B BRAUN
SHARING EXPERTISE

Blood Glucose
Measurement

Omnitest® 3

ACCURACY TEST
INTERNATIONAL STANDARD ISO 15197:2013

Omnitest® 3 Accuracy Test

In accordance with the ISO 15197:2013 standard, new criteria for blood glucose meters have been published.

The aim of this document is to present a summary of the key requirements concerning the new and stricter international standard. It describes the different acceptance criteria which are now part of the original ISO document and how Omnitest® 3 meets these new requirements.

THE MAIN TOPICS AT A GLANCE

System Accuracy Evaluation

TEST INFORMATION

SYSTEM ACCURACY

The accuracy of Omnitest® 3 blood glucose monitoring system was assessed by comparing patients' blood glucose results obtained with Omnitest® 3 with those of a standard laboratory instrument, the YSI 2300 auto analyzer.

1) Test date	November 26, 2012 – December 12, 2012
2) Test meter serial number	GAA2RDMC00049 – GAA2RDMC00054
3) Test strip lot numbers	G5MJ24 (Lot #1), G5MJ25 (Lot #2), G5MJ26 (Lot #3)
4) Sample numbers	▪ 6 x Omnitest® 3 meter ▪ 600 x Omnitest® 3 test strips (three lots) ▪ 1 x YSI 2300 auto analyzer
5) Standard/guidance documents referenced	▪ ISO/DIS 15197:2010 In Vitro diagnostic test systems Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus (during clinical trial) ▪ ISO 15197:2013 In Vitro diagnostic test systems Requirements for blood-glucose monitoring systems for self-testing in managing diabetes mellitus (for data analysis) ▪ CLSI EP09-A2: 2004 Method comparison and bias estimating using patient samples

SAMPLE DISTRIBUTION

SYSTEM ACCURACY

Glucose concentration mmol/L	Percentage of sample	Sample numbers	Preparation of sample
≤ 2.77	5 %	5	glycolyzed
> 2.77 – 4.44	15 %	15	unaltered
> 4.44 – 6.66	20 %	20	unaltered
> 6.66 – 11.10	30 %	30	unaltered
> 11.10 – 16.65	15 %	15	unaltered
> 16.65 – 22.20	10 %	10	unaltered
> 22.20	5 %	5	supplemented with glucose
Total	100 %	100	

Distribution of glucose concentrations in samples for system accuracy evaluation

System Accuracy Evaluation Difference Plot

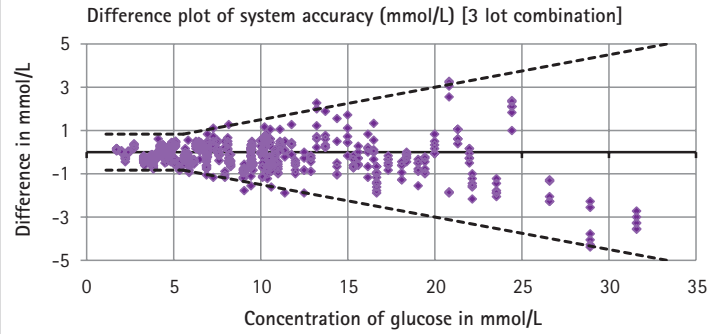
ACCEPTANCE CRITERIA

ACCURACY PLOT – PART 1

Blood glucose concentration & requirements	Tolerance range
< 5.55 mmol/L	± 0.83 mmol/L
≥ 5.55 mmol/L	± 15 %
Minimum requirement: 95 % of all results within tolerance range	

TEST RESULTS

SYSTEM ACCURACY PLOT



Difference plot of system accuracy of 3 x 200 blood glucose samples with Omnitest® 3 compared to YSI 2300 in a hospital using 3 lots of test strips

DATA ANALYSIS

BIAS DISTRIBUTION ANALYSIS COMPARED WITH YSI 2300

System accuracy results for glucose concentration < 5.55 mmol/L

Strip lot	Within ±0.28 mmol/L	Within ±0.56 mmol/L	Within ±0.83 mmol/L
Lot 1	**74.2 %** [46/62]	**93.5 %** [58/62]	**100.0 %** [62/62]
Lot 2	**64.5 %** [40/62]	**95.2 %** [59/62]	**100.0 %** [62/62]
Lot 3	**58.1 %** [36/62]	**93.5 %** [58/62]	**100.0 %** [62/62]
Combined	**65.6 %** [122/186]	**94.1 %** [175/186]	**100.0 %** [186/186]

Combined lots within ± 0.83 mmol/L: **100.0 %** [186/186]

System accuracy results for glucose concentration ≥ 5.55 mmol/L

Strip lot	Within ±5 %	Within ±10 %	Within ±15 %
Lot 1	**55.8 %** [77/138]	**91.3 %** [126/138]	**95.7 %** [132/138]
Lot 2	**50.7 %** [70/138]	**88.4 %** [122/138]	**97.1 %** [134/138]
Lot 3	**49.3 %** [68/138]	**85.5 %** [118/138]	**96.4 %** [133/138]
Combined	**51.9 %** [215/414]	**88.4 %** [366/414]	**96.4 %** [399/414]

Combined lots within ± 15 %: **96.4 %** [399/414]

System accuracy results for glucose concentrations between 1.7 mmol/L and 31.6 mmol/L
Within ± 0.83 mmol/L or ± 15 %

97.5 % [585/600]

RESULT

97.5 % of results are within ± 0.83 mmol/L or ± 15 % for combined lots.

CONCLUSION

Omnitest® 3 exceeds the minimum requirement of 95 % system accuracy.

System Accuracy Evaluation
Consensus Error Grid

ACCEPTANCE CRITERIA

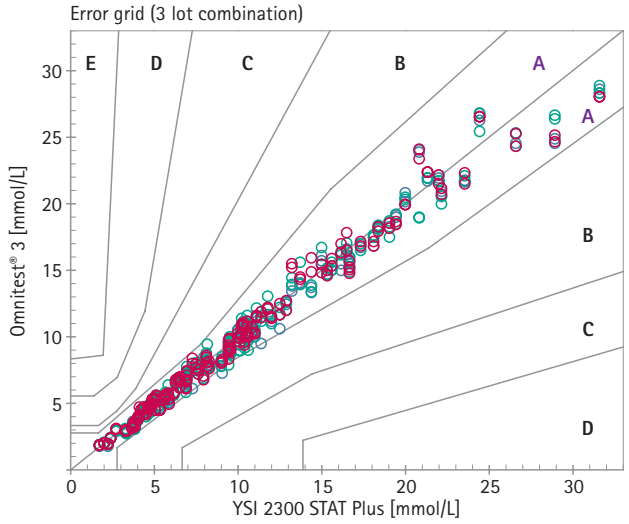
ACCURACY PLOT – PART 2

Test criteria	Tolerance range
Consensus error grid	99 % of results within zones A and B of the consensus error grid for type 1 diabetes

Zone	Classification
A	No effect on clinical action.
B	Altered clinical action – little or no effect on clinical outcome.
C	Altered clinical action – likely to affect clinical outcome.
D	Altered clinical action – could have significant medical risk.
E	Altered clinical action – could have dangerous consequences.

TEST RESULTS

CONSENSUS ERROR GRID



Definition of zones in consensus error grid

DATA ANALYSIS

CONSENSUS ERROR GRID

Strip lot	Zone A	Zone B	Zone C	Zone D	Zone E	Total
Lot 1	**99.5** % [199/200]	**0.5** % [1/200]	0 % [0/200]	0 % [0/200]	0 % [0/200]	**100** % [200/200]
Lot 2	**99.5** % [199/200]	**0.5** % [1/200]	0 % [0/200]	0 % [0/200]	0 % [0/200]	**100** % [200/200]
Lot 3	**100** % [200/200]	**0.0** % [0/200]	0 % [0/200]	0 % [0/200]	0 % [0/200]	**100** % [200/200]
Combined	**99.7** % [598/600]	**0.3** % [2/600]	0 % [0/600]	0 % [0/600]	0 % [0/600]	**100** % [600/600]

RESULT

100 % of results are within zones A and B of the consensus error grid.

CONCLUSION

Omnitest® 3 exceeds the system accuracy requirement that 99 % of results are within zones A and B.

User Performance Evaluation

The user performance evaluation is split into two test components:
accuracy of user performance and user evaluation of the instructions for use.

TEST INFORMATION

USER PERFORMANCE EVALUATION

- 100 lay persons took part in the study, representing different ages, genders and educational levels.
- Participants were given the instructions for use and an Omnitest® 3 test kit.
- No further instructions, training, assistance, feedback or supplementary instructional material were provided.
- Test persons were then asked to measure their blood glucose level with Omnitest® 3, afterwards the results were compared with those measured by the laboratory reference method.

1) Study period	April 13, 2015 – April 30, 2015
2) Test meter serial number	GAA2RDPB00042
3) Test strip lot number	G5QC17
4) Reference laboratory device	YSI 2300 auto analyzer
5) Standard/guidance document referenced	ISO 15197:2013 In vitro diagnostic test systems Requirements for blood glucose monitoring systems for self-testing in managing diabetes mellitus

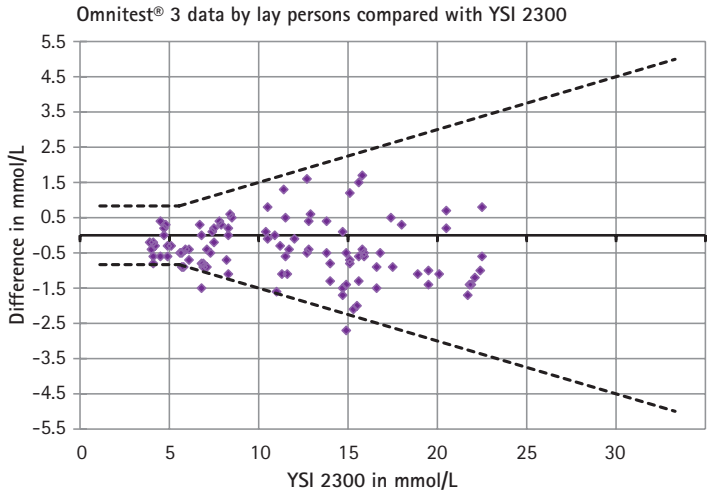
ACCEPTANCE CRITERIA

USER PERFORMANCE EVALUATION

Blood glucose concentration & requirements	Tolerance range
< 5.55 mmol/L	± 0.83 mmol/L
≥ 5.55 mmol/L	± 15 %
Minimum requirement: 95 % of all results within tolerance range	

TEST RESULTS

USER PERFORMANCE EVALUATION



Difference plot of the 100 blood glucose samples of the lay persons compared with YSI 2300

DATA ANALYSIS

LAY PERSONS COMPARED WITH YSI 2300

System accuracy results for glucose concentration < 5.55 mmol/L

Within ±0.28 mmol/L	Within ±0.56 mmol/L	Within ±0.83 mmol/L
35.7 % [5/14]	**78.6** % [11/14]	**100.0** % [14/14]

System accuracy results for glucose concentration ≥ 5.55 mmol/L

Within ±5 %	Within ±10 %	Within ±15 %
43.0 % [37/86]	**79.1** % [68/86]	**96.5** % [83/86]

System accuracy results for glucose concentrations between 3.93 mmol/L and 22.5 mmol/L **Within ± 0.83 mmol/L or ± 15 %**	**97.0 %** [97/100]

RESULT

97.0 % of the results within ± 0.83 mmol/L or ± 15 % for combined lots.

CONCLUSION

Omnitest® 3 exceeds the required system accuracy of 95 % with regards to the user performance evaluation.

User Performance Evaluation

TEST INFORMATION

EVALUATION OF INSTRUCTIONS FOR USE BY LAY PERSONS

The participants had to complete a questionnaire about the system components, handling and features. They were supposed to indicate their impression on the ease of use of the meter on a six-point scale (1 = excellent, 2 = very good, 3 = good, 4 = bad, 5 = very bad, 6 = terrible).

DATA ANALYSIS

QUESTIONNAIRE RESULTS FOR OMNITEST® 3

How would you rate the ...	Mean average
Size of the meter	2.3
Design of the meter	2.4
Size of the meter buttons	2.4
Readability of the blood glucose value	2.3
Readability of date, time and symbols	2.7
Handling of test strip vial	2.5
Design of test strip (application and insertion site clearly visible?)	2.5
Size of test strip	2.6
Insertion of test strip	2.6
Test procedure	2.3
Impression of automatic coding	2.0
Understandability of the shown symbols/icons	2.9
Recognizability, that meter is ready for measurement	2.2
Blood sample volume	2.1
Convenience of blood sample input	2.5
Buzzer volume	2.3
Measuring time	2.1
Strip ejector	2.6
Total	**2.4**

DATA ANALYSIS

EVALUATION OF INSTRUCTIONS FOR USE BY LAY PERSONS

Scale	Response	Number	Percentage (%)
1	Excellent	779	25.6
2	Very good	857	28.2
3	Good	916	30.1
4	Bad	382	12.6
5	Very bad	91	3.0
6	Terrible	17	0.6
Total		**3042**	**100**

Altogether, 3042 statements were evaluated (169 participants x 18 questions).

Data evaluation result for Omnitest® 3

83.9 %

excellent, very good or good

CONCLUSION

The received average scores prove that Omnitest® 3 is excellent, very good or good to handle for lay persons.

Hematocrit Interference Evaluation

TEST INFORMATION

HEMATOCRIT INTERFERENCE EVALUATION

The evaluation of the effect of hematocrit levels was carried out with various blood samples:

- Different percentages:
  < 8.32 mmol/L: 20, 30, 42, 50, 60 %
  ≥ 8.32 mmoL/L: 20, 30, 35, 42, 50, 55, 60 %
- Adjustment of glucose concentration to 4 levels: 2.39, 6.16, 18.93 and 24.25 mmol/L
- 20 tests of each sample

1) Test date	February 12, 2013
2) Test meter serial number	GAA2RDMC00049 – GAA2RDMC00068
3) Test strip lot numbers	G5MJ24 (lot #1), G5MJ25 (lot #2), G5MJ26 (lot #3)
4) Sample numbers	▪ 20 Omnitest® 3 test meters ▪ 1 YSI 2300 auto analyzer ▪ 900 Omnitest® 3 test strips
5) Standard/guidance documents referenced	ISO 15197:2013 In vitro diagnostic test systems Requirements for blood glucose monitoring systems for self-testing in managing diabetes mellitus

ACCEPTANCE CRITERIA

HEMATOCRIT INTERFERENCE EVALUATION

Blood glucose concentration	Tolerance range
< 5.55 mmol/L	± 0.56 mmol/L [mean bias of normal hematocrit level (= 42 %)]
≥ 5.55 mmol/L	± 10 % [mean bias of normal hematocrit level (= 42 %)]

DATA ANALYSIS AND CONCLUSION

After analysis of test data according to ISO 15197:2013, Omnitest® 3 can be used within a hematocrit range of 20 – 60 % below 8.32 mmol/L and within a hematocrit range of 30 - 55 % above 8.32 mmol/L.

Endogenous and Exogenous Interfering Substances Evaluation

TEST INFORMATION

INTERFERING SUBSTANCES

ISO 15197:2013 includes a list of substances that may appear in blood and have been found to interfere with glucose measurement procedures.

The evaluation was carried out using two glucose concentrations, within the interval of 2.77 mmol/L to 5.55 mmol/L and within the interval of 13.88 mmol/L to 19.43 mmol/L.

ACCEPTANCE CRITERIA

INTERFERING SUBSTANCES

Blood glucose concentration	Tolerance range
< 5.55 mmol/L	± 0.56 mmol/L mean error between the test sample and the control sample
≥ 5.55 mmol/L	± 10 % mean error between the test sample and the control sample

Substances causing interferences that exceed the acceptance criteria have to be listed in the instructions for use.

DATA ANALYSIS

INTERFERING SUBSTANCES

Substance tested	Substance concentration	Tolerance range with glucose 2.77 – 5.55 mmol/L	Tolerance range with glucose 13.88 – 19.43 mmol/L	Criteria
Acetaminophen	10 mg/dL	- 0.39 mmol/L	5.7 %	Passed
Ascorbic acid	6 mg/dL	0.40 mmol/L	4.2 %	Passed
Bilirubin	4 mg/dL	- 0.37 mmol/L	- 4.2 %	Passed
Cholesterol	500 mg/dL	0.18 mmol/L	2.8 %	Passed
Creatinine	4 mg/dL	0.22 mmol/L	- 0.8 %	Passed
Dopamine	0.09 mg/dL	- 0.31 mmol/L	1.3 %	Passed
EDTA	180 mg/dL	0.26 mmol/L	- 0.2 %	Passed
Ethanol	400 mg/dL	- 0.04 mmol/L	- 5.5 %	Passed
Galactose	15 mg/dL	0.01 mmol/L	1.4 %	Passed
Gentistic acid	2 mg/dL	0.06 mmol/L	- 3.1 %	Passed
Glutathione	3 mg/dL	0.13 mmol/L	- 1.2 %	Passed
Hemoglobin	200 mg/dL	- 0.41 mmol/L	- 4.7 %	Passed
Heparin	6800 mg/dL	- 0.12 mmol/L	- 1.7 %	Passed
Ibuprofen	21 mg/dL	0.44 mmol/L	5.2 %	Passed
Icodextrin	500 mg/dL	0.15 mmoL/L	- 0.7 %	Passed
Lactose	100 mg/dL	0.22 mmol/L	3.8 %	Passed
Levodopa	1 mg/dL	0.04 mmol/L	- 4.9 %	Passed
Maltose	300 mg/dL	0.12 mmol/L	2.9 %	Passed
Mannitol	600 mg/dL	0.15 mmol/L	2.3 %	Passed
Methyldopa	2 mg/dL	0.04 mmol/L	- 3.5 %	Passed
Penicillin	12 mg/dL	0.16 mmol/L	0.7 %	Passed
Pralidoxime iodide	20 mg/dL	0.11 mmoL/L	1.9 %	Passed
Salicylic acid	60 mg/dL	- 0.19 mmol/L	- 1.7 %	Passed
Sorbitol	70 mg/dL	0.17 mmol/L	0.9 %	Passed
Tetracycline	2 mg/dL	- 0.08 mmol/L	- 4.1 %	Passed
Triglyceride	3000 mg/dL	0.19 mmol/L	4.0 %	Passed
Tolazamide	5 mg/dL	- 0.08 mmol/L	- 4.8 %	Passed
Tolbutamide	32 mg/dL	- 0.20 mmol/L	- 4.5 %	Passed
Urea	260 mg/dL	- 0.22 mmol/L	- 2.0 %	Passed
Uric acid	24 mg/dL	- 0.18 mmol/L	- 1.2 %	Passed
Warfarin	1 mg/dL	0.01 mmol/L	- 0.0 %	Passed
Xylose	10 mg/dL	0.43 mmol/L	7.6 %	Passed

For further details, refer to the instructions for use for the test strips.

CONCLUSION

All 30 substances tested do not significantly interfere with the performance of Omnitest® 3.

Precision Test and Repeatability Evaluation

TEST INFORMATION

PRECISION TEST

The precision of Omnitest® 3 was assessed by using venous whole blood samples. The glucose concentration in the venous whole blood samples was adjusted by supplementing the sample with an aqueous glucose solution.
To achieve lower glucose concentration, anticoagulant blood samples were allowed to age until the glucose is depleted to the desired level.

The glucose levels in the blood samples were measured using the laboratory reference equipment (YSI 2300 auto analyzer). The five glucose levels were tested with three lots of test strips and on ten different meters ten times each.

ACCEPTANCE CRITERIA

PRECISION TEST

ISO 15197:2013 does not specify acceptance criteria for the precision test. Therefore, B. Braun has set the following criteria:

Standard deviations (SD) of each glucose concentration
< 5.55 mmol/L should be below 0.28 mmol/L.

Coefficient variations (CV) of each glucose concentration
≥ 5.55 mmol/L should be below 5 %.

DATA ANALYSIS

PRECISION TEST

		< 5.55 mmol/L		≥ 5.55 mmol/L		
Lot 1	Mean	2.44 mmol/L	4.22 mmol/L	7.27 mmol/L	11.38 mmol/L	18.37 mmol/L
	SD	0.06 mmol/L	0.13 mmol/L	NA	NA	NA
	CV	NA	NA	2.5 %	1.6 %	1.1 %
Lot 2	Mean	2.28 mmol/L	4.11 mmol/L	7.33 mmol/L	11.27 mmol/L	18.70 mmol/L
	SD	0.07 mmol/L	0.09 mmol/L	NA	NA	NA
	CV	NA	NA	2.0 %	1.7 %	1.4 %
Lot 3	Mean	2.44 mmol/L	4.33 mmol/L	7.38 mmol/L	11.10 mmol/L	18.70 mmol/L
	SD	0.06 mmol/L	0.12 mmol/L	NA	NA	NA
	CV	NA	NA	1.5 %	1.6 %	1.7 %
Total	**Grand mean**	**2.39 mmol/L**	**4.22 mmol/L**	**7.33 mmol/L**	**11.27 mmol/L**	**18.59 mmol/L**
	Pooled SD	**0.09 mmol/L**	**0.14 mmol/L**	**NA**	**NA**	**NA**
	Pooled CV	**NA**	**NA**	**2.1 %**	**1.9 %**	**1.6 %**

CONCLUSION

Omnitest® 3 has proven excellent precision and repeatability at all blood glucose levels tested.

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