

# LSC Geometry

# Activity 가

2007 9 19 / 2008 1 8

Activity가 20 dpm <sup>3</sup>H Activity  
 Geometry 가 , Activity  
 가 , 가  
 Chi-square test ,  
 1 3% 가 Activity Geometry , Activity가  
 : , , , Activity , Geometry

1.

2.

가 <sup>3</sup>H Vial  
 , <sup>3</sup>H 가  
 20 DPM(Disintegration Per Minute) , photon PMT 가  
 Activity 가 , Geometry <sup>3</sup>H 가  
 가 .  
 가 [1,9] .  
 Geometry Activity  
 가 <sup>3</sup>H .

SQP(E)(Spectral Quench Parameter of External Standard Method)  
 . SQP(E) Compton electron  
 Scintillation spectrum Total Intensity 1%  
 Channel number  
 spectrum SQP(E) Compton electron Scintillation  
 External standard source <sup>152</sup>Eu [4,6].

<sup>3</sup>H 20 dpm Activity가

Geometry 가 Activity Unquenched LSC-standards Performance test

Geometry 가 Activity Activity Chi square test[5]

<sup>3</sup>H [1,9] Human error

Activity 가 Geometry 20

75 Repeat

Chi square test

Chi square test 20 50 <sup>3</sup>H

Known value Activity Activity

CPM(Count Per Minute) SQP(E) Known value

DPM CPM Chi square test Chi square probability 0.02 0.98

Fig. 1 Fig. 1 Fig. 2 Fig. 2

Replicate 가 가

20 Activity

Geometry <sup>3</sup>H Table 1 가

**Table 1.** <sup>3</sup>H standard source used.

	Activity (DPM)	(%)		
20	204,700	0.45	PerkinElmer	'04.5.1
	199,100	0.90	PerkinElmer	'05.10.1
20	225,079	3.64	PerkinElmer	'05.11.1
	190,620	0.67	KRISS	'06.5.15
	110,299	4.09	PerkinElmer	'05.6.23
10	108,722	4.09	PerkinElmer	'05.6.23
	97,980	0.74	KRISS	'06.5.15
	29,742	0.93	KRISS	'06.5.15
3	29,742	0.93	KRISS	'06.5.15
1	10,176	1.36	KRISS	'06.5.15

가 3:17, 5:15, 8:12

Activity Known value Activity

가 3:17, 5:15, 8:12

Activity Known value Activity

Fig. 3

Activity가 20 dpm <sup>3</sup>H

Activity Geometry

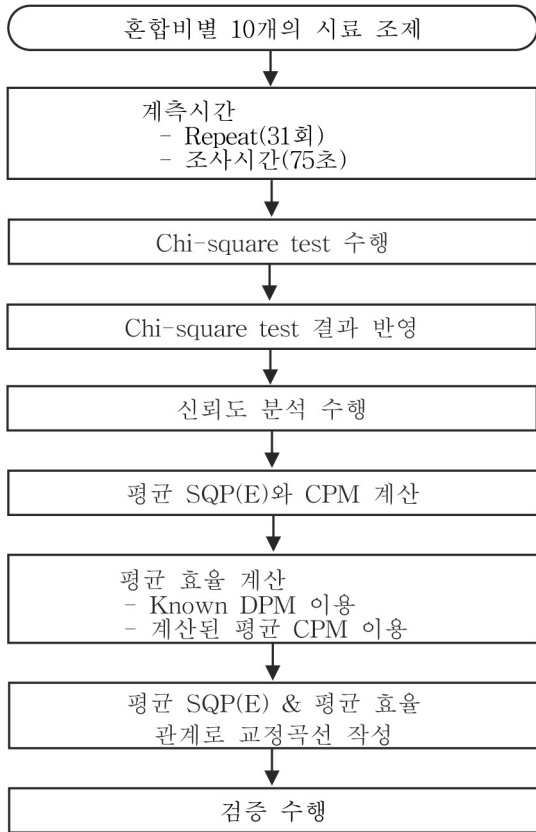


Fig. 1. Modification calibration procedure.

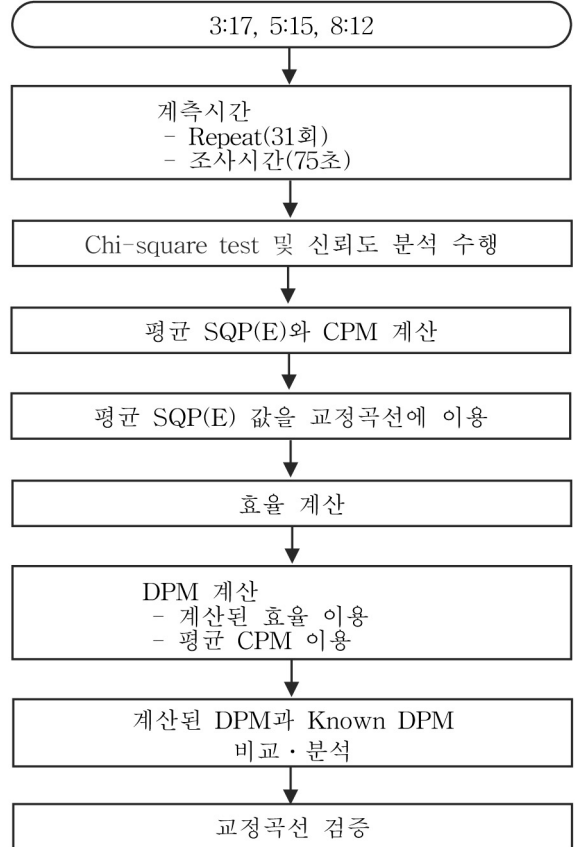


Fig. 3. Verification procedure on calibration curve.

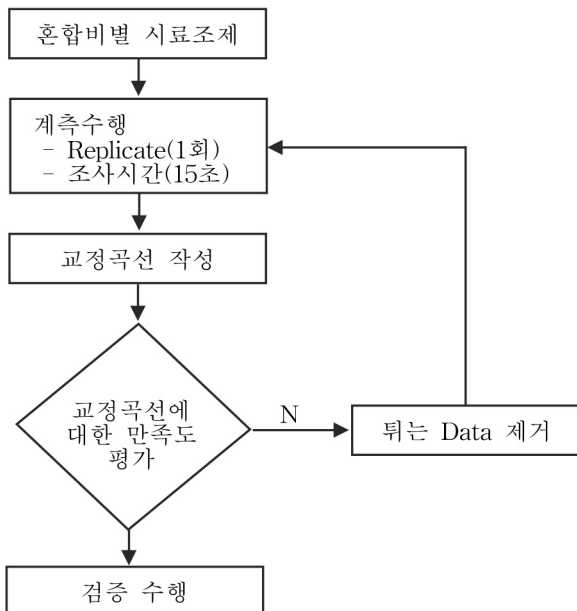


Fig. 2. Mechanical calibration procedure.

가 Activity 가 Geometry  
가 ,  
가

4.

4.1 Performance Chi square test

Unquenched LSC-standards

가  
65% 65.5%

Chi square test Table 2

Table 2 60 54

가 Chi square probability range 가

10:10 가 Range

[2,3].

가 2 2 Chi square probability range

가

Geometry

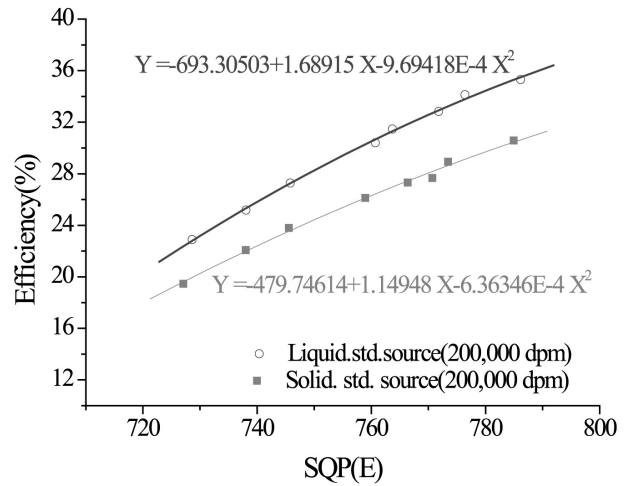
**Table 2.** Chi square test result.

	(C+S) <sup>1)</sup>	2)		2)			
		20	10	3	1	1,000	
1	1:19	19.94	28.38	42.92	51.88	37.26	28.79
2	2:18	26.32	27.87	38.21	35.27	18.65	19.10
3	3:17	32.99	38.24	34.33	30.74	48.06	28.15
4	4:16	19.07	38.97	22.16	35.14	58.99	31.40
5	5:15	35.60	43.24	32.59	30.78	16.71	21.52
6	6:14	128.3	168.9	82.41	55.03	39.39	39.33
7	7:13	36.10	39.17	23.94	31.19	36.94	23.20
8	8:12	23.19	29.19	28.05	21.50	30.88	31.09
9	9:11	61.07	46.92	38.62	29.78	26.46	24.21
10	10:10	831.6	1952	952.1	156.6	78.30	18.17

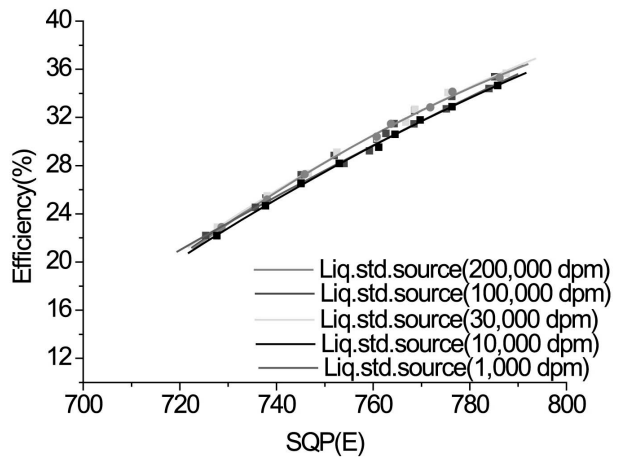
<sup>1)</sup>(C+S)는 Cocktail 대 Sample 의 혼합비임  
<sup>2)</sup>단위는 dpm임.

4.2 Geometry Activity

Table 2 Chi square test 54, Fig. 4 Fig. 5, Fig. 4 Geometry Activity가 20 dpm, 3H, 5%, Fig. 5 Activity 가 Activity가 20, 10, 3, 1, 1000 dpmH Activity



**Fig. 4.** Evaluation result on geometry difference.



**Fig. 5.** Evaluation result on activity difference.

4.3

Fig. 4 Fig. 5, Fig. 3, Table 3, Fig. 6, Table 3, 0.242 3.830%, 0.028 1.832%, Activity level, Fig. 6, Fig. 6, Fig. 3, Fig. 4 Fig. 5, Fig. 6, 3%, Geometry, 12%

**Table 3.** Verification result on calibration curve.

(dpm)	(%)		
	3:17	5:15	8:12
20	1.370	3.132	1.113
	1.832	0.068	0.439
20	0.907	0.867	0.232
	0.189	0.844	0.396
10	1.412	0.454	0.942
	0.799	1.571	0.028
3	1.749	0.242	1.593
	1.212	1.412	0.086
1	2.338	0.767	1.328
	0.445	1.202	0.057
1	3.662	3.830	2.814
	0.227	0.872	0.195

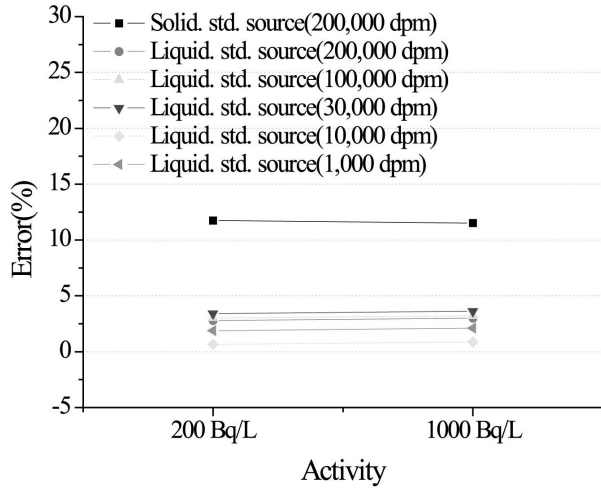


Fig. 6. Radioactivity error analysis result.

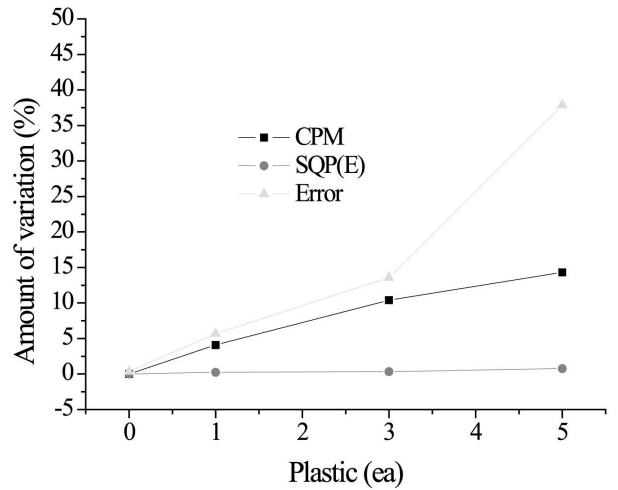


Fig. 8. Trend of CPM, SQP(E) and Error according to the number of plastic.

4.4

Activity Geometry

Geometry

가

Teflon vial

Activity

가

Fig. 8, Table 5

CPM, SQP(E), Error

Teflon vial

CPM, SQP(E), Error

Fig. 7

가 8:12

3, 1,000 dpm <sup>3</sup>H

Error

Table 5. Evaluation result on the difference of source configuration.

	(DPM)		SQP(E)	CPM	<sup>1</sup> Eff	<sup>2</sup> Error(%)
CaseA	20	×	736.8 (0.00%)	47,121 (0.00%)	25.13	0.53
CaseB	20	(1)	735.7 (0.15%)	46,748 (0.58%)	24.99	1.21
CaseC	20	×	738.1 (0.00%)	38,805 (0.00%)	25.32	18.7
CaseD	20	(1)	736.5 (0.22%)	38,732 (0.19%)	24.92	17.4

<sup>1</sup>은 액상 20 만 dpm으로 작성한 소광보정곡선을 적용한 것임.  
<sup>2</sup>는 시료 조제할 때 알고 있는 Activity와 측정된 Activity를 비교한 것임.

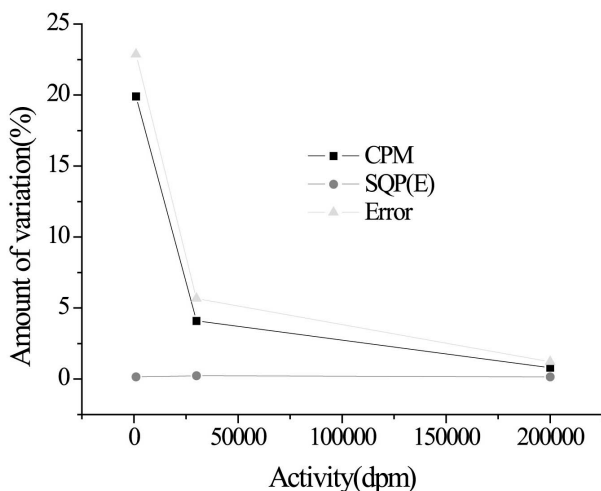


Fig. 7. Trend of CPM, SPQ(E) and Error when plastics exist into Teflon vial.

Known value Activity 20 dpm

Activity

Error 0.35 2.65%

Error.21 22.86

Activity가 가

Error

CPM 1,000 dpm 3 dpm

0.8 19.9%

Activity가 가 CPM

Fig. 8

Activity 가 3 dpm 8:12

Error, CPM SQP(E)

가 가 Error CPM 가

SQP(E)

CPM 4.14.3%

Activity	Geometry	Repeat	Chi square test
0.24	0.77%	SQP(E)	Repeat 75 ( ) 가 1 3%
		Quencher	- Chi square test
Activity가		PMT 가	- Geometry
		가 PMT	
CPM		가 Activity가 가	Activity가 가
			20 dpm
Table 5		<sup>3</sup> H	<sup>3</sup> H
		Case C Case D 17.4	1000 dpm <sup>3</sup> H
18.7%	0.53 1.21%	Case A Case B	
		Activity가 20 dpm	
		Case A Case C	
		Case C 가 Case A Error가	
1,000 dpm		<sup>3</sup> H	
5.			
Geometry	Activity		가
		Performance	
Chi square test			가

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## Effect Evaluation by Activity and Geometry Difference in Calibration on LSC

Sang Jun Han\*, Kyung Jin Lee<sup>†</sup>, Seung Jin Lee, Hee Gang Kim, Eung Seop Park

\*Department of Nuclear Engineering, Chosun University, Yeong-Gwang NPP Supervisory Center for Environment Radiation & Safety

**Abstract** - When the calibration on Liquid Scintillation Counter using the Solid <sup>3</sup>H Standard Source of 200,000DPM is executed, the uncertainty due to activity and geometry difference, exists. Therefore, this paper intends to evaluate environmental samples comparatively accurately as decreasing this uncertainty existing in the process of calibration. For this, measurements on samples manufactured by <sup>3</sup>H Standard Source and sensitivity study were performed. Also, this paper verified calibration results using Radioactivity-Error-Analysis Method, and evaluated quantitatively the effect by geometry and activity difference based on verification result. According to the result of sensitivity study, in case of using the exposure time of 75 sec and Repeat method, the measuring accuracy and precision of about 1~3% were increased in comparison with the existing method. By analysis result, the effect by activity difference did not appear, and a plastic cell existing into Teflon vial made a role as reflector. The less the effect of plastic cells are decreased, the more activity is high, and the effect of those can be neglected at the activity of 200,000 DPM.

**Keywords** : Liquid Scintillation Counter, Sensitivity Index, Activity Difference, Geometry Difference