

**510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION  
DECISION MEMORANDUM  
ASSAY AND INSTRUMENT COMBINATION TEMPLATE**

**A. 510(k) Number:**

k142789

**B. Purpose for Submission:**

Modification of a previously cleared test system to include updated software and hardware.

**C. Measurand:**

Glycosylated hemoglobin (HbA1c)

**D. Type of Test:**

Quantitative, Immuno-turbidmetric assay

**E. Applicant:**

SAKAE Corporation

**F. Proprietary and Established Names:**

A1c iGear System

**G. Regulatory Information:**

1. Regulation section:

<b>Classification Name</b>	<b>Product Code</b>	<b>Device Class</b>	<b>Regulation Number</b>
Glycosylated hemoglobin assay	LCP	II	21 CFR 864.7470
Discrete photometric chemistry analyzer for clinical and point of care use.	JJE	I	21 CFR 862.2160

2. Panel:

81 Hematology

## H. Intended Use:

1. Intended use(s):

See indications for use below.

2. Indication(s) for use:

The A1c iGear is intended for in vitro diagnostic use only for the quantitative measurement of the percent hemoglobin A1c (%HbA1c) from finger-stick blood or venous blood collected in either EDTA or sodium fluoride (NaF) for clinical laboratory and point of care use. The measurement of HbA1c is recommended to monitor long-term glycemic control of persons previously diagnosed with diabetes mellitus. This test is not for screening or diagnosis of diabetes.

3. Special conditions for use statement(s):

- For prescription use only.
- This test is not for screening or diagnosis of diabetes.
- Clinical setting and Point-of-Care.
- This test should not be used in monitoring daily glucose control.
- Should not be used to replace daily home testing of urine and blood glucose levels.
- Should not be used for analyzing samples from patients with conditions causing shortened red cell survival, such as hemolytic disease, pregnancy, and significant acute or chronic blood loss.
- Hemoglobinopathies may interfere with glycosylated hemoglobin analysis. Samples containing the following hemoglobin variant have been shown to interfere with this assay: Hemoglobin C, Hemoglobin D, Hemoglobin E, Hemoglobin F (>10%), and Hemoglobin S.

4. Special instrument requirements:

A1c iGear spectrophotometric analyzer

## I. Device Description:

The A1c iGear System is comprised of a fully automated electrical spectrophotometer that measures %HbA1c in human whole blood or finger-stick samples using a dedicated reagent (MEDIDAS HbA1c). The A1c iGear system shines light from a 660 nm light emitting diode (LED) through the test material and measures the quantity of hemoglobin A1c in the total hemoglobin (HbA1c%) based on the lot-specific reagent parameter and changes in light absorbency caused by antigen-antibody reactions.

The MEDIDAS HbA1c test kit is comprised of test cartridge, capillary, pipette tip, and master calibration card. The cartridge is pre-filled with reagent: latex (Reagent 1:R1), antibody (Reagent 2:R2), and sample diluent solution.

R1 Reagent:

- 0.3% w/v latex particles
- 0.2% w/v triethanolamine
- 0.02% w/v sodium hydrogen carbonate
- 0.02% w/v sodium azide
- 15mM bicine buffer

R2 Reagent:

- 0.002% w/v mouse monoclonal IgG anti-human HbA1c antibody
- 0.0001% w/v goat anti-mouse IgG antibodies
- 1.3% w/v sodium chloride
- 1.3% w/v nonreactive ingredients
- 5mM bis-tris buffer

Controls are sold separately and are not a part of the A1ciGear System.

The A1ciGear System is the same device as the A1cGear system previously cleared in k130014; however, the device has been modified to include a change in the name of the test system, an external connection has been added to enable the analyzer to connect to external PC and USB flash memory, and the air filter has been simplified and air circulation has been improved from the front side of the analyzer. Finally, electrical system improvements included addition of a color LCD touch panel and control, A/D converter, external communication, and Operational board integrations. There was no change to the reagent component (MEDIDAS HbA1c cartridge).

**J. Substantial Equivalence Information:**

1. Predicate device name(s):  
SAKAE A1c Gear System
2. Predicate 510(k) number(s):  
K130014
3. Comparison with predicate:

<b>Similarities and Differences</b>		
<b>Item</b>	<b>New Device A1c iGear and MEDIDAS HbA1c</b>	<b>Predicate Device A1c Gear System (k130014)</b>
Intended Use	Quantitative measurement of percent hemoglobin A1c in human whole blood	Same
Methodology	Immuno-turbidimetric	Same
Sample Type	Finger stick blood or venous whole	Same

<b>Similarities and Differences</b>		
<b>Item</b>	<b>New Device A1c iGear and MEDIDAS HbA1c</b>	<b>Predicate Device A1c Gear System (k130014)</b>
	blood collected in K <sub>2</sub> -EDTA or sodium fluoride (NaF)	
Recommended Testing Environment	Professional use; clinical laboratory and Point of Care	Same
Analytical Range	4.0 – 13.0%	Same
Reagent Storage	2-8 °C (36-46 °F)	Same
Hemolysate preparation	Automatic	Same
Visual Display	Color LCD touch panel	LCD

**K. Standard/Guidance Document Referenced (if applicable):**

Guidance for the Content of Premarket Submissions for Software in Medical Devices, 2005

IEC60601-1: Medical Electrical Equipment-Part 1: General requirements for Basic Safety and Essential Performance, 1988

IEC60601-1+A1: Medical electrical equipment-Part1: General requirements for basic safety and essential performance, 1991

IEC60601-1+A2: Medical electrical equipment-Part 1: General requirement for basic safety and essential performance, 1995

IEC61326-2-6: Electrical equipment for measurement, control and laboratory use – EMC requirements-Part 2-6: Particular requirements – In vitro diagnostic (IVD) medical equipment, 2012

IEC62304: Medical Device Software-Software Life Cycle Processes, 2006

ISO14971: Medical Devices-Application of Risk Management of Medical Devices, 2007

**L. Test Principle:**

The A1c iGear system is an immune-turbidimetric method enhanced by latex particles using a two-reagent sequence. Hemolysate is mixed with the R1 reagent. Total Hemoglobin and HbA1c have the same absorption affinity for these particles; therefore, the % of HbA1c present in the total hemoglobin is proportional to the latex-bound HbA1c. Addition of R2 reagent leads to agglutination complexes, formed by the interaction between latex-bound HbA1c and the corresponding antibodies. Turbidity created by these aggregates is proportional to the amount of latex-bound HbA1c therefore is proportional to the % of

HbA1c in the total hemoglobin.

**M. Performance Characteristics (if/when applicable):**

1. Analytical performance:

a. *Precision/Reproducibility:*

Internal Precision Study

Precision studies were performed according to CLSI EP5-A2 guideline. The within-run precision, between-run precision, between-day precision and total precision were determined using the A1c iGear System. The study included whole blood samples representing low, middle, and high levels of %HbA1c and a 3-level whole blood control. The mean values for the controls were 5.9% (low level), 7.4% (middle level), and 11.7% (high level). The mean value for the whole blood samples were 5.6% (low level), 7.3% (middle level), and 10.7% (high level). Each sample was tested in duplicate for 10 days on two iGear instruments for a total of 40 results per sample. Results are shown below:

Sample	N	Mean %HbA1c	Within-run		Between-run		Between-day		Total Precision	
			SD	%CV	SD	%CV	SD	%CV	SD	%CV
Control L	40	5.9	0.06	0.93	0.05	0.85	0.02	0.34	0.08	1.30
Control M	40	7.4	0.08	1.04	0.11	1.50	0.00	0.00	0.14	1.82
Control H	40	11.7	0.10	0.87	0.13	1.10	0.09	0.75	0.19	1.59
Sample 1	40	5.6	0.06	1.02	0.19	3.33	0.00	0.00	0.20	3.47
Sample 2	40	7.3	0.06	0.78	0.03	0.37	0.07	0.88	0.09	1.24
Sample 3	40	10.7	0.09	0.83	0.24	2.24	0.45	0.45	0.26	2.43

External Precision Study

The external precision study was performed at 3 Point of Care (POC) sites using the A1c iGear System. Three whole blood control (~5.9, ~7.4, ~11.4) samples and three EDTA whole blood samples (~5.4, ~7.2, and ~10.1) were analyzed. The control material was analyzed in duplicate twice a day two tests per day for 20 days and the patient samples was analyzed in duplicate twice per day for each sample for 10 days. Results are shown below:

Sample	N	Site	Mean %HbA1c	Within-site CV (%)	Overall mean	Reproducibility CV (%)
Control L	120	A	5.9	1.40	5.9	1.96
	120	B	5.8	1.03		
	120	C	5.9	1.59		
Control M	120	A	7.5	1.32	7.4	1.42
	120	B	7.4	1.01		
	120	C	7.4	1.56		
Control H	120	A	11.6	1.60	11.4	2.42

	120	B	11.3	2.19		
	120	C	11.4	1.78		
Sample 1	60	A	5.4	2.04	5.4	2.29
	60	B	5.3	1.37		
	60	C	5.4	2.98		
Sample 2	60	A	7.2	1.09	7.2	1.24
	60	B	7.2	1.14		
	60	C	7.2	1.23		
Sample 3	60	A	10.2	1.03	10.1	1.68
	60	B	10.0	1.11		
	60	C	10.1	2.23		

*b. Linearity/assay reportable range:*

Linearity was previously evaluated for this assay under k130014. The reportable range for this device is 4.0-13.0% HbA1c.

*c. Traceability, Stability, Expected values (controls, calibrators, or methods):*

Traceability: The A1c iGear System is certified with the National Glycohemoglobin Standardization Program (NGSP). The NGSP certification expires in one year. See NGSP website for current certification at <http://www.ngsp.org>.

Value Assignment: The sponsor recommends the use of Bio-Rad Lyphochek Diabetes Control (k070546) as a commercially available external control to be used with this device.

Calibration: The values for calibration curve for each reagent lot are contained within the barcode and encoded onto the Master Calibration card and are traceable to the International Federation of Clinical Chemistry (IFCC) reference material.

Stability: The A1c iGear System (Master Calibration Card and test cartridge) should be refrigerated at 2-8 °C (36-46 °F) and used immediately after opening. The expiration date of the Master Calibration Card and cartridge as stated on the seal of the outer box package is 12 months after the date of manufacture.

*d. Detection limit:*

The Limit of Blank (LoB) and Limit of Detection (LoD) were previously evaluated in K130014. The assay has a reportable range of 4.0-13.0% HbA1c. Detection limits are summarized in the table below:

LoB	LoD
2.3%	2.6%

e. *Analytical specificity:*

Interference studies were previously evaluated in K130014

The interferent study results are summarized in the table below:

Potential Interferent	Highest concentration in which no significant interference was observed
Unconjugated Bilirubin	37 mg/dL
Triglycerides	2,000 mg/dL
Conjugated Bilirubin	40 mg/dL
Rheumatoid Factor	550 IU/mL
Acetaminophen	20 mg/dL
Ibuprofen	50 mg/dL
Glibenclamide	0.2 mg/dL
Metformin	5.1 mg/dL
Ascorbic Acid	6.0 mg/dL

An interference study was previously evaluated to assess the effect of labile A1c, Carbamylated hemoglobin, and acetylsalicylic acid with the A1c Gear System in k130014. The sponsor concluded there was no significant interference with the following:

- Labile A1c concentrations up to 2000 mg/dL
- Carbamylated hemoglobin up to 10 mg/dL
- Acetylated hemoglobin up to 200 mg/dL

A hemoglobin variant study was evaluated using commercial samples known to contain Hemoglobin variants C, D, E, S, and F in k130014. Samples contained both low and high levels of % HbA1c at concentrations from 4.2-11.6% HbA1c. These variant samples were tested in duplicate using the A1C Gear System. The results indicated samples containing Hemoglobin C were elevated by 24%, samples containing Hemoglobin D were elevated by 16%, samples containing Hemoglobin E were elevated by 13%, and samples containing Hemoglobin S were elevated by 13%. Samples containing >10% Hemoglobin F were decreased by 22%. All variants tested were shown to interfere with this device.

The device labeling contains the following boxed warning:

“Hemoglobinopathies may interfere with glycated hemoglobin analysis. Samples containing the following hemoglobin variants have been shown to interfere with this assay: Hemoglobin C, Hemoglobin D, Hemoglobin E, Hemoglobin F (>10%) and Hemoglobin S.”

f. *Assay cut-off:*

Not Applicable

2. Comparison studies:

a. *Method comparison with predicate device:*

An external method comparison study was performed using finger-stick samples at 3 POC sites and analyzed on the A1c iGear System versus venous EDTA whole blood samples collected from the same patients and analyzed on the Tosoh G8 analyzer. The samples tested range from 5.1 – 11.7% HbA1c to include the clinically relevant range. The results are as follows:

Study Site	N	Min	Max	Slope (95% CI)	Intercept (95% CI)	R <sup>2</sup>
1	42	5.2	11.3	0.95 (0.93 to 0.98)	0.10 (-0.13 to 0.32)	0.99
2	44	5.1	11.7	0.95 (0.91 to 0.98)	0.20 (-0.03 to 0.44)	0.99
3	40	5.2	9.3	0.94 (0.88 to 0.99)	0.34 (-0.02 to 0.70)	0.97

b. *Matrix comparison:*

Finger stick blood or venous whole blood collected in K<sub>2</sub>EDTA or sodium fluoride (NaF) have been shown to be acceptable for use with the A1c iGear System. Previously established in K130014

3. Clinical studies:

a. *Clinical Sensitivity:*

Not Applicable

b. *Clinical specificity:*

Not Applicable

c. *Other clinical supportive data (when a. and b. are not applicable):*

4. Clinical cut-off:

Not Applicable

5. Expected values/Reference range:

Reference Range<sup>1</sup>

The American Diabetes Association (ADA) expected value range is 4.0-6.0% HbA1c for people without diabetes.

The American Diabetes Association's (ADA) most recent Clinical Practice Recommendation for diabetes specified a treatment goal of less than 7% and suggests additional action when HbA1c level is above 8%.

HbA1c Value	Glycemic Goal
<8% HbA1c	Less stringent
<7% HbA1c	General (Non-Pregnant Adult)
<6.5% HbA1c	More stringent

As recommended by the ADA, patients in the range of 5.7-6.4% HbA1c would be in the category of increased risk for diabetes.

<sup>1</sup>American Diabetes Association. Diabetes Care 37 (January 2014): Suppl. 1. S14-S80.

**N. Instrument Name:**

A1c iGear System

**O. System Descriptions:**

1. Modes of Operation:

Fully automated desktop Spectrophotometric analyzer

Does the applicant's device contain the ability to transmit data to a computer, webserver, or mobile device?

Yes  or No

Does the applicant's device transmit data to a computer, webserver, or mobile device using wireless transmission?

Yes  or No

2. Software:

FDA has reviewed applicant's Hazard Analysis and software development processes for this line of product types:

Yes  or No

3. Specimen Identification:

Barcoding or Manual entry

4. Specimen Sampling and Handling:

Sample is obtained via a capillary tube that is inserted into a sampling cartridge. A pipette tip is added to the sampling cartridge along with the capillary tube. The sampling cartridge, which contains the capillary tube and the pipette tip, are inserted into the sampling slot. Samples must be tested within one hour after inserting the capillary into the cartridge. The sampling door is closed and the system beeps to start the test. A barcode printed on the reagent cartridge is recognized by a barcode reader and verified to use the appropriate calibration values for the particular lot number of the test cartridge.

5. Calibration:

The reagent kit contains a master calibration card. It is recommended to enroll the Master Calibration card after opening every reagent kit.

6. Quality Control:

In the labeling the sponsor recommends that control measurements be assayed when installing the device, when using a new lot of reagent, when using a new shipment of reagent, when test results do not match other clinical findings or symptoms, when using the device or reagent that had been stored for long-term, when reagents are stored improperly, when training and confirming performance of new operators, following national and/or local regulations for the facility, at regular intervals determined by the laboratory procedures.

**P. Proposed Labeling:**

The labeling is sufficient and it satisfies the requirements of 21 CFR Part 809.10.

**Q. Conclusion:**

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.