

Performance Characteristic Sheet

EFFECTIVE DATE: October 7, 1996

EDITION NO.: 3

MANUFACTURER AND MODEL :

Make: *Advanced Detectors, Inc.*
Model: *LeadStar*
Source: ⁵⁷Co
Note: This sheet supersedes all previous sheets for the XRF instrument of the make, model, and source shown above.

FIELD OPERATION GUIDANCE

OPERATING PARAMETERS

Nominal Reading Time is 15 seconds Fixed mode; or Brief mode.

XRF CALIBRATION CHECK LIMITS

For this instrument, calibration check readings should be taken in *Fixed Mode*.

Instruments with software versions 4.1 to 4.30*
0.83 to 1.02 mg/cm ² (inclusive)
* This guidance may be used for software versions higher than 4.30 if the higher software version incorporates the same signal processing and data treatment algorithms that are in software version 4.30

Instruments with software versions earlier than version 4.1
0.83 to 1.12 mg/cm ² (inclusive)

(Operators may choose to use limits in the manufacturer's operations manual for this calibration check. The rate of an incorrect result if the limits in the manufacturer's operations manual are followed may be different from the rate of an incorrect result stated here.)

SUBSTRATE CORRECTION:

Substrate correction recommended for XRF results below 4.0 mg/cm²:

For those instruments with software versions 4.1 to 4.30 (this guidance may be used for software versions higher than 4.30 if the higher software version incorporates the same signal processing and data treatment algorithms that are in software version 4.30):

None

For those instruments with software versions earlier than version 4.1 :

Metal

Substrate correction not recommended for:

For those instruments with software versions 4.1 to 4.30:

Brick, Concrete, Drywall, Metal, Plaster, and Wood

For those instruments with software versions earlier than version 4.1:

Brick, Concrete, Drywall, Plaster, and Wood

INCONCLUSIVE RANGE OR THRESHOLD

For those instruments with software versions 4.1 to 4.30 (this guidance may be used for software versions higher than 4.30 if the higher software version incorporates the same signal processing and data treatment algorithms that are in software version 4.30).:

15-SECOND FIXED MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm ²)	INCONCLUSIVE RANGE (mg/cm ²)
Results not corrected for substrate bias	Brick	None	0.91 to 1.09
	Concrete	None	0.91 to 1.09
	Drywall	None	0.91 to 1.09
	Metal	None	0.91 to 1.19
	Plaster	1.0	None
	Wood	None	0.91 to 1.09

BRIEF MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD in mg/cm ²
Results not corrected for substrate bias	Brick	1.0
	Concrete	1.0
	Drywall	1.0
	Metal	1.0
	Plaster	1.0
	Wood	1.0

For those instruments with software versions earlier than version 4.1:

15-SECOND FIXED MODE READING DESCRIPTION	SUBSTRATE	INCONCLUSIVE RANGE in mg/cm ²
Results corrected for substrate bias for readings on metal substrates only	Brick	0.91 to 1.29
	Concrete	0.91 to 1.29
	Drywall	0.91 to 1.09
	Metal	0.91 to 1.09
	Plaster	0.91 to 1.09
	Wood	0.91 to 1.09

BACKGROUND INFORMATION

EVALUATION DATA SOURCE AND DATE

This sheet is supplemental information to be used in conjunction with Chapter 7 of the HUD *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* ("HUD Guidelines"). Performance parameters shown on this sheet are calculated from evaluation data collected during the EPA/HUD field evaluation study conducted from March through October 1993. The data were collected from four instruments at approximately 1,200 15-second test locations and 300 60-second test locations. One instrument had a January 1993 source and the other three instruments had July 1993 sources. All four instruments had sources with 40 mCi initial strengths. The results of this study are reported in *A Field Test of Lead-Based Paint Testing Technologies: Technical Report*, EPA 747-R-95-002b, May 1995.

OPERATING PARAMETERS

Performance parameters shown in this sheet are applicable only when properly operating the instrument using the manufacturer's instructions and procedures described in Chapter 7 of the HUD Guidelines.

XRF CALIBRATION CHECK:

The calibration of the XRF instrument should be checked using the paint film nearest 1.0 mg/cm² in the NIST Standard Reference Material (SRM) used (e.g., for NIST SRM 2579, use the 1.02 mg/cm² film).

If readings are outside the acceptable calibration check range, follow the manufacturer's instructions to bring the instruments into control before XRF testing proceeds

SUBSTRATE CORRECTION VALUE COMPUTATION

Chapter 7 of the HUD Guidelines provides guidance on correcting XRF results for substrate bias. Supplemental guidance for using the paint film nearest 1.0 mg/cm² for substrate correction is provided:

XRF results are corrected for substrate bias by subtracting from each XRF result a correction value determined separately in each house for single-family housing or in each development for multifamily housing, for each substrate. The correction value is an average of XRF readings taken over the NIST SRM paint film nearest to 1.0 mg/cm² at test locations that have been scraped bare of their paint covering. Compute the correction values as follows:

- Using the same XRF instrument, take three readings on a bare substrate area covered with the NIST SRM paint film nearest 1 mg/cm². Repeat this procedure by taking three more readings on a second bare substrate area of the same substrate covered with the NIST SRM.
- Compute the correction value for each substrate type where XRF readings indicate substrate correction is needed by computing the average of all six readings as shown below.

For each substrate type (the 1.02 mg/cm² NIST SRM is shown in this example; use the actual lead loading of the NIST SRM used for substrate correction):

$$\left. \begin{array}{l} \text{Correction} \\ \text{Value} \end{array} \right\} = \frac{1^{st} + 2^{nd} + 3^{rd} + 4^{th} + 5^{th} + 6^{th} \text{ Reading}}{6} - 1.02 \text{mg/cm}^2$$

- Repeat this procedure for each substrate requiring substrate correction in the house or housing development.

EVALUATING THE QUALITY OF XRF TESTING

Randomly select ten testing combinations for retesting from each house or from two randomly selected units in multifamily housing. Use either 15-second readings or 60-second readings.

Conduct XRF retesting at the ten testing combinations selected for retesting.

Determine if the XRF testing in the units or house passed or failed the test by applying the steps below.

Compute the Retest Tolerance Limit by the following steps:

Determine XRF results for the original and retest XRF readings. Do not correct the original or retest results for substrate bias. In single-family and multi-family housing, a result is defined as a single

reading. Therefore, there will be ten original and ten retest XRF results for each house or for the two selected units.

Calculate the average of the original XRF result and retest XRF result for each testing combination.

Square the average for each testing combination.

Add the ten squared averages together. Call this quantity C.

Multiply the number C by 0.0072. Call this quantity D.

Add the number 0.032 to D. Call this quantity E.

Take the square root of E. Call this quantity F.

Multiply F by 1.645. The result is the Retest Tolerance Limit.

Compute the average of all ten original XRF results.

Compute the average of all ten retest XRF results.

Find the absolute difference of the two averages.

If the difference is less than the Retest Tolerance Limit, the inspection has passed the retest. If the difference of the overall averages equals or exceeds the Retest Tolerance Limit, this procedure should be repeated with ten new testing combinations. If the difference of the overall averages is equal to or greater than the Retest Tolerance Limit a second time, then the inspection should be considered deficient.

Use of this procedure is estimated to produce a spurious result approximately 1% of the time. That is, results of this procedure will call for further examination when no examination is warranted in approximately 1 out of 100 dwelling units tested.

TESTING TIMES:

For *Fixed Mode*, the LeadStar instrument tests for a set length of time before a result is obtained and displayed. For *Brief Mode*, the LeadStar instrument tests until a reading is obtained relative to an operator set *Action Level*. The following table provides a summary of testing times for readings taken in *Brief Mode* with an *Action Level* set to 1.0 mg/cm². All times have been scaled relative to an initial source strength of 15 mCi. Note that source strength and factors such as substrate may affect testing times.

Results from testing in August 1996 and September 1996

BRIEF MODE TESTING TIMES (Seconds)						
SUBSTRATE	ALL DATA			MEDIAN FOR LABORATORY-MEASURED LEAD LEVELS (mg/cm ²)		
	25 th Percentile	Median	75 th Percentile	Pb < 0.25	0.25 ≤ Pb < 1.0	1.0 ≤ Pb
Wood Drywall	7	7	8	7	8	7
Metal	7	7	8	7	8	7
Brick Concrete Plaster	8	8	9	8	8	8

*Testing times are based on readings obtained relative to a 1.0 mg/cm² Action Level.

BIAS AND PRECISION

Do not use these bias and precision data to correct for substrate bias. These bias and precision data were computed without substrate correction from samples with reported laboratory results less than 4.0 mg/cm² lead. There were 15 test locations taken in *Fixed Mode* with a laboratory reported result equal to or greater than 4.0 mg/cm² lead. The fifteen test locations were each tested four times in *Fixed Mode*, once under software version 4.05, once under software version 4.08, and twice under software version 4.30. Of the 15 test locations tested under software version 4.05, one case resulted in an XRF reading was less than 1.0 mg/cm². Of the 45 test locations tested under software versions 4.08 and 4.30, there were no instances in which an XRF reading was less than 1.0 mg/cm². Each of the fifteen test locations were tested in *Brief Mode* twice, both under software version 4.30. Out of the 30 *Brief Mode* testing cases, there were no instances in which an XRF reading was less than 1.0 mg/cm². The following data are for illustrative purposes only. Actual bias must be determined on-site. Inconclusive ranges provided above already account for bias and precision.

For those instruments with software versions 4.1 to 4.30.

FIXED MODE READINGS MEASURED AT	SUBSTRATE	BIAS (mg/cm ²)	PRECISION ¹ (mg/cm ²)
0.0 mg/cm ²	Brick	0.0	0.1
	Concrete	0.0	0.1
	Drywall	0.0	0.1
	Metal	0.1	0.1
	Plaster	-0.1	0.1
	Wood	0.0	0.1
0.5 mg/cm ²	Brick	0.1	0.2
	Concrete	0.1	0.2
	Drywall	0.0	0.2
	Metal	0.1	0.2
	Plaster	0.0	0.2
	Wood	0.1	0.2
1.0 mg/cm ²	Brick	0.1	0.3
	Concrete	0.1	0.3
	Drywall	0.1	0.3
	Metal	0.2	0.3
	Plaster	0.0	0.3
	Wood	0.1	0.3
2.0 mg/cm ²	Brick	0.2	0.4
	Concrete	0.2	0.4
	Drywall	0.2	0.4
	Metal	0.3	0.4
	Plaster	0.1	0.4
	Wood	0.2	0.4
¹ Precision at 1 standard deviation			

For those instruments with software versions earlier than version 4.1.

FIXED MODE READINGS MEASURED AT	SUBSTRATE	BIAS (mg/cm ²)	PRECISION ¹ (mg/cm ²)
0.0 mg/cm ²	Brick	0.1	0.1
	Concrete	0.1	0.1
	Drywall	0.0	0.1
	Metal	0.1	0.1
	Plaster	0.0	0.1
	Wood	0.0	0.1
0.5 mg/cm ²	Brick	0.2	0.2
	Concrete	0.2	0.2
	Drywall	0.1	0.2
	Metal	0.2	0.2
	Plaster	0.1	0.2
	Wood	0.1	0.2
1.0 mg/cm ²	Brick	0.3	0.3
	Concrete	0.3	0.3
	Drywall	0.1	0.3
	Metal	0.2	0.3
	Plaster	0.1	0.3
	Wood	0.1	0.3
2.0 mg/cm ²	Brick	0.4	0.5
	Concrete	0.4	0.5
	Drywall	0.3	0.5
	Metal	0.4	0.5
	Plaster	0.3	0.5
	Wood	0.3	0.5
¹ Precision at 1 standard deviation			

CLASSIFICATION OF RESULTS

XRF results are classified as positive if they are greater than the upper boundary of the inconclusive range, and negative if they are less than the lower boundary of the inconclusive range, or inconclusive if in between. The inconclusive range includes both its upper and lower bounds. Earlier editions of this *XRF Performance Characteristics Sheet* did not include both bounds of the inconclusive range as "inconclusive." While this edition of the Performance Characteristics Sheet uses a different system, the specific XRF readings that are considered positive, negative, or inconclusive for a given XRF model and substrate remain unchanged, so previous inspection results are not affected.

DOCUMENTATION

A document titled *Methodology for XRF Performance Characteristic Sheets* provides an explanation of the statistical methodology used to construct the data in the sheets, and provides empirical results from using the recommended inconclusive ranges or thresholds for specific XRF instruments. For a copy of this document call the National Lead Information Center Clearinghouse at 1-800-424-LEAD.

This XRF Performance Characteristics Sheet is a joint product of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD). The issuance of this sheet does not constitute rulemaking. The information provided here is intended solely as guidance to be used in conjunction with Chapter 7, Lead-Based Paint Inspection, of the *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*. EPA and HUD reserve the right to revise this guidance. Please address questions and comments on this sheet to: Director, Office of Lead Hazard Control (L), U.S. Department of Housing and Urban Development, 451 Seventh St, S.W., Washington, DC 20410.