United States
Environmental Protection
Agency

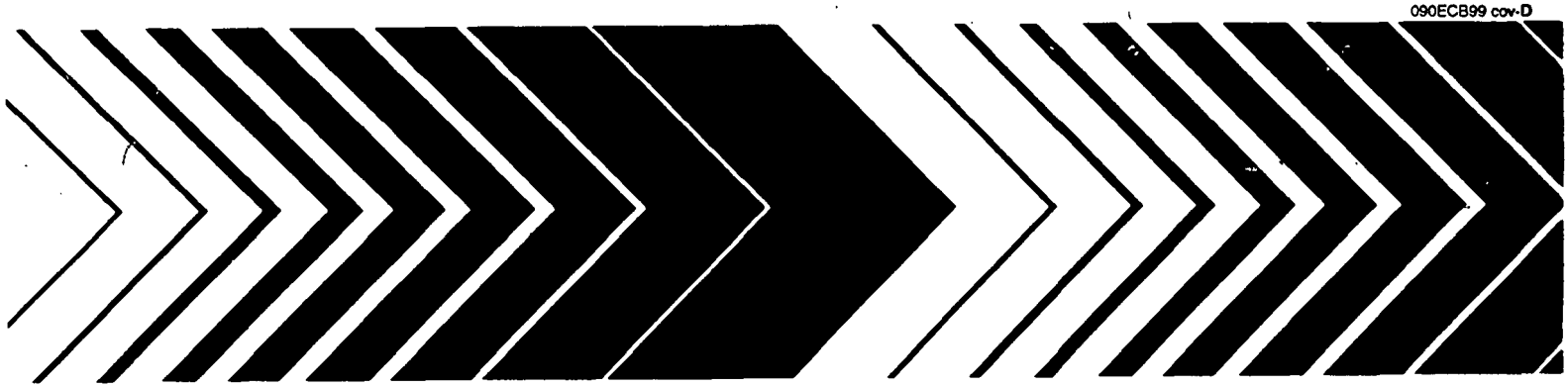
Office of Research and
Development
Washington, DC 20460

EPA 600/R-98/176
December 1998

EPA

Iodine in Water Performance Evaluation Study

A Statistical Evaluation of the September 11, 1998 Data



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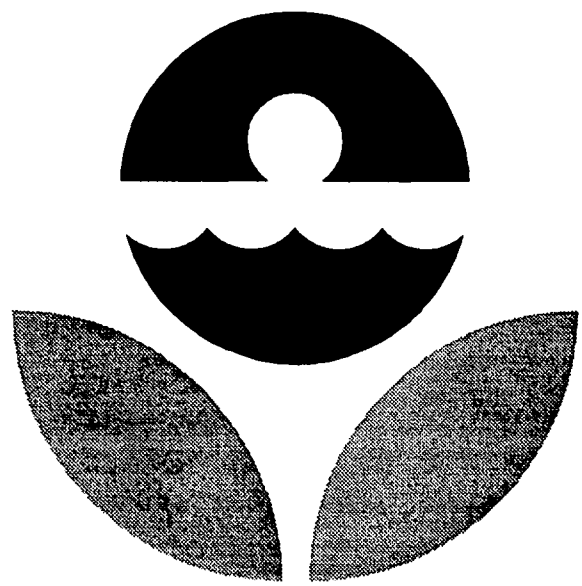
Iodine in Water

Performance Evaluation Study

September 11, 1998



Environmental Protection Agency

National Exposure Research Laboratory

Environmental Sciences Division

Las Vegas, Nevada

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
NATIONAL EXPOSURE RESEARCH LABORATORY
ENVIRONMENTAL SCIENCES DIVISION-LAS VEGAS
P.O. BOX 93478
LAS VEGAS, NEVADA 89193-3478
(702/798-2100)

Dear Participant,

Enclosed are the results of the Environmental Sciences Division (ESD-LV) Performance Evaluation Study for ***Iodine in Water; September 11, 1998.***

The known value for each analysis was determined by gravimetric methods, checked by chemical analyses performed by ESD-LV's Radiochemistry Laboratory, and compared to the participating laboratories' grand average.

The expected precision, determined by the known value, was taken from "Table 3. Laboratory Precision: One Standard Deviation Values and Control Limits for Various Analyses", which is based on data accumulated over the years by the Performance Evaluation Program, and can be found in the Environmental Radioactivity Performance Evaluation Studies Program and Radioactive Standards Distribution Program information brochure.

Please take a few minutes to review this report and the analytical data your laboratory submitted to us. If there are any apparent discrepancies, please notify us immediately.

We encourage you to make use of the computer-automated data-entry system that has been in place for some time now. As the number of participants increases, and it becomes unrealistic for us to receive results by mail or FAX, the computer system will be our only avenue for accepting data.

If you have any questions or comments, please send a message via the data-entry system or contact Stephen Pia at 702/798-2102 or Patricia Honsa at 702/798-2141.

Sincerely,

Stephen Pia

Stephen Pia
Team Leader
RADQA Program

Enclosure

NOTICE

This material has been funded wholly by
the U.S. Environmental Protection Agency.
It has been subjected to the Agency's review,
and has been approved for publication as
an EPA document.

The following pages consist of separate sections for each of the nuclides in this study with four parts per section. After the first, each part is separated from the next by a new page or a thick horizontal bar. The first page of each section is a statistical summary for the nuclide and starts with a statement of the known value, the control limits, and the warning limits.

The warning limits are placed at two normalized standard deviations above and below the known value and the control limits are three normalized standard deviations above and below the known value. If you keep control charts, these values will be useful for anticipating problems with the accuracy of your analytical methods.

The coin shaped pie chart at the top of the summary page shows the fate of all the samples sent out in number and percentage terms. The pie chart starts at the top and rotates clockwise. The first sector represents those participants who submitted analytical results within both the warning and control limits. The next sector represents those who are in the warning region but not out of control. The third sector represents those who are out of control, but have passed the outlier test. The fourth sector represents those who have failed the outlier test. The last sector represents those participants who have failed to respond properly. This is the case if no analytical results were returned, or less than three determinations were reported, or if the results were received too late. The reeding on the edge of the coin is spaced at one percent intervals, and the sector shading becomes darker as the data reliability decreases. Sectors with zero width are not shown.

The table in the center shows a number of statistical quantities calculated from the submitted data based on the mean and median values in relation to the known value, both before and after outlier removal. The lower pie chart uses the same construction as the upper chart and shows the distribution of properly submitted data in terms of deviation from the known value divided into sectors representing one, two, three, and greater than three normalized standard deviations.

The second part is an alphabetical listing, in lab-code order, of submitted data and several calculated quantities. An entry that is shaded has been rejected because of one of the reasons listed above or failure of the outlier test. The fifth and sixth columns are a measure of laboratory precision. The Range analysis is a normalized value that you may use to keep precision control charts. The eighth and ninth columns are the differences from the mean of all non-outliers and from the known value, respectively. If this value is between 2.0 and 3.0, your analytical process precision is in the warning zone; if it exceeds 3.0 it is out of control. A tag symbol may appear in the last column. Each page with tags has a symbol definition summary at the bottom. If there is no tag symbol, the data is within the control limits, but it may be in the warning zone.

The third part is a three-column listing of result average, tag symbol, and lab-code in average order excluding those labs not responding properly. In this order, all outliers and out-of-control results appear at the top or bottom of the list.

The last part is two bar chart displays showing frequency distributions of responding participants. The first chart places the known value at the center and a bar at each 0.2 unit of expected precision. The second chart places the mean of the reported measurements at the center and a bar at each 0.2 unit of standard deviation. In both cases, a bar includes those results within 0.1 unit up to the maximum of six. Any results more than six units from the center value are shown cumulatively by a shaded bar one past the sixth unit. If the central tendency of the known value distribution falls away from the center, an error in accuracy is indicated. If the distribution is broad, poor precision is indicated. The mean value distribution is similar but uses the average and standard deviation of reported results as its basis.

The Range Analysis(R + SR) is calculated from the range, mean range and standard error of the range values. The range is the difference between the maximum and minimum results for the laboratory. The mean range is calculated by multiplying the expected precision by 1.693(for three results). The standard error of the range is calculated by multiplying the mean range by 2.575(for three results), subtracting the mean range from this product, and dividing the result by 3. If the range is greater than the mean range, then the range analysis is calculated by subtracting the mean range from the range, dividing the result by the standard error of the range and adding 1. If the mean range is greater than or equal to the range, then the range analysis is calculated by dividing the range by the mean range.

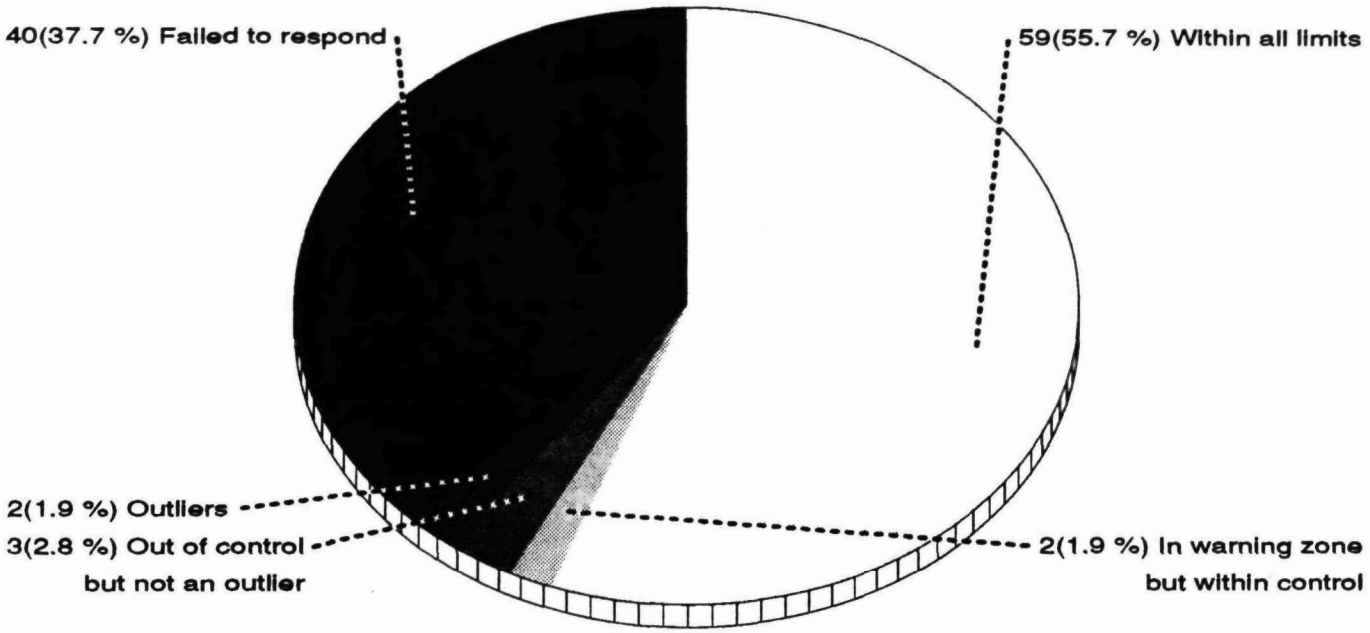
The normalized deviation of the mean from the grand average is calculated from the deviation of the mean from the grand average and the standard error of the mean values. The deviation of the mean from the grand average is calculated by subtracting the grand average from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the grand average is calculated by dividing the deviation of the mean from the grand average by the standard error of the mean.

The normalized deviation of the mean from the known value is calculated from the deviation of the mean from the known value and the standard error of the mean values. The deviation of the mean from the known value is calculated by subtracting the known value from the average of the laboratory's three results. The standard error of the mean is calculated by dividing the expected precision by the square root of 3(the number of results). The normalized deviation of the mean from the known value is calculated by dividing the deviation of the mean from the known value by the standard error of the mean.

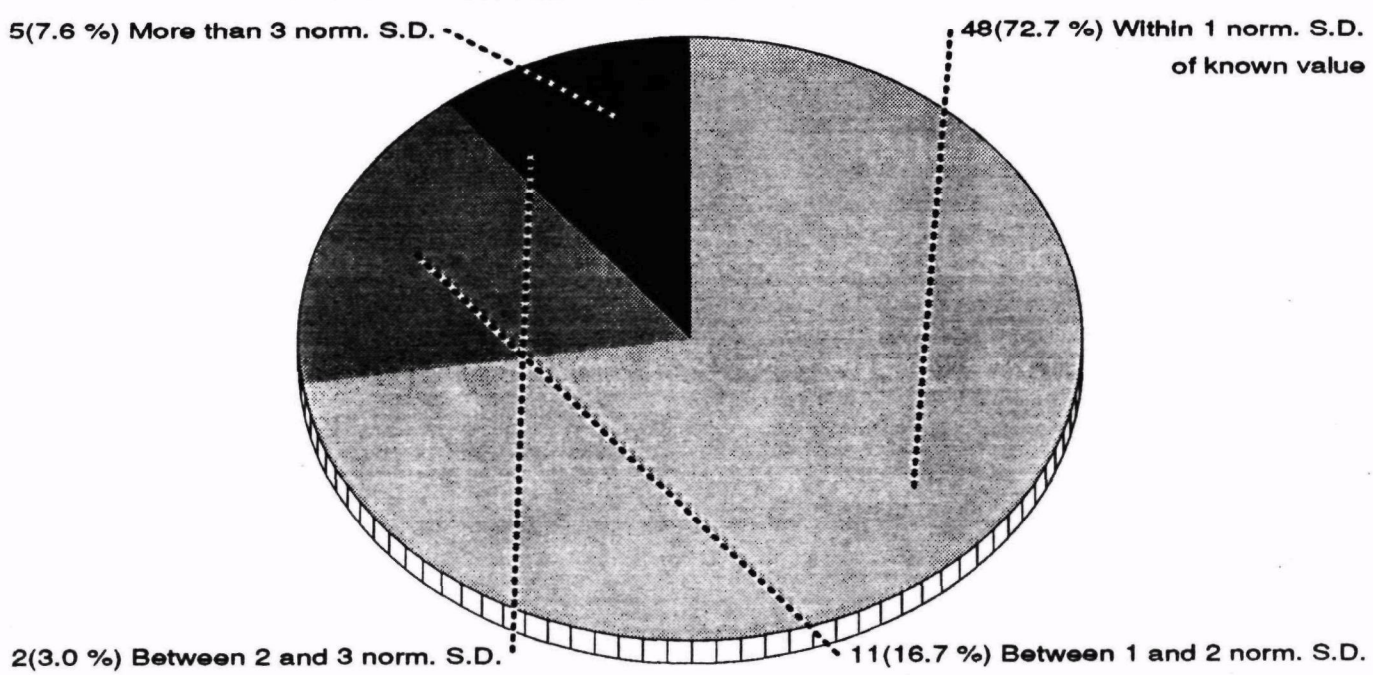
A complete explanation of the statistical calculations involved in the report may be found in the Environmental Radioactivity Performance Evaluation Studies Program information brochure [Draft Revision of EPA-600/4-81-004], available from Patricia Honsa, ESD-LV, 702/798-2141.

Iodine-131 Statistical Summary 106 Participants

The known value of this nuclide is **6.1 pCi/l** with an expected precision of **2.0**; the control limits are 2.6 to 9.6; the warning regions are 2.6 to 3.8 and 8.4 to 9.6



Statistic	Respondents	Non-outliers
Mean	6.91	**Grand Avg 6.70**
Std. Dev.	1.69	1.17
Variance	2.87	1.38
% Coef. of Var.	24.50	17.55
% deviation of mean from known value	13.28	9.77
Norm. dev. of mean from known value	0.48	0.51
Median	6.48	6.43
% deviation of median from known value	6.28	5.46
Norm. dev. of median from known value	0.23	0.28



ESD-LV Performance Evaluation: Iodine in Water, 11-Sep-1998

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
A	6.5	6.1	5.7	0.40	0.236	6.10	-0.52	0.00	
AF	7.2	6.1	6.0	0.67	0.354	6.43	-0.23	0.29	
AJ	7.4	11.1	3.6	3.75	3.314	7.37	0.58	1.10	
AK	7.9	9.1	7.2	0.96	0.561	8.07	1.19	1.70	
AL	5.2	6.7	5.1	0.90	0.473	5.67	-0.89	-0.38	
AP									•
AU									•
AW	5.9	5.9	6.2	0.17	0.089	6.00	-0.60	-0.09	
AY	9.2	11.4	9.4	1.22	0.650	10.00	2.86	3.38	⇑
AZ	6.4	4.0	4.9	1.21	0.709	5.10	-1.38	-0.87	
BA	7.7	4.9	6.0	1.41	0.827	6.20	-0.43	0.09	
BC									•
BH	7.4	8.3	7.1	0.62	0.354	7.60	0.78	1.30	
BK	6.9	7.1	8.5	0.87	0.473	7.50	0.70	1.21	
BL	7.2	6.2	6.4	0.53	0.295	6.60	-0.08	0.43	
BM	6.3	6.8	5.4	0.71	0.413	6.17	-0.46	0.06	
BO	5.9	6.1	5.3	0.42	0.236	5.77	-0.80	-0.29	
C	5.8	5.2	6.0	0.42	0.236	5.67	-0.89	-0.38	
CA	6.0	6.0	5.8	0.12	0.059	5.93	-0.66	-0.14	
CC									•
CE	6.8	7.8	6.0	0.90	0.532	6.87	0.15	0.66	
CJ	5.4	5.9	6.5	0.55	0.325	5.93	-0.66	-0.14	
CP									•
CS									•
CX	5.5	10.2	9.0	2.44	1.739	8.23	1.33	1.85	
D	7.0	6.0	7.0	0.58	0.295	6.67	-0.03	0.49	
DD	7.7	8.4	8.0	0.35	0.207	8.03	1.16	1.67	
DE	9.6	9.8	10.0	0.20	0.118	9.80	2.69	3.20	⇑
DR	8.3	10.6	9.0	1.18	0.679	9.30	2.26	2.77	
DT	5.2	6.3	5.7	0.55	0.325	5.73	-0.83	-0.32	
DY	6.7	6.4	5.6	0.57	0.325	6.23	-0.40	0.12	
E	8.1	8.2	4.5	2.11	1.177	6.93	0.21	0.72	
EB	5.5	4.8	5.3	0.36	0.207	5.20	-1.30	-0.78	
EH	5.4	5.6	6.8	0.76	0.413	5.93	-0.66	-0.14	
EL	6.0	6.0	4.8	0.69	0.354	5.60	-0.95	-0.43	
EX	6.8	5.8	6.7	0.55	0.295	6.43	-0.23	0.29	
FE									•
FL	6.8	7.1	5.7	0.74	0.413	6.53	-0.14	0.38	
GI	5.8	7.8	6.8	1.00	0.591	6.80	0.09	0.61	
HK	6.9	6.6	6.3	0.30	0.177	6.60	-0.08	0.43	
HP									•
I	5.7	5.5	5.8	0.15	0.089	5.67	-0.89	-0.38	
IA									•
IU									•
J	6.4	5.8	5.4	0.50	0.295	5.87	-0.72	-0.20	

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit

⇓ ≡ Below control limit

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
JR									•
JS	5.5	6.4	6.0	0.45	0.266	5.97	-0.63	-0.12	
JY	5.0	5.0	5.0	0.00	0.000	5.00	-1.47	-0.95	
K	8.3	5.7	6.0	1.42	0.768	6.67	-0.03	0.49	
KL	5.6	6.3	7.0	0.70	0.413	6.30	-0.34	0.17	
KM	5.4	5.5	5.3	0.10	0.059	5.40	-1.12	-0.61	
KX									•
L	6.9	6.5	6.3	0.31	0.177	6.57	-0.11	0.40	
LF	7.2	6.4	7.4	0.53	0.295	7.00	0.26	0.78	
LR	8.3	6.5	10.4	1.95	1.289	8.40	1.48	1.99	
M	5.8	5.0	5.4	0.40	0.236	5.40	-1.12	-0.61	
MN									•
MP									•
MV	13.4	16.4	14.8	1.50	0.886	14.87	7.08	7.59	×
N	6.6	7.9	6.4	0.81	0.443	6.97	0.23	0.75	
NH	7.4	6.1	6.6	0.66	0.384	6.70	0.00	0.52	
NJ	6.3	5.1	5.7	0.60	0.354	5.70	-0.86	-0.35	
NO									•
O	6.3	6.4	6.1	0.15	0.089	6.27	-0.37	0.14	
OA	4.5	7.0	6.9	1.42	0.738	6.13	-0.49	0.03	
OB									•
OT	13.0	9.0	16.0	3.51	3.033	12.67	5.17	5.69	×
PB									•
PE									•
PW	7.0	8.0	6.0	1.00	0.591	7.00	0.26	0.78	
Q	6.7	8.3	7.8	0.82	0.473	7.60	0.78	1.30	
QX	5.1	6.0	7.6	1.27	0.738	6.23	-0.40	0.12	
QY									•
QZ	6.1	6.5	6.4	0.21	0.118	6.33	-0.31	0.20	
R	7.0	6.6	7.0	0.23	0.118	6.87	0.15	0.66	
RK									•
S	5.4	6.1	4.4	0.85	0.502	5.30	-1.21	-0.69	
SD									•
SM									•
SS	5.8	6.0	6.3	0.25	0.148	6.03	-0.57	-0.06	
SV	10.6	8.9	7.8	1.41	0.827	9.10	2.08	2.60	
SZ									•
TA									•
TC	7.3	7.4	7.8	0.26	0.148	7.50	0.70	1.21	
TD									•
TF									•
TL									•
TQ	5.4	7.7	3.7	2.01	1.345	5.60	-0.95	-0.43	
U	7.1	7.6	7.1	0.29	0.148	7.27	0.49	1.01	
UC									•

• ≡ No data submitted

∅ ≡ Insufficient data

TAG SYMBOLS

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⇑ ≡ Above control limit

⇓ ≡ Below control limit

ESD-LV Performance Evaluation: Iodine in Water, 11-Sep-1998

Iodine-131

Lab	Res. 1	Res. 2	Res. 3	Exper. Sigma	Rng anal (R + SR)	Average	Normalized deviation (grand-avg)	Normalized deviation (known)	Tag
UI									•
UM									•
UP	5.2	6.3	6.0	0.57	0.325	5.83	-0.75	-0.23	
UY									•
VA									•
VC									•
VM	10.0	10.0	10.0	0.00	0.000	10.00	2.86	3.38	⇑
VN									•
W									•
WM									•
WO									•
X	9.5	7.5	3.7	2.95	2.358	6.90	0.18	0.69	
XK									•
XQ									•
XT									•
Y	7.0	8.6	8.3	0.85	0.473	7.97	1.10	1.62	

Data sorted by Laboratory Average

Average	Tag	Lab	Average	Tag	Lab	Average	Tag	Lab
5.00		JY	6.10		A	6.93		E
5.10		AZ	6.13		OA	6.97		N
5.20		EB	6.17		BM	7.00		PW
5.30		S	6.20		BA	7.00		LF
5.40		M	6.23		QX	7.27		U
5.40		KM	6.23		DY	7.37		AJ
5.60		TQ	6.27		O	7.50		TC
5.60		EL	6.30		KL	7.50		BK
5.67		I	6.33		QZ	7.60		Q
5.67		C	6.43		AF	7.60		BH
5.67		AL	6.43		EX	7.97		Y
5.70		NJ	6.53		FL	8.03		DD
5.73		DT	6.57		L	8.07		AK
5.77		BO	6.60		BL	8.23		CX
5.83		UP	6.60		HK	8.40		LR
5.87		J	6.67		K	9.10		SV
5.93		EH	6.67		D	9.30		DR
5.93		CJ	6.70		NH	9.80	⇑	DE
5.93		CA	6.80		GI	10.00	⇑	VM
5.97		JS	6.87		R	10.00	⇑	AY
6.00		AW	6.87		CE	12.67	×	OT
6.03		SS	6.90		X	14.87	×	MV

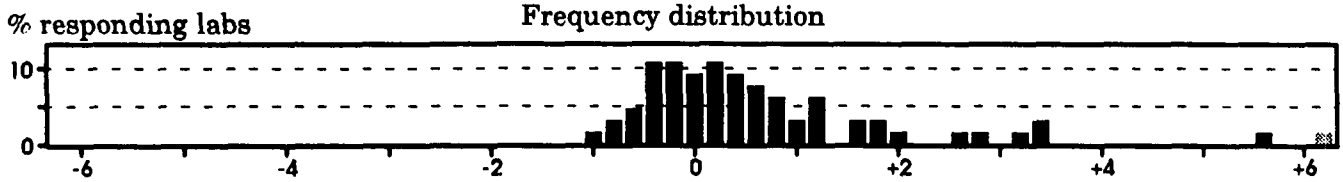
• ≡ No data submitted
∅ ≡ Insufficient data

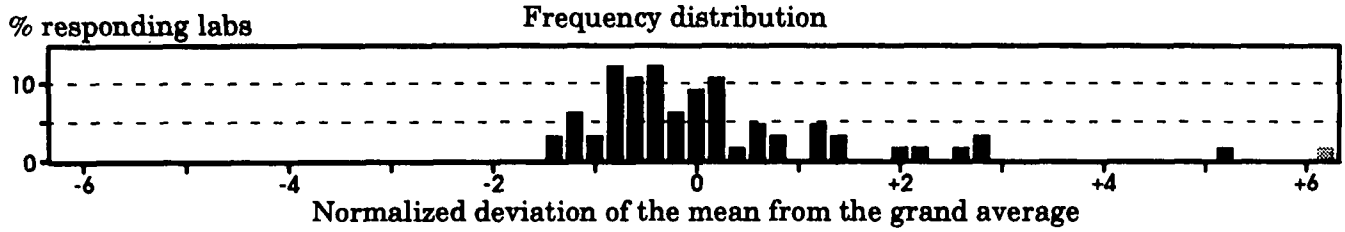
TAG SYMBOLS

× ≡ Determined to be an outlier

⇑ ≡ Above control limit
⇓ ≡ Below control limit

Iodine-131


% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the known value


% responding labs
Frequency distribution
10
0
-6
-4
-2
0
+2
+4
+6
Normalized deviation of the mean from the grand average