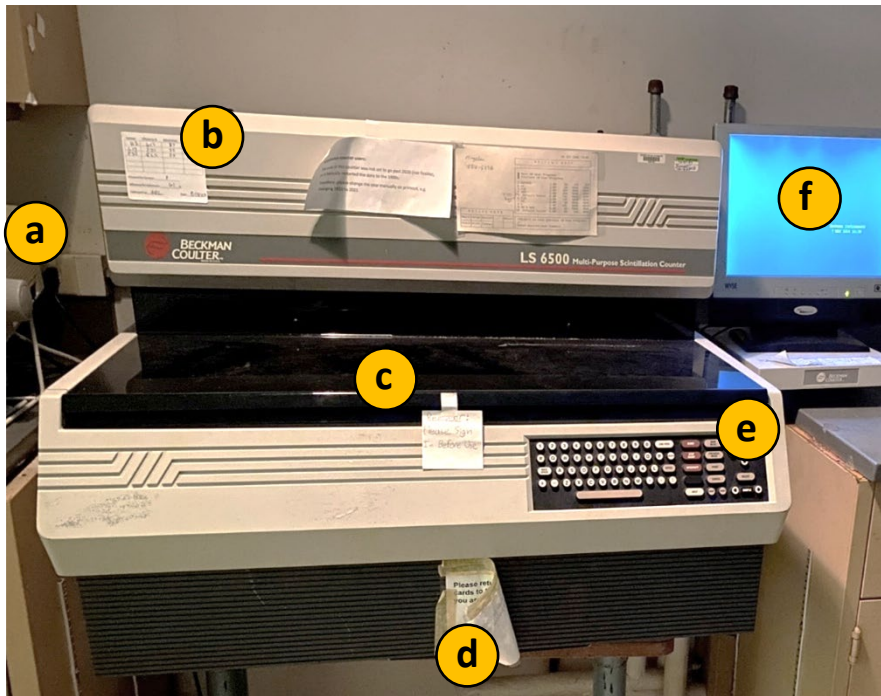


Calibrating and Operating the Beckman 6500 Liquid Scintillation Counter

SOP NUMBER	SUPERCEDES SOP (IF APPLICABLE)	EFFECTIVE DATE	PAGE NUMBERING
WORKING GUIDE	N/A	11/1/24	Page 1 of 6
Latest Version Prepared By Leona Choi, HP	APPROVAL Rachel Nichols, ARSO		

The purpose of this working guide is to provide the Radiation Safety Staff (RSS), Permitted Individuals (PI) and their secondaries step-by-step instructions on how to calibrate and operate the Beckman 6500 Liquid Scintillation Counter (LSC) commonly found around MU.



Pictured above is a Beckman LS 6500 located in Schweitzer 17. Important components include: (a) printer, (b) calibration sticker, (c) cover, (d) user program flag drawer, (e) keyboard, (f) monitor. Pictured below is a closer look at the keyboard.



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WORKING GUIDE	N/A		
Latest Version Prepared By Leona Choi, HP	APPROVAL Rachel Nichols, ARSO	EFFECTIVE DATE 11/1/24	PAGE NUMBERING Page 2 of 6

1. Calibration

- 1.1 For calibration, you will need a set of 7 ml unquenched standards. This would typically include a background, 3H, 14C, and 32Si (a progeny of 32P).
- 1.2 On the “MAIN MENU” screen, use the arrow keys to highlight “Review and Edit User Programs” and press **SELECT** on the keyboard (Fig. 1).
- 1.3 On the “REVIEW / EDIT” screen, use the arrow keys to highlight your counting protocol and press **SELECT** on the keyboard. In this guide, we are using protocol 4 SWIPES (Fig. 2).

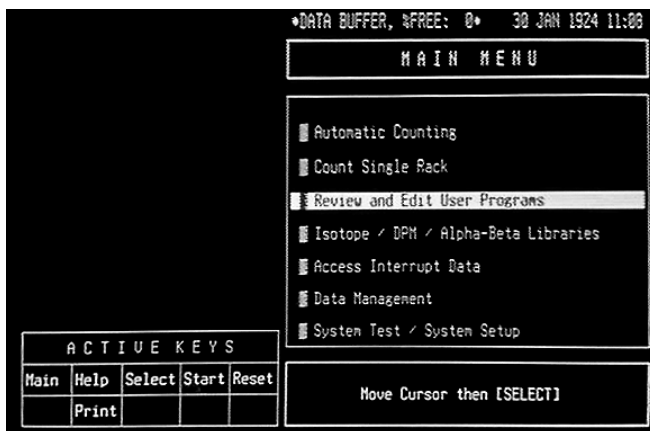


Figure 1. Main menu.

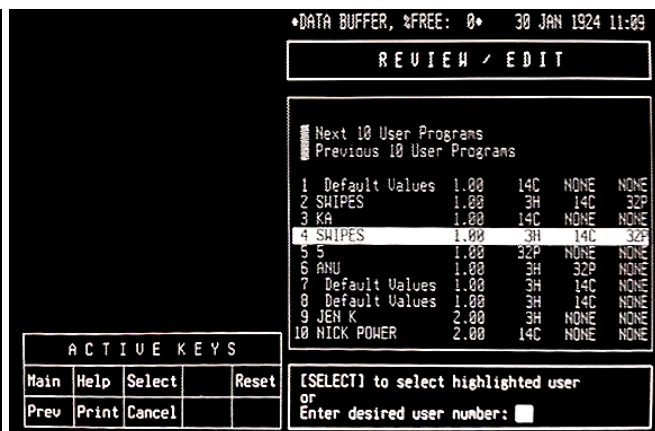


Figure 2. Selecting the user program “4 SWIPES” to edit its settings.

- 1.4 Verify that the protocol has a count time of **1 minute** and the correct isotopes are listed based on the standards you will be using (Fig. 3a). If changes are needed, highlight the appropriate field with the arrow keys and press **SELECT**. Use the keyboard to input your desired changes and press **ENTER** to submit the change. To return, press **PREVIOUS MENU** on the keyboard.
- 1.5 On the “REVIEW / EDIT” screen for the user program, highlight “Edit Other Parameters” and press **SELECT** (Fig. 3b). Press **SELECT** again to enter the “Data Calculation” screen (Fig. 5).

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SOP NUMBER	SUPERCEDES SOP (IF APPLICABLE)		EFFECTIVE DATE	PAGE NUMBERING
WORKING GUIDE	N/A		11/1/24	Page 3 of 6
Latest Version Prepared By Leona Choi, HP	APPROVAL Rachel Nichols, ARSO			

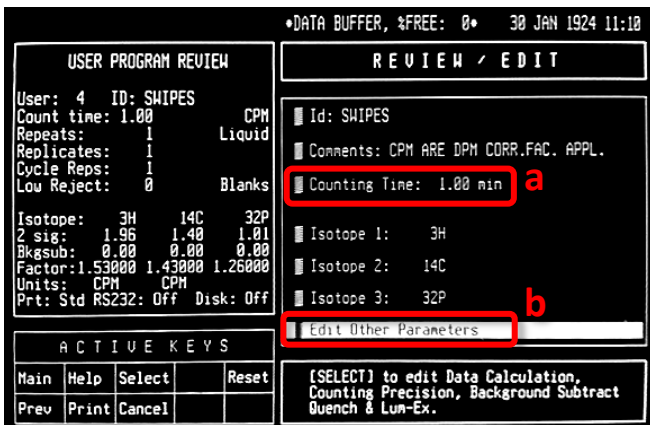


Figure 3. The “Review/Edit” page for the selected user protocol.

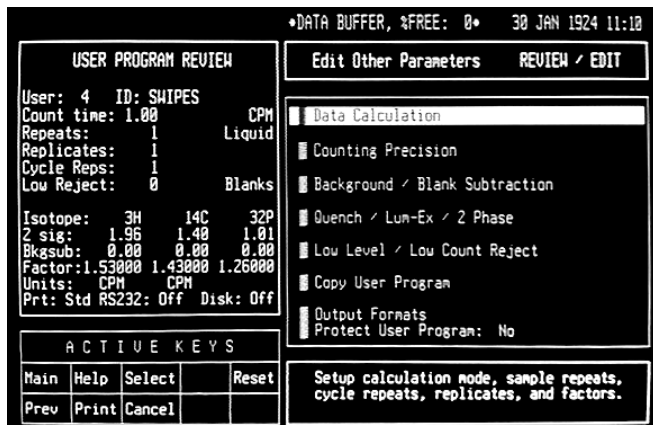


Figure 4. Select “Data Calculation” after you select “Edit Other Parameters.”

- 1.6 In “Data Calculation,” check that the background subtraction is set to **0** (Fig. 5a). Edit the factors for each isotope. Use the arrow keys to highlight the isotope, enter a factor of **1**, and then press **ENTER** (Figure 6). Repeat for each isotope then return to the “MAIN MENU” by pressing **MAIN MENU** on the keyboard.
- 1.7 Load a rack with the standards (left to right) and protocol flag into the right side of the LSC. The order doesn’t matter, but you should be aware of the order you choose since it will be critical for transferring data into the spreadsheet. It is recommended to load the standards by mass number for convenience: background, 3H, 14H, and 32Si. Load another empty rack with the **HALT** flag following. Note that these flags should be facing away from you. Be sure that the printer is on, and the paper is properly aligned. Shut the LSC lid and press the **START** button to begin “Automatic Counting” on the Main Menu.

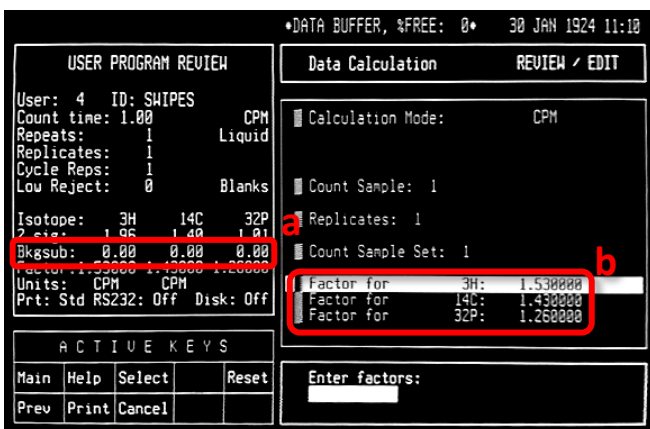


Figure 5. In the “Data Calculation page,” check that “Bkgsb” is set to 0 for each region and set each isotope factor to 1.

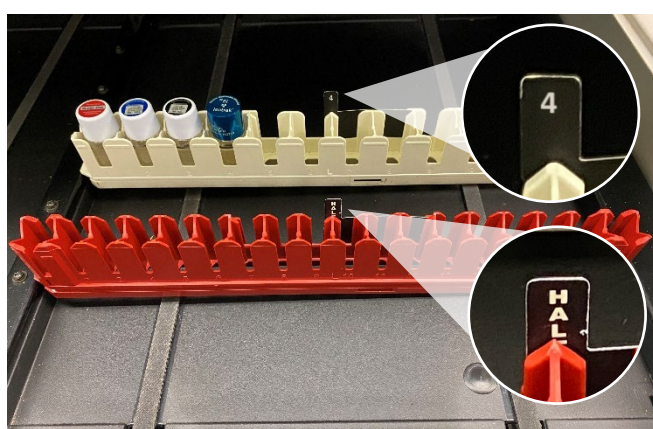


Figure 6. LSC sample racks should be loaded on the right-side, top to bottom. The racks should be oriented such that only the top part of the flag is facing you. Don’t forget the **HALT** rack!

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SOP NUMBER	SUPERCEDES SOP (IF APPLICABLE)		
WORKING GUIDE	N/A		
Latest Version Prepared By Leona Choi, HP	APPROVAL Rachel Nichols, ARSO	EFFECTIVE DATE 11/1/24	PAGE NUMBERING Page 4 of 6

1.8 Next, the data from the counting results will need to be entered to the spreadsheet[†] to calculate the new isotope factors and minimum detectable activity (Fig. 7, 8). Enter the background CPM for each respective isotope region (Fig. 7a). Then enter the data for each standard according to the isotope and region of interest (Fig. 7b). Note that the CPM taken for each sample number corresponds to the isotope standard used in that position. E.g. The 3H standard was placed in the second slot of the rack, so the CPM result we use is in column 3H, row 2 (Fig. 7c, d).

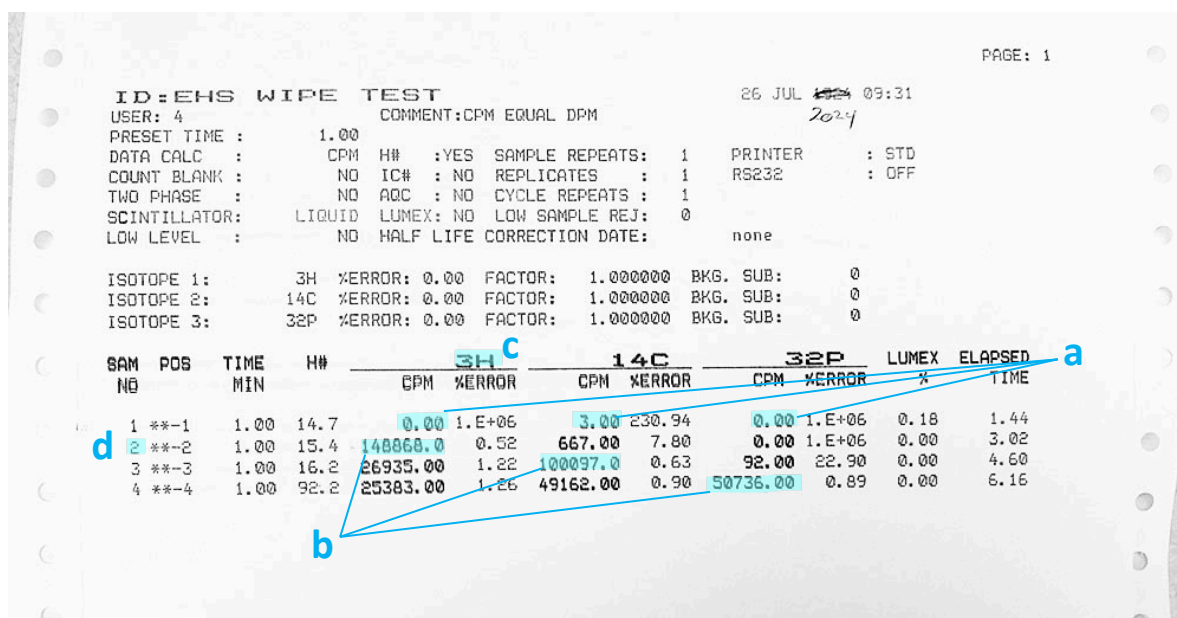


Figure 7. Counting analysis print-out results: (a) contains the background counts for each isotope region, (b) contains the CPM taken for each isotope region with respect to the sample number, (c) shows the isotope region column headers.

[†]The fillable spreadsheet referenced here is attached separately.

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SOP NUMBER	SUPERCEDES SOP (IF APPLICABLE)		
WORKING GUIDE	N/A		
Latest Version Prepared By Leona Choi, HP	APPROVAL Rachel Nichols, ARSO	EFFECTIVE DATE 11/1/24	PAGE NUMBERING Page 5 of 6

Radionuclide	Serial No.	Instrument Setting (Window)	Channel/Region	Sample Count Time (min)	Background Count Time (min)	Background (CPM)	Gross Sample (CPM)	Net Sample (CPM)	Standard Assay Activity (DPM)	Standard Assay Reference Date	Half-Life (days)	Decayed Activity (DPM)	Efficiency	Calibration Factor	MDA (DPM)
P-32/Si-32	256-2000	C		1	1	0	50736	50736	75180	4/30/2019	5.73E+04	73456.8147	0.69	1.45	4
C-14	18.5-256	B		1	1	3	100097	100094	99900	10/8/2018	2.08E+06	99829.4316	1.00	1.00	11
H-3	2-18.6	A		1	1	0	148968	148968	213120	10/8/2018	4.50E+03	153687.225	0.97	1.03	3
Swipe Protocol #:		4													
Calibration performed by:		EHS													
Unknown Efficiency:		69%													
How to use this spreadsheet:															
Step 1: All highlighted fields are where you enter your data. Example data has been entered for demonstration purposes and will need to be updated with your data.															
Step 2: RSS recommends counting your samples for 1 minute. Most of the time, LSC standards sets come with a background, C-14, and H-3 standard. If you have more sources to count, you can adjust the above template as you need.															
Step 3: Make sure to enter each standard's Assay Date and Assay Activity so the spreadsheet can decay correct it to today's date.															
Step 4: The Calibration Date above will auto populate with the day you open the spreadsheet.															
Step 5: If you have an older LSC such as a Beckman, you will need to make sure your swipe protocol has a calibration factor set to 1 for each isotope before you collect data. This will ensure that your results will be in CPM. See the red circle below for the calibration factors.															
Step 6: Once you collect data, enter the background cpm for each region. Data from the image below has been entered as an example															
Enter the data for each standard. Only enter the cpm that corresponds to the isotope and region of interest. See the highlighted portions in the below example, data has been															

Figure 8. This spreadsheet calculates calibration factors based on the counting efficiencies.

- 1.9 Check that your MDAs are <200 dpm which is the trigger level for removable contamination.
- 1.10 If the data looks good, press MAIN MENU and steps 1.2 – 1.5 to navigate back to where you can enter the new calibration factors for each isotope. The calibration is then complete.
- 1.11 It can be useful to create a “calibration sticker” where you can record the efficiencies for each region, the date of calibration, and the name or initials of the person that performed the calibration. Some form of calibration information should be on the equipment.
- 1.12 Be sure to send your calibration print-out to EHS so radiation safety may update your LSC’s records.

2. Counting


- 2.1 Once an LSC is within calibration, it can be used to analyze contamination swipes. Depending on the location of the LSC and the supplies available, you may need to prepare your vials in advance. Be sure to have a blank vial for background counts.
- 2.2 Load the sample vials from right to left, beginning with the blank vial.
- 2.3 Insert the protocol flag designated for counting on the first rack only. load your samples into the rack(s). From the “MAIN MENU” window, highlight “Automatic Counting” and press the **START** button.

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SOP NUMBER	SUPERCEDES SOP (IF APPLICABLE)	EFFECTIVE DATE	PAGE NUMBERING
WORKING GUIDE	N/A	11/1/24	Page 6 of 6
Latest Version Prepared By Leona Choi, HP	APPROVAL Rachel Nichols, ARSO		

3. Troubleshooting

3.1 Cancel analysis/counting

To interrupt the counting process, simply press  on the keyboard.

3.2 Reset

If the LSC is unresponsive, you can do a soft reset by pressing  simultaneously.