PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Distilled Water	Laboratory	Environment
Spike Value	0.005 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0057	0.0008	0.0049	0.00003	0.000000001
2	0.0061	0.0008	0.0053	-0.00037	0.000000138
3	0.0057	0.0008	0.0049	0.00003	0.000000001
4	0.0049	0.0008	0.0041	0.00083	0.000000687
5	0.0061	0.0008	0.0053	-0.00037	0.000000138
6	0.0055	0.0008	0.0047	0.00023	0.000000052
7	0.0061	0.0008	0.0053	-0.00037	0.000000138
	Mean		0.00493	Jumlah(x-xi)2 =	0.00000115

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

$= 0.0004$

Variability, (@ 95% confidence level)

$2s = 0.0009$

$3s = 0.0013$

Coefficient of Variation,

$Cv = s/x*100$

$= 8.90$

Accuracy

$$\% \text{ error} = \frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$$

$= 1.43$

$$\% \text{ recovery} = \frac{\text{Mean Value}}{\text{Ref. Value}} * 100$$

$= 98.57$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Distilled Water	Laboratory	Environment
Spike Value	0.05 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0522	0.0021	0.0501	0.00014	0.000000020
2	0.0530	0.0021	0.0509	-0.00066	0.000000432
3	0.0522	0.0021	0.0501	0.00014	0.000000020
4	0.0524	0.0021	0.0503	-0.00006	0.000000003
5	0.0524	0.0021	0.0503	-0.00006	0.000000003
6	0.0520	0.0021	0.0499	0.00034	0.000000118
7	0.0522	0.0021	0.0501	0.00014	0.000000020
	Mean		0.05021	Jumlah(x-xi)2 =	0.00000062

Precision

No. of replicates, n = 7

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

= 0.0003

Variability, 2s = 0.0006
(@ 95% confidence level)

3s = 0.0010

Coefficient of Variation,

Cv = s/x*100

= 0.64

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

= -0.43

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

= 100.43

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Distilled Water	Laboratory	Environment
Spike Value	0.25 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.2518	0.0021	0.2497	-0.00040	0.000000160
2	0.2512	0.0021	0.2491	0.00020	0.000000040
3	0.2516	0.0021	0.2495	-0.00020	0.000000040
4	0.2514	0.0021	0.2493	0.00000	0.000000000
5	0.2512	0.0021	0.2491	0.00020	0.000000040
6	0.2514	0.0021	0.2493	0.00000	0.000000000
7	0.2522	0.0021	0.2491	0.00020	0.000000040
	Mean		0.24930	Jumlah(x-xi)2 =	0.00000032

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

$= 0.0002$

Variability, (@ 95% confidence level)

$2s = 0.0005$

$3s = 0.0007$

Coefficient of Variation,

$Cv = s/x*100$

$= 0.09$

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

$= 0.28$

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 99.72$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Seawater	Laboratory	Environment
Spike Value	0.005 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0073	0.00233	0.0050	0.00026	0.000000066
2	0.0071	0.00233	0.0048	0.00046	0.000000209
3	0.0075	0.00233	0.0052	0.00006	0.000000003
4	0.0077	0.00233	0.0054	-0.00014	0.000000020
5	0.0077	0.00233	0.0054	-0.00014	0.000000020
6	0.0079	0.00233	0.0056	-0.00034	0.000000118
7	0.0077	0.00233	0.0054	-0.00014	0.000000020
	Mean		0.00523	Jumlah(x-xi)2 =	0.00000046

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \sum (x-x_i)^2 \, ^{1/2}$ / $n-1$

$= 0.0003$

Variability, (@ 95% confidence level)

$2s = 0.0006$

$3s = 0.0008$

Coefficient of Variation,

$Cv = s/x*100$

$= 5.28$

Accuracy

% error = Ref. Value - Mean Value * 100 / Ref. Value

$= -4.54$

% recovery = Mean Value * 100 / Ref. Value

$= 104.54$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Seawater	Laboratory	Environment
Spike Value	0.05 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0525	0.00233	0.0502	-0.00017	0.000000029
2	0.0523	0.00233	0.0500	0.00003	0.000000001
3	0.0519	0.00233	0.0496	0.00043	0.000000184
4	0.0521	0.00233	0.0498	0.00023	0.000000052
5	0.0519	0.00233	0.0496	0.00043	0.000000184
6	0.0519	0.00233	0.0496	0.00043	0.000000184
7	0.0537	0.00233	0.0514	-0.00137	0.000001881
	Mean		0.05000	Jumlah(x-xi)2 =	0.00000251

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \left[\frac{\sum (x-x_i)^2}{n-1}\right]^{1/2}$

$= 0.0006$

Variability, (@ 95% confidence level) $2s = 0.0013$

$3s = 0.0019$

Coefficient of Variation,

$Cv = s/x*100$

$= 1.29$

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

$= 0.00$

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 100.00$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Seawater	Laboratory	Environment
Spike Value	0.25 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.2484	0.00233	0.2461	0.00081	0.000000663
2	0.2482	0.00233	0.2459	0.00101	0.000001029
3	0.2488	0.00233	0.2465	0.00041	0.000000172
4	0.2494	0.00233	0.2471	-0.00019	0.000000034
5	0.2494	0.00233	0.2471	-0.00019	0.000000034
6	0.2507	0.00233	0.2484	-0.00149	0.000002207
7	0.2496	0.00233	0.2473	-0.00039	0.000000149
	Mean		0.24688	Jumlah(x-xi)2 =	0.00000429

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \left[\frac{\sum (x-x_i)^2}{n-1}\right]^{1/2}$

$= 0.0008$

Variability, (@ 95% confidence level)

$2s = 0.0017$

$3s = 0.0025$

Coefficient of Variation,

$Cv = s/x*100$

$= 0.34$

Accuracy

$\%\ error = \frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

$= 1.25$

$\%\ recovery = \frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 98.75$

PRECISION AND ACCURACY
(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	River Water	Laboratory	Environment
Spike Value	0.005 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0224	0.0174	0.0050	-0.00001	0.000000000
2	0.0220	0.0174	0.0046	0.00039	0.000000149
3	0.0222	0.0174	0.0048	0.00019	0.000000034
4	0.0226	0.0174	0.0052	-0.00021	0.000000046
5	0.0229	0.0174	0.0055	-0.00051	0.000000264
6	0.0224	0.0174	0.0050	-0.00001	0.000000000
7	0.0222	0.0174	0.0048	0.00019	0.000000034
	Mean		0.00499	Jumlah(x-xi)2 =	0.00000053

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

$= 0.0003$

Variability, (@ 95% confidence level) $2s = 0.0006$

$3s = 0.0009$

Coefficient of Variation,

$Cv = s/x*100$

$= 5.95$

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

$= 0.29$

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 99.71$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	River Water	Laboratory	Environment
Spike Value	0.05 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0619	0.0123	0.0496	-0.00041	0.000000172
2	0.0616	0.0123	0.0493	-0.00011	0.000000013
3	0.0611	0.0123	0.0488	0.00039	0.000000149
4	0.0613	0.0123	0.0490	0.00019	0.000000034
5	0.0613	0.0123	0.0490	0.00019	0.000000034
6	0.0616	0.0123	0.0493	-0.00011	0.000000013
7	0.0616	0.0123	0.0493	-0.00011	0.000000013
	Mean		0.04919	Jumlah(x-xi)2 =	0.00000043

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \left[\frac{\sum (x-x_i)^2}{n-1}\right]^{1/2}$

$= 0.0003$

Variability, (@ 95% confidence level) $2s = 0.0005$

$3s = 0.0008$

Coefficient of Variation,

$Cv = s/x*100$

$= 0.54$

Accuracy

$\%\ error = \frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

$= 1.63$

$\%\ recovery = \frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 98.37$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	River Water	Laboratory	Environment
Spike Value	0.25 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.2471	0.0123	0.2348	-0.00030	0.000000090
2	0.2456	0.0123	0.2333	0.00120	0.000001440
3	0.2462	0.0123	0.2339	0.00060	0.000000360
4	0.2448	0.0123	0.2325	0.00200	0.000004000
5	0.2487	0.0123	0.2364	-0.00190	0.000003610
6	0.2479	0.0123	0.2356	-0.00110	0.000001210
7	0.2473	0.0123	0.2350	-0.00050	0.000000250
	Mean		0.23450	Jumlah (x-xi)2 =	0.00001096

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

$= 0.0014$

Variability, (@ 95% confidence level) $2s = 0.0027$

$3s = 0.0041$

Coefficient of Variation,

$Cv = s/x*100$

$= 0.58$

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} *100$

$= 6.20$

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 93.80$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Industrial Effluent	Laboratory	Environment
Spike Value	0.005 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0283	0.0234	0.0049	0.00009	0.000000007
2	0.0283	0.0234	0.0049	0.00009	0.000000007
3	0.0283	0.0234	0.0049	0.00009	0.000000007
4	0.0283	0.0234	0.0049	0.00009	0.000000007
5	0.0288	0.0234	0.0054	-0.00041	0.000000172
6	0.0281	0.0234	0.0047	0.00029	0.000000082
7	0.0286	0.0234	0.0052	-0.00021	0.000000046
	Mean		0.00499	Jumlah(x-xi)2 =	0.00000033

Precision

No. of replicates, n = 7

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

= 0.0002

Variability, (@ 95% confidence level) 2s = 0.0005

3s = 0.0007

Coefficient of Variation,

Cv = s/x*100

= 4.69

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

= 0.29

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

= 99.71

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Industrial Effluent	Laboratory	Environment
Spike Value	0.05 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.0680	0.0234	0.0446	0.00019	0.000000034
2	0.0682	0.0234	0.0448	-0.00001	0.000000000
3	0.0687	0.0234	0.0453	-0.00051	0.000000264
4	0.0680	0.0234	0.0446	0.00019	0.000000034
5	0.0682	0.0234	0.0448	-0.00001	0.000000000
6	0.0685	0.0234	0.0451	-0.00031	0.000000099
7	0.0677	0.0234	0.0443	0.00049	0.000000236
	Mean		0.04479	Jumlah(x-xi)2 =	0.00000067

Precision

No. of replicates, $n = 7$

Std. Deviation, $s = \left[\frac{\sum (x-x_i)^2}{n-1}\right]^{1/2}$

$= 0.0003$

Variability, (@ 95% confidence level) $2s = 0.0007$

$3s = 0.0010$

Coefficient of Variation,

$Cv = s/x*100$

$= 0.75$

Accuracy

$\%\ error = \frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

$= 10.43$

$\%\ recovery = \frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

$= 89.57$

PRECISION AND ACCURACY

(From Replicate Analysis of a Reference Sample Carried Out In a Single Batch)

METHOD TITLE : Hexavalent Chromium 6+

Sample Type/Matrix	Industrial Effluent	Laboratory	Environment
Spike Value	0.25 mg/L	Analytical Staff	Yong Pui San
Parameter	Cr 6+		

No	Analysis	Blank	Actual Value	$x-x_i$	$(x-x_i)^2$
1	0.2418	0.0234	0.2184	0.00183	0.000003344
2	0.2425	0.0234	0.2191	0.00113	0.000001274
3	0.2449	0.0234	0.2215	-0.00127	0.000001617
4	0.2449	0.0234	0.2215	-0.00127	0.000001617
5	0.2441	0.0234	0.2207	-0.00047	0.000000222
6	0.2412	0.0234	0.2178	0.00243	0.000005898
7	0.2460	0.0234	0.2226	-0.00237	0.000005624
	Mean		0.22023	Jumlah(x-xi)2 =	0.00001959

Precision

No. of replicates, n = 7

Std. Deviation, $s = \frac{\sum (x-x_i)^2}{n-1}^{1/2}$

= 0.0018

Variability, 2s = 0.0036
(@ 95% confidence level)

3s = 0.0054

Coefficient of Variation,

Cv = s/x*100

= 0.82

Accuracy

% error = $\frac{\text{Ref. Value - Mean Value}}{\text{Ref. Value}} * 100$

= 11.91

% recovery = $\frac{\text{Mean Value}}{\text{Ref. Value}} * 100$

= 88.09