BETHLEHEM STEEL CORPORATION
RADIOACTIVE SOURCE LEAK TEST
HANDLING AND EVALUATION PROCEDURES

1. INTRODUCTION

1.1 The EQC Division, Industrial Relations Department, provides a radioactive material leak testing and contamination analysis service to all corporation facilities and operations as required. This service is provided by the Radiation Control Laboratory, B-244, Martin Tower.

1.2 Analyses can be made of cotton patches or filter papers having a maximum diameter of 1.25 inches (3 cm.) or from cotton-tipped swabs.

2. COUNTING SYSTEM

2.1 The counting system consists of the following Harshaw modules:

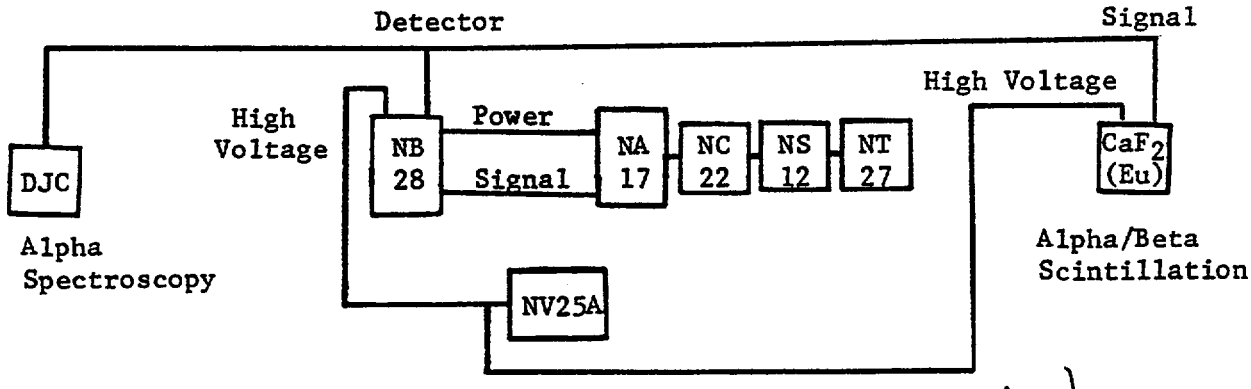
NA17	Amplifier
NB28	Preamplifier
NC22	Single Channel Analyzer
NS12	Scaler
NT27	Timer
NV25A	High Voltage Power Supply

Diffused Junction Silicon Detector for Alpha Spectroscopy

Calcium Fluoride (Eu doped) Scintillation Crystal for Alpha and Beta Analysis

Model GU-4 Gamma Shield

2.2 The components are assembled as shown below:



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3. PREPARATION OF WIPES

3.1 Only clean wipes and envelopes are to be used.

3.2 From the most recent inventory list, prepare an envelope for each source to be tested.

3.2.1 Fill in the following on each envelope:

Month Due	Model No.
Facility	Serial No.
Location	Source
Device	Strength
Mfg.	

3.3 Insert a single clean wipe into each envelope.

3.4 Send out envelopes to the respective facility early enough so that they will receive them prior to the beginning of the month for which the leak tests are due.

3.5 Fill out the annual log with the following information:

Location	Month Due
Leak Test Frequency	Date Mailed
No. Envelopes	

3.6 When the returned envelopes are received by EQC, record the date returned and the number returned on the log.

3.7 Check each wipe with a thin window GM before counting to make sure they do not contain excessive contamination.

4. INITIAL SETUP OF COUNTING SYSTEM

4.1 Alpha Spectroscopy (DJC)

4.1.1 Make sure the analyzer is set as follows:

NA17
Course Gain - 160
Fine Gain - ~ 1.4
Non-Inverted Pulse
Unipolar Pulse

NC22 Set E and ΔE according to Table 1.

Table 1.

Specific Isotope	Adjust Fine Gain To Read Maximum At		60 Min. Background Count	1 Min. Standard Count	Counting Settings		EFFIC
	E	ΔE			E	ΔE	

NS12 Discriminator 3 to 4/Preset off/Scaler.

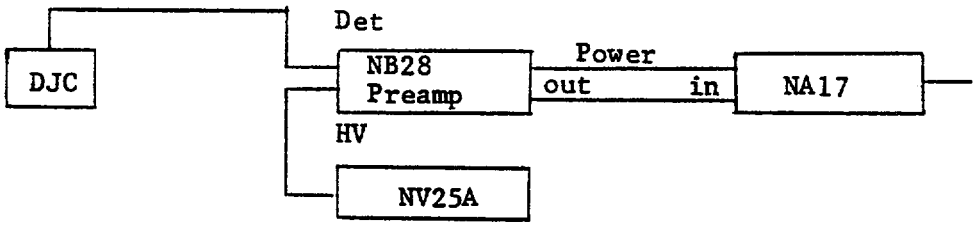
NT27 Internal timer/Preset.
Select desired counting time.
Thumbwheel selects time integer from 1-99.

Min/Sec selects appropriate time unit.

Select desired time multiplier (0.1-1-10).

NV25A 100 volts

4.1.2 Make sure unit is wired as shown below:



4.1.3 Turn on power to NH85 and NV25A.

4.1.4 Place cover on sample chamber. Close large valve (clockwise). Open small exhaust valve (counterclockwise). Turn on vacuum pump and evacuate sample chamber (> 25 inches Hg).

4.1.5 Take a 60 minute background reading at the desired counting settings. It should correspond to the value stated in 4.1.1.

Depress "reset" button to zero scaler. Initiate count by depressing "start" button.

4.1.6 At conclusion of the background count, record background count and count time on the data form. Open large valve (counterclockwise) and allow counting chamber to reach atmospheric pressure.

4.1.7 Remove cover and place sample on sample tray. Use forceps. Make sure the wipe surface points upward. Replace cover. Close large valve and evacuate the counting chamber.

4.1.8 Depress reset button and then start button.

4.1.9 At the conclusion of the sample count, record the sample count and the count time on the data form. Open the large valve and equalize the pressure in the sample chamber. Remove the cover and remove the sample with forceps and replace it in the envelope. Record the sample and background counts and counting times on the envelope.

4.1.10 If additional samples are to be analyzed, repeat Steps 4.1.7 to 4.1.9.

4.1.11 At the conclusion of counting, take a 60 minute background check count and compare it to the initial 60 minute background reading.

4.2 Alpha Scintillation (CAF_2)

4.2.1 Make sure the analyzer is set as follows:

NA17 Course Gain - 160
Fine Gain - ~1.6
Non-inverted Pulse
Bipolar Pulse ~

NC22 ΔE - 9. 5
E - 2.1
Integrate

NS12 Discriminator 3-4/Preset off/Scaler.

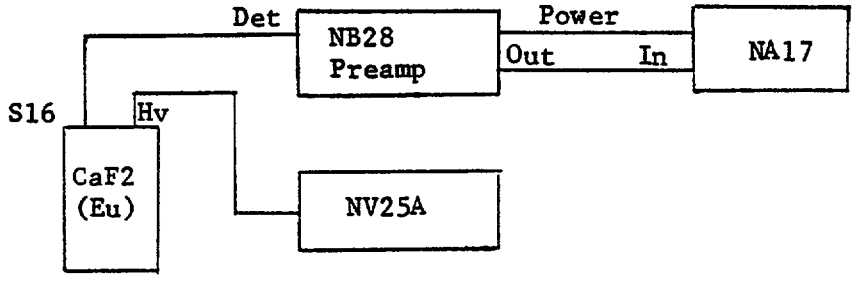
NT27 Internal timer/Preset.
Select desired counting time.
Thumbwheel selects time integer from 1-99.
Min/Sec selects appropriate time unit.
Select desired time multiplier (0.1-1-10).

NV25A 965 Volts

Table 2.

Specific Isotope	30 Min. Background Count	1 Min. Standard Count	Energy Mev.	EFFIC

4.2.2 Make sure the system is wired as shown below:



4.2.3 Turn on power to NH85 and NV25A.

4.2.4 Close door to the gamma shield and begin a 30 minute background count. It should not exceed 80 cpm. If it does, check for contamination in the sample area or incorrect electronic settings.

4.2.5 Record the background count and count time on the data form at the conclusion of the background count.

4.2.6 Place a sample on the sample tray using forceps. Make sure the wipe surface points upward. Close the door to the Gamma Shield and begin a 10 minute sample count.

4.2.7 At the conclusion of the sample count, record the sample count and count time on the data form. Remove the sample with forceps and replace it in the envelope. Record the sample and background counts and counting times on the envelope.

4.2.8 If additional samples are to be analyzed, repeat Steps 4.2.6 and 4.2.7.

4.2.9 At the conclusion of counting, take a 5 minute background check count and compare it to the 30 minute background reading.

4.3 Beta Scintillation (CaF_2)

4.3.1 Make sure the analyzer is set as follows:

NA17	Course Gain - 160 Fine Gain - ~1.6 Non-Inverted Pulse Bipolar Pulse ~
NC22	ΔE - 9.5 E - 2.1 Integrate
NS12	Discriminator 3-4/Preset off/Scaler.
NT27	Internal timer/Preset. Select desired counting time. Thumbwheel selects time integer from 1-99. Min/Sec selects appropriate time unit. Select desired time multiplier (0.1-1-10).
NV25A	965 Volts

Table 3.

Specific Isotope	30 Min. Background Count	1 Min. Standard Count	Energy Mev.	EFFIC

4.3.2 The system is wired the same as in 4.2.2.

4.3.3 Repeat Steps 4.2.3 to 4.2.9 for Beta analysis.

4.4 Clean Up

4.4.1 Non-contaminated samples may be disposed of following analysis through the normal trash. Any contaminated samples (exceeding 100 cpm above the background count) are to be placed in a plastic bag and handled as radioactive trash.

4.4.2 Wash your hands at the conclusion of the analysis.

5. DATA ANALYSIS

5.1 Complete all necessary information, including the counter system efficiency for the isotope being counted, on the data form and keypunch the data.

5.2 Submit the data to the computer, request 3 copies. Copies are distributed as follows:

One Copy Each to: Facility Radiation Coordinator
A. LaMastra
V. E. Kobordo

5.3 Review the computer output for keypunch errors. If none, give two copies to A. LaMastra for approval and signature.

5.4 Mail signed copy to facility.

5.5 File the data forms as a permanent record of leak test analysis results.

5.6 Annually file the log sheets as a permanent record.

6. CALIBRATION

6.1 Alpha Spectroscopy

6.1.1 Follow Steps 4.1.1 to 4.1.5.

6.1.2 Place a calibrated Alpha Standard on the sample tray and follow Steps 4.1.7 and 4.1.8.

6.1.3 It may be necessary to adjust the fine gain so that the peak response occurs at an E to ΔE setting which equals the Alpha energy in Mev. for the particular Alpha emitter involved. Record all results.

6.1.4 Repeat above steps as necessary for each standard.

6.2 Alpha Scintillation (CaF_2)

6.2.1 Follow Steps 4.2.1 to 4.2.5.

6.2.2 Place a calibrated Alpha Standard on the sample tray. Close the door to the Gamma Shield and begin a 1-5 minute sample count.

6.2.3 Record the sample count and count time at the conclusion of the test.

6.2.4 Repeat Steps 6.2.2 and 6.2.3 for several different Alpha standards.

6.3 Beta Scintillation

6.3.1 Follow Steps 4.3.1 and 4.2.2 to 4.2.5.

6.3.2 Place a calibrated Beta Standard on the sample tray. Close the door to the Gamma Shield and begin a 5-10 minute sample count.

6.3.3 Record the sample count and count time at the conclusion of the test.

6.3.4 Repeat Steps 6.3.2 and 6.3.3 for several different Beta Standards.

6.4 Data Analysis

6.4.1 Find the efficiency of each standard for each energy range used by the following formula.

$$\text{Efficiency} = \frac{\text{Sample cpm - Background cpm}}{\text{Standard dpm}}$$

6.4.2 Draw a graph of Beta energy versus efficiency.

6.4.3 Determine the minimum detectable activity in picocuries as follows:

$$\text{Minimum Detectable Count} = 3\sqrt{\text{Background Count}}$$

$$\text{Minimum Detectable Count Rate} = \frac{\text{Min. Det. Count}}{\text{Background Count Time}}$$

$$\text{MDA(pCi)} = \frac{\text{Min. Det. Count Rate}}{\text{Efficiency x 2.22 dpm/pCi}}$$

MINIMUM DETECTABLE ACTIVITIES

Isotope	E.Max. (Mev.)	% Occur	EFFIC	BKGD Count	Count Time (Min.)	STD Count Rate (cpm)	MDA (pCi)
Alpha Spectroscopy							
Alpha Scintillation							
Beta Scintillation							

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