



rad-D

INSTRUCTION MANUAL

Part Number DT2705-01

rad-D

Operating Instructions

General Description

The rad-D system has been designed as a “stand-alone” user-friendly Gamma ray detector for use in package inspection areas and portals. It has been optimized to operate in the immediate vicinity of luggage-type X-ray machines. This system requires no operator intervention unless a radioactive source is found. It is rugged and easy to use with minimal training required.

The small operator information panel may be mounted remotely from the detector itself. An audio alarm as well as a visual alarm indicator has been provided so that the operator need not watch the display under normal circumstances. The system is powered from 110VAC, 60 Hz but can be configured to operate from 208 VAC, 50 Hz power as well.

Theory of Operation

The rad-D is a very sensitive Gamma detector system designed to be mounted on X-ray machines whose emission energy is less than 200 keV. (X-rays and Gamma rays are both photons and as such will be detected.) The rad-D is mounted in a lead lined collimator where it is recessed 3 inches from the end of the case. This arrangement gives the rad-D a field of view of approximately 45° from the centerline. Limiting the field of view to 45° reduces the number of stray X-rays which enter the detector while focusing on the item to be screened. There is approximately 25 pounds of lead in the rad-D used for shielding.

The rad-D detector is a 3” diameter by 2” thick sodium iodide crystal mounted on a 2” photomultiplier tube. The detector is mounted in a .5” sleeve of thermally insulating material to prevent thermal shock or mechanical shock from damaging the detector.

System Description

A rad-D system consists of the detector unit and the display unit which are connected to each other by means of a cable. The detector unit is a right cylinder weighing approximately 30 pounds. There are two circular military-style connectors mounted on the rear of the housing: 110 VAC and serial communications connectors. This assembly is sealed and is waterproof.

The operator’s display unit is housed in a black plastic splash-proof enclosure. This unit is cabled directly to the detector unit. There is a red LED single-digit **ALARM LEVEL** display mounted on the front of this unit. The ALARM LEVEL denotes how strong the radiation is. The rad-D unit is calibrated to read from level 1 to level 9 with level 9 being the highest level of radiation detected.



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Upon application of power a repetitive sequence will be displayed for approximately one and a half minutes. After successful power on, two “beeps” will be heard and the **System OK** light will begin flashing.

The highest alarm level encountered will be held by the display so that the operator will know how strong the radioactive source that triggered the alarm is. The display can be cleared by pressing the **reset** button. The audible alarm only sounds while the radioactive material is activating the detector. The intensity of the sound will vary proportionately with the strength of the radioactive source.

There is a flashing green **System OK** light which flashes approximately once per second during normal operation. An acoustic alarm is also mounted on this panel. Whenever an alarm condition is encountered, an audible signal is given to alert the operator. The level of the audio alarm can be adjusted but cannot be turned off so that there will always be a minimum audible alarm.

The **On/Off** switch is to be used to disable the unit in the event of a malfunction of the unit. This switch will prevent the audible alarm and the Alarm Level display from functioning.

Power On Operation

When power is applied, the rad-D begins a 1.5 minute warm-up sequence. The red LED display should begin repeating a pulsating XXXX. During the last half minute of this warm up period, rad-D measures the background radiation present. At the end of this period, the LED display should show a periodically flashing line. In addition, the green **System OK** LED should be flashing approximately once per second. If any other messages are displayed, refer to the problems section of this document.

If the unit fails to operate properly after application of power, check that the unit is plugged into an active AC power outlet and that all connectors are securely fastened. Also, the circuit breaker on the front of the panel must remain in the “in” position to power the rad-D.

Error Codes

rad-D continuously checks itself for operational problems. Whenever a problem is detected, the operator is notified via the LED display and audio alarm. The following error codes are given:

1. Detector or high voltage failure = **flashing “H”**.
2. Serial communications failure = **flashing “S”**.
3. Microprocessor failure = **flashing “C”**.
4. Detector Failure = **flashing “U”**.



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Note that if the unit is powered on while there are X-rays present, it is possible for the scattered X-rays to be counted as part of the natural background. When the X-ray scatter stops, the rad-D system then “thinks” that the natural background level has fallen significantly (which is quite unlikely) and therefore flags an error condition of too few counts.

Operators Instructions

rad-D is designed to be used for screening packages and cargo for radioactive content during normal X-ray screening procedures. While it is designed to detect very small amounts of radioactive material, rad-D can also provide a safety warning to operators when highly radioactive parcels are being handled. All packages which generate an alarm should be investigated. Dangerous special nuclear materials and nuclear weapons being smuggled may not emit high levels of radiation if they have been adequately shielded.

False alarms due to X-rays may occasionally be generated. For an alarm level of 3 or less, the package should be placed immediately in front of the detector with the X-ray machine inactive. If an alarm is still generated, the parcel contains radioactive material and should be treated as such. If the alarm is no longer present, the alarm was caused by X-ray scatter.



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