

**LUDLUM MODEL 25 AND 25-1
PERSONAL RADIATION MONITOR
USER'S MANUAL**

October 2014

**Serial Number 25000100 and Succeeding
Serial Numbers**

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LUDLUM MEASUREMENTS, INC
501 OAK STREET, P.O. BOX 810
SWEETWATER, TEXAS 79556
325-235-5494, FAX: 325-235-4672

STATEMENT OF WARRANTY

Ludlum Measurements, Inc. warrants the products covered in this manual to be free of defects due to workmanship, material, and design for a period of twelve months from the date of delivery. The calibration of a product is warranted to be within its specified accuracy limits at the time of shipment. In the event of instrument failure, notify Ludlum Measurements to determine if repair, recalibration, or replacement is required.

This warranty excludes the replacement of photomultiplier tubes, G-M and proportional tubes, and scintillation crystals which are broken due to excessive physical abuse or used for purposes other than intended.

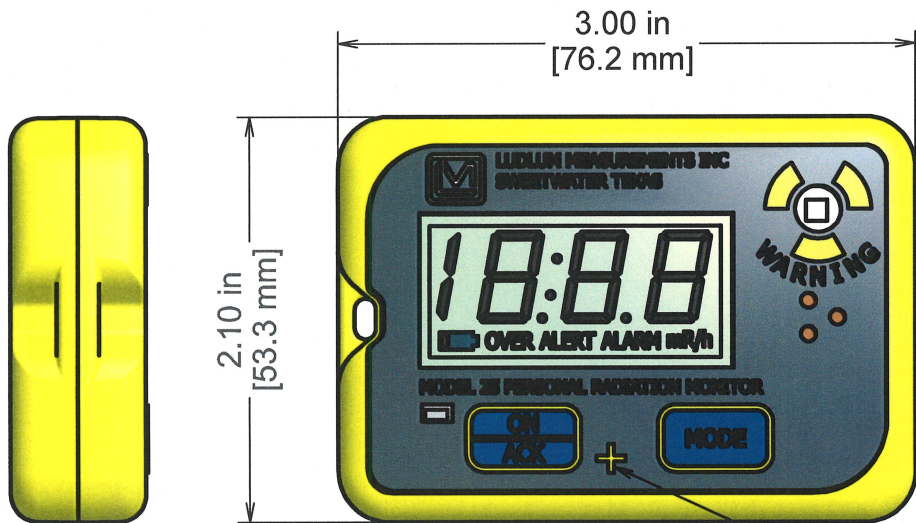
There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face there of. If the product does not perform as warranted herein, purchaser's sole remedy shall be repair or replacement, at the option of Ludlum Measurements. In no event will Ludlum Measurements be liable for damages, lost revenue, lost wages, or any other incidental or consequential damages, arising from the purchase, use, or inability to use product.

RETURN OF GOODS TO MANUFACTURER

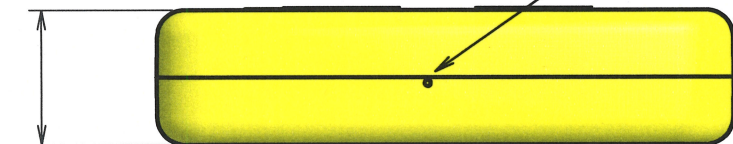
If equipment needs to be returned to Ludlum Measurements, Inc. for repair or calibration, please send to the address below. All shipments should include documentation containing return shipping address, customer name, telephone number, description of service requested, and all other necessary information. Your cooperation will expedite the return of your equipment.

**LUDLUM MEASUREMENTS, INC.
ATTN: REPAIR DEPARTMENT
501 OAK STREET
SWEETWATER, TX 79556**

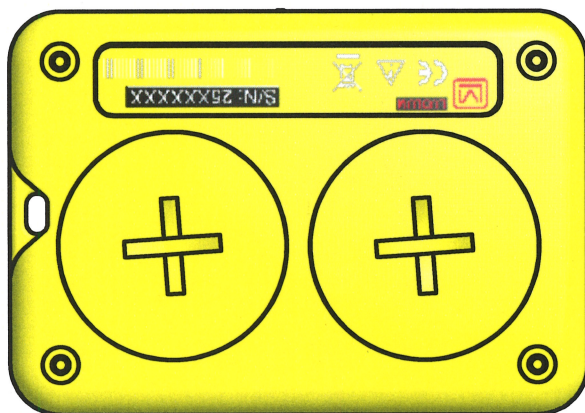
**800-622-0828 325-235-5494
FAX 325-235-4672**



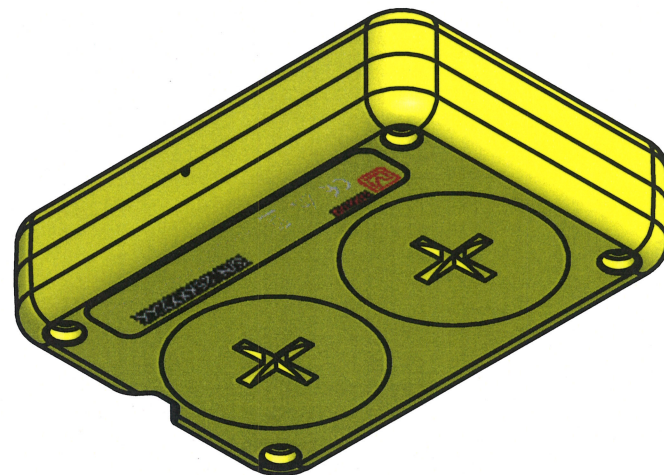
DETECTOR
CENTERLINE



0.70 in [17.8 mm]



| REVISION HISTORY | | | |
|------------------|--|-----------|----------|
| REV | DESCRIPTION | DATE | APPROVED |
| 1 | VALID | 7/12/2007 | RHS |
| 2 | CHANGED SCREWS FROM 17-8501 TO 17-8777 | 3-19-08 | RHS |
| 3 | MODIFIED NOTES | 3-28-08 | RHS |
| 4 | SEE ECF 2519 | 2/8/12 | MSC |



| | | | | | |
|--|---------|-----|---------------|---|---------|
| DWN | DATE | CHK | DATE | APP | DATE |
| TMM | 7/20/12 | | | <i>[Signature]</i> | 7-20-12 |
| DWG NUM: 4498-137 | | | | SCALE: FULL <input checked="" type="checkbox"/> OTHER | |
| TITLE M 25 RADIATION MONITOR | | | | | |
| LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556 | | | SERIES 498 | SHEET 137 | |

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Section

1

Introduction

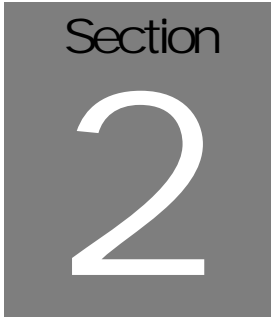
The Model 25 and 25-1 is a personal radiation detection and warning instrument. The instrument features a large backlit LCD (liquid crystal display), a bright (daylight-visible) warning light, and a piercing audio warning. The unit body is made of lightweight but durable plastic and can survive brief immersion in water. The Model 25 may be clipped to a belt or worn around the neck with a lanyard.

The Model 25-1 readout is in mSv/h or Sv/h, whereas the Model 25 readout is in mR/hr or R/hr. This being the only difference between the two, this manual will refer to the two instruments as “Model 25.”

The detector inside the Model 25 measures gamma radiation up to 999 R/hr (9.99 Sv/h). The display, which normally shows exposure rate, will also display total accumulated dose, and time remaining. In an alarm situation, the display (automatically backlit if light levels are dim) rotates every two seconds among the three displays: exposure rate, accumulated dose, and time remaining. Thus, in an emergency situation, a responder can be warned of the radiation level and informed of the time remaining before their maximum allowed dose is reached.

Setup of the instrument is accomplished also through the front-panel buttons. The advanced user or administrator can set ALERT and ALARM levels (both exposure rate and accumulated dose), change calibration parameters, and zero the total accumulated dose within the setup routine.

The unit is operated with two coin cell batteries for operation from -40 to 65 °C (-40 to 150 °F). Battery life should be approximately 6000 hours under non-alarming conditions. A low-battery indicator on the LCD warns when less than eight hours of battery life remain.

A dark gray square graphic with the word "Section" in a small, white, sans-serif font at the top. Below it is a large, white, stylized number "2".

Getting Started

Unpacking and Repacking

Remove the calibration certificate and place it in a secure location. Remove the instrument and accessories (lanyard, case, etc.) and ensure that all of the items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match. The Model 25 serial number is located on the back panel below the battery compartments.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment.

Every returned instrument must be accompanied by an Instrument Return Form, which can be downloaded from the Ludlum website at www.ludlums.com. Find the form by clicking the "Support" tab and selecting "Repair and Calibration" from the drop-down menu. Then choose the appropriate Repair and Calibration division where you will find a link to the form.

Battery Installation

Open each battery lid by using a large coin or screwdriver to unscrew (counter-clockwise) the two round battery holders on the back of the instrument. Remove the two old batteries, and replace with new batteries. Ensure that both batteries have the plus (+) sign facing outwards. Screw each battery holder clockwise until the holder is flush with the case. Battery replacement may be done by the user, and is not considered a reason for recalibration.

Instrument Operational Test

Turn the instrument ON by pressing the ON/ACK button for about a second, and then releasing. The instrument should activate all the LCD segments, the audio, and the warning light. It then displays a version number before displaying the current exposure rate, normally 0.0 mR/hr (or .000 mSv/h).

Ensure that the low-battery indicator is not present. If the low-battery indicator is present, replace the batteries as soon as possible. Under extremely low battery conditions, be aware that the unit may not even turn on, or may turn itself off abruptly.

If possible, expose the detector to a source of radiation. Small check sources of radiation are available from Ludlum Measurements. While exempt from many regulations because of their small size, these sources are large enough to produce a response on this instrument. The detector's position is marked by the small plus (+) sign on the front panel of the Model 25. A typical 1 μCi (37 kBq) ^{137}Cs check source will produce an exposure rate of approximately 3 mR/hr (.003 mSv/h). If this procedure is done routinely with the same radiation source, instrument malfunction may be detected when anomalous readings are observed.

A reference reading with a check source should be obtained at the time of calibration or at the time the instrument is received in the field. If at any time the instrument fails to read within 20% of the reference reading when using the same check source, it should be sent to a calibration facility for recalibration and/or repair.

Note that the Model 25 has its own diagnostic tests to ensure that the detector is functioning correctly. The Model 25 can detect when the radiation detector is malfunctioning and will flash "0.0 mR/hr" (.000 mSv/h) with "F," the warning audio, and the light to indicate a detector malfunction. If this indication is observed, remove the unit from service and have it evaluated by a qualified repair and calibration technician.

Once this procedure has been completed, the instrument is ready for use.

Instrument Use and Controls

With only two front-panel buttons, the Ludlum Model 25 is simple and easy to use with minimal training required. Under typical use, the display shows just the current exposure rate. Whenever the MODE button is pressed, or during an ALERT or ALARM condition, the display rotates among the exposure rate, the total accumulated dose, and the time remaining (in hh:mm format). The additional display modes may help the user to decide how long to stay in a high-radiation area.

See the Model 25 front-panel drawing at the beginning of this manual to reference the following two controls:

ON/ACK button: Used to power the Model 25 ON and OFF, and acknowledge audio on alerts and alarms.

- ON: Press for approximately one second and release (all LCD segments will activate, and firmware version will be shown).
- OFF: Press for approximately five seconds (audio will beep and LCD will clear).
- ACK (acknowledge): Will silence audio during an ALERT or ALARM condition, but in an ALARM condition the audio will continue to be activated once every 60 seconds to remind the user.

MODE button: When pressed under non-alarm conditions, the display rotates between the total accumulated dose, the time remaining, and back to the normal exposure rate display. If the light is very dim, pressing the MODE button will also turn on the backlight while the display cycles among the three display modes.

The Exposure Rate (main active screen) at typical background radiation levels shows a number similar to 0.04 mR/hr. Figure 1 (on the following page) also shows the low-battery icon.

Figure 1: The Exposure Rate Screen shows typical background radiation rate and the low-battery icon.



Zeroing Accumulated Dose: In order to “zero” the accumulated dose, the user must enter the setup mode, and then not press any other buttons. The parameters will change every four seconds, and the unit will return automatically to the normal mode after the last parameter is presented. The accumulated dose has now been reset to zero.

The Accumulated Dose screen is shown in Figure 2. 80.5 R is a significant dose, and thus Figure 2 also shows the ALARM indication.

Figure 2: Accumulated Dose Screen with ALARM indicator



The Time Remaining screen shown in Figure 3 displays 10 hours and 30 minutes (10:30) remaining before the user receives the maximum allowed accumulated dose. An ALERT indication is also shown in Figure 3.

Figure 3: Time Remaining Screen with ALERT indication



OVER icon: Whenever the calibrated range (9.99 Sv/h or 999 R/hr) is exceeded, the OVER icon is activated. This is to alert the user that the Model 25 Radiation Monitor is out of range. The display will also flash the maximum displayed value (9.99 Sv/h or 999 R/hr).

Distinguishing ALERTs and ALARMs

There are four independent radiation alarms:

Exposure Rate ALERT: distinguished by the word ALERT in the exposure rate display and a slow, single beep of the audio.

Exposure Rate ALARM: distinguished by the word ALARM in the exposure rate display and a fast, single beep of the audio.

Accumulated Dose ALERT: distinguished by the word ALERT in the accumulated dose display and a slow, double beep of the audio.

Accumulated Dose ALARM: distinguished by the word ALARM in the accumulated dose display and a fast, double beep of the audio.

Note that an ALARM condition will override a lower priority ALERT condition.

The audible alarms consist of a single frequency tone and are easily distinguishable from the Personal Alert Safety System (PASS) alarms typically worn by firefighters.

Section

3

Specifications

Detector High Voltage: internally fixed at 550 Vdc

Linearity: reading within 10% of true value within calibration range

Accuracy: within 10%

Angular Response: <25% deviation from ^{137}Cs response, detector axis parallel to field

Gamma Response: typically 18 cpm per mR/hr (1800 cpm per mSv/h)

Beta Response: typically <0.10 mR/hr (< .001 mSv/h) with a 101 kdpm ^{90}SrY beta source on contact

Neutron Response: typically 0.3 mR/hr (.003 mSv/h) in a 10 mrem/hr (0.1 mSv/h) neutron field from a brass shielded Am-Be source

Response Time: varies by exposure rate, faster response times with high exposure rates; normally under 10 seconds from <1 to 10 mR/hr (0.1 mSv/h), 2 seconds or less from <1 to 50 mR/hr (0.5 mSv/h)

Energy Dependency: within 15% of true value (60 keV to 3MeV)

Maximum Accumulated Dose: limited by display, 999 R for the Model 25 and 9.99 Sv for the Model 25-1

Display: backlit 1.3 cm (0.5 in.) digits with readings from .001 to 999, or from 00:01 to 19:59 in hours/min format, indications of (m)R(/hr), (m)Sv(/h), ALERT, ALARM, a low-battery symbol, and OL (over limit)

Display range: **for Model 25:** 0.01 mR/hr to 999 R/hr

for Model 25-1: .001 mSv/h to 9.99 Sv/h

Calibrated range (exposure rate): normally calibrated from 2 mR/hr (0.02 mSv/h) to 999 R/hr (9.99 Sv/h)

Self-Diagnostics: If no pulses are received from the detector in 60 minutes, instrument failure is indicated by an audible and visual alarm, and the display alternating between "0.0" and "F."

Battery Dependence: less than 3% change in readings to battery failure indication

End-of-Battery Life Warning: At approximately 2.3 Vdc, the low-battery symbol is displayed on the front-panel LCD, indicating that eight hours of use remain. Below 2.0 Vdc, the unit may abruptly turn off (blank the display).

Calibration Controls: Front-panel buttons provide setup routine to view or change ALERT and ALARM setpoints, calibration constants, and to zero the accumulated dose.

Audio: built-in speaker with a typical intensity of 95 dB at 30.5 cm (1 ft) at a frequency of 3.5 kHz

Power: two DL2450 (NEDA/ANSI/IEC #5029LC) coin cell batteries housed in two externally accessible compartments

Battery Life: typically 6000 hours under non-alarm conditions

Size: 7.6 x 5.4 x 1.7 cm (3.0 x 2.1 x 0.69 in.) (H x W x thickness)

Weight: 144 g (5.1 oz), including batteries

Temperature Range: -40 to 65 °C (-40 to 150 °F)

Construction: injection-molded plastic body

Note: This instrument is not intended for measuring of background levels of radiation.

Section

4

Calibration and Changing Parameters

Warning!

Only advanced users or administrators should consider changing any of the parameters in the following section. Incorrect settings could jeopardize the safety of users depending on this instrument.

Calibration Overview

Your instrument has been shipped from Ludlum Measurements only after passing electronic checkout, a 30-hour burn-in process, and a careful calibration process. Calibration papers are supplied with each instrument shipped from Ludlum Measurements.

Recalibration should be accomplished after maintenance or adjustments have been performed on the instrument. Recalibration is not normally required following instrument cleaning or battery replacement. Recalibration does not require any special tools or software to perform.

Ludlum Measurements offers a full-service repair and calibration department. Not only do we repair and calibrate our own instruments, we also service most other manufacturers' instruments. Calibration procedures are available upon request for customers who choose to calibrate their own instruments.

Note:

Ludlum Measurements, Inc. recommends recalibration at intervals no greater than two years, assuming that regular operational checks are performed. Check the appropriate local, state, and federal regulations to determine required recalibration intervals.

Note: Calibration of the Model 25 requires a gamma radiation source (typically ^{137}Cs that is traceable to a national standard or other suitable reference, and can produce radiation fields from 2 mR/hr (0.2 mSv/h) to 800 R/hr (8 Sv/h). Before calibrating the instrument, the user may wish to adjust the ALERT and ALARM setpoints to 999.

Entering SETUP Mode and Changing Parameters

Calibration involves the changing of parameters, accessed via the SETUP mode. The following parameters are adjustable to suit the user's needs (default values are in parentheses). Radiological alert and alarm parameters are values recommended by the National Council on Radiation Protection and Measurements (NCRP).

- Rate Alert (10 mR/hr) (0.1 mSv/h)
- Rate Alarm (10 R/hr) (0.1 Sv/h)
- Dose Alert (10 R) (0.1 Sv)
- Dose Alarm (50 R) (0.5 Sv)
- Calibration Constant (300 cps/R/hr) (300 cps per 0.01 Sv/h)
- Dead Time Constant (30 μsec)
- Series Constant (285)

NOTE: Successful completion of the SETUP mode also zeros the accumulated dose. Powering down (by pressing the ON/ACK button) will result in change to parameters or the accumulated dose.

Entering Setup Mode

To enter setup mode, power down the Model 25, then turn the unit back ON. When "0.00 mR/hr" ("0.000 mSv/h") appears on the LCD, press the MODE button three times within four seconds to enter Setup Mode. You will know that the unit is in SETUP mode when the display suddenly changes to "10 mR/hr ALERT" (or whatever the current rate alert is set to). If you simply wish to view the parameters, you may do so by not pressing any other buttons. The parameters will change every four seconds when no buttons are pressed. The unit will return automatically to normal mode after the last parameter is presented.

Using Setup Mode to Change Parameters

Once the Model 25 is in SETUP mode, the Rate Alert Setpoint should be displayed on the LED, and the units for the Rate Alert Setpoint

(mR/hr, R/hr, mSv/h, or Sv/h) should be blinking. For the first four parameters (Rate Alert, Rate Alarm, Dose Alert, and Dose Alarm), there are five items to adjust, namely :

Units (mR/hr, R/hr, mSv/h, or Sv/h)

Number of Decimal Places (0, 1, or 2)

Ones Place (0-9)

Tens Place (0-9)

Hundreds Place (0-9)

NOTE: The remaining parameters do not have the option to change the units or the number of decimal places.

Use the MODE button to toggle the options for the selected item. When the appropriate value is selected for that item, press the ON/ACK button to adjust the next item.

When the desired Rate Alert Setpoint is displayed, simply wait for four seconds. The Model 25 will then switch to the next parameter (Rate Alarm Setpoint in this case).

NOTE: If no buttons are pressed for four seconds, the Model 25 will switch to the next parameter, and if on the last parameter, will save the parameters and exit SETUP mode.

Repeat this process until all of the setup parameters are set to the desired values. After the last setup mode (Series Constant), the Model 25 will resume normal activity after four seconds of inactivity.

Calibration Procedure

Expose the instrument to a radiation field of 80 mR/hr (0.8 mSv/h) and adjust the Calibration Constant until the Model 25 display reads within 10% of 80.0 mR/hr (0.8 mSv/h). Expose the instrument to a radiation field of 80 R/hr (0.8 Sv/h), and adjust the Dead Time Constant until the Model 25 display reads within 10% of 80.0 R/hr (0.8 Sv/h).

Expose the instrument to a radiation field of 800 R/hr (8 Sv/h), and adjust the Series Constant until the Model 25 display reads within 10% of 800 R/hr (8 Sv/h).

Record and document the following readings, and verify that all of the readings are within 10% of the appropriate radiation field:

- 2 mR/hr (0.02 mSv/h) and 8 mR/hr (0.08 mSv/h)
- 20 mR/hr (0.2 mSv/h) and 80 mR/hr (0.8 mSv/h)

- 200 mR/hr (2 mSv/h) and 800 mR/hr (8 mSv/h)
- 2 R/hr (0.02 Sv/h) and 8 R/hr (0.08 Sv/h)
- 20 R/hr (0.2 Sv/h) and 80 R/hr (0.8 Sv/h)
- 200 R/hr (2 Sv/h) and 800 R/hr (8 Sv/h)

Reset the ALERT and ALARM setpoints to the desired levels. Record all parameters.

Section

5

Safety Considerations

Environmental Conditions for Normal Use

Indoor or outdoor use

No maximum altitude

Temperature range of -40 to 65 °C (-40 to 150 °F)

Maximum relative humidity of less than 95% (non-condensing)

Pollution Degree 3 (as defined by IEC 664): (Occurs when conductive pollution or dry nonconductive pollution becomes conductive due to condensation. This is typical of industrial or construction sites.)

Not certified for use in an explosive atmosphere

Warning Markings and Symbols

Caution!

The operator or responsible body is cautioned that the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by Ludlum Measurements, Inc.

The Model 25 Survey Meter is marked with the following symbols:



CAUTION (per ISO 3864, No. B.3.1): designates hazardous live voltage and risk of electric shock. During normal use, internal components are hazardous live. This instrument must be isolated or disconnected from the hazardous live voltage before accessing the internal components. This symbol appears on the front panel. Be sure to take the precautions noted in the next section whenever necessary.



The “**crossed-out wheellie bin**” symbol notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding. Each material must be separated. The symbol is placed on the serial number label located on the back panel. See section 7, “Recycling,” for further information.



The “CE” mark is used to identify this instrument as being acceptable for use within the European Union.

Cleaning and Maintenance Precautions

The Model 25 may be cleaned externally with a damp cloth, using only water as the wetting agent. Observe the following precautions when cleaning or performing maintenance on the instrument:

1. Turn the instrument OFF and remove the batteries.
2. Allow the instrument to sit for one minute before cleaning the exterior or accessing any internal components for maintenance.

Section

6

Revision History

NOTE: This section of the manual will be updated with each revision of the Model 25 in order to document changes over time. Ludlum Measurement's policy is to provide free software upgrades to instruments for the life of the instrument.

Revision-May 2009: Model 25, "312"

Revision-February 2009: Model 25, "403"

Revision-May 2008: "401" shown on power-up.

Original January 2008: "309" shown on power-up.

Section

7

Recycling

Ludlum Measurements, Inc. supports the recycling of the electronics products it produces for the purpose of protecting the environment and to comply with all regional, national and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies – public and private – involved in this pursuit, it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

| | | |
|----------------|----------|------------------------------|
| Batteries | Glass | Aluminum and Stainless Steel |
| Circuit Boards | Plastics | Liquid Crystal Display (LCD) |

Ludlum Measurements, Inc. products that have been placed on the market after August 13, 2005, have been labeled with a symbol recognized internationally as the “crossed-out wheelie bin,” which notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding. Each material must be separated. On the Model 25, the symbol will be placed on the serial number label located on the back panel of the instrument.

The symbol appears as such:

