with the Service Department if any strange effects are noted.
- Careful recording of these data on a regular basis will provide a reasonable estimate of system long-term performance. Some ageing of the system with time will probably be seen but this should typically be less than 5-10%/year. Data changes significantly greater than this would suggest premature failure of some components - please discuss with the Service department if this occurs.