510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY

A. 510(k) Number:

K172514

B. Purpose for Submission:

Modified collection cup

C. Measurand:

Sperm concentration and semen volume

D. Type of Test:

Centrifuged packed cell height via density gradient separation for estimation of sperm concentration and visual readout of fluid height for semen volume

E. Applicant:

Sandstone Diagnostics, Inc.

F. Proprietary and Established Names:

Trak® Male Fertility Testing System

G. Regulatory Information:

1. Regulation section:

   21 CFR § 864.5220, Automated differential cell counter

2. Classification:

   Class II

3. Product code:

   POV – Semen Analysis Device

4. Panel:

   Hematology (81)

H. Intended Use:

1. Intended use(s):

   The Trak Male Fertility Testing System is intended for semi-quantitative assessment of sperm concentration at 15 million sperm per milliliter (M/mL) or below, between 15 and 55 M/mL, and above 55 M/mL. It also provides a qualitative assessment of semen volume.

   Sperm concentration and semen volume are only two factors that could impact a man's fertility status and time to pregnancy. For complete assessment of male reproductive health, the user should consult a physician. For *in vitro*, over the counter home use.

2. Indication(s) for use:

   Same as Intended Use

3. Special conditions for use statement(s):

   For over-the-counter (OTC) use

4. Special instrument requirements:

   The Trak Male Fertility Testing System (Trak) includes a small instrument, the Engine. It spins a test Prop to compact sperm cells within an introduced semen sample into a visible column.

I. Device Description:

The Trak Male Fertility Testing System (Trak) includes: (1) small instrument (the Engine), (2) AA batteries for the engine, (4) disposable units in which liquefied semen is introduced and where the sperm concentration is interpreted (the Prop), (4) volume cups with lids, (8) sample droppers, (1) bottle of control solution A, and (8) “seal before spin” stickers.

The volume cup is a single-use disposable collection cup with an integrated volume measurement feature. The volume cup contains a small measurement column with markings incorporated into the outer surface, two channels to collect and drain the semen sample into the measurement region, and a sloped surface that funnels captured semen into the column and channels. Once the semen is liquefied the volume cup is used to qualitatively assess the semen volume: low semen volume (≤ 1.5 mL) or normal semen volume (>1.5 mL).

J. Substantial Equivalence Information:

1. Predicate device name(s):

   Trak® Male Fertility Testing System

2. Predicate 510(k) number(s):

   K153683

3. Comparison with predicate:

Similarities		
Item	Device	Predicate
Intended Use	The Trak® Male Fertility Testing System is intended for semi-quantitative assessment of sperm concentration at 15 million sperm per milliliter (M/mL) or below, between 15 and 55 M/mL, and above 55 M/mL. It also provides a qualitative assessment of semen volume. Sperm concentration and semen volume are only two factors that could impact a man's fertility status and time to pregnancy. For complete assessment of male reproductive health, the user should consult a physician. For in vitro, over the counter home use.	The Trak® Male Fertility Testing System is intended for semi- quantitative assessment of sperm concentration at 15 million sperm per milliliter (M/mL) or below, between 15 and 55 M/mL, and above 55 M/mL. Sperm concentration is only one factor that could impact a man's fertility status and time to pregnancy. For complete assessment of male reproductive health, the user should consult a physician. For *in vitro*, over the counter home use
Sample Type	Human Semen	Same
Threshold Values	15 M/mL (lower reference limit)[1] 15–55 M/mL > 55 M/mL	Same
Test Control Method	External quality control	Same

Differences		
Item	Device	Predicate
Measurand	Semen volume and sperm concentration	Sperm concentration
Test Type	Semi-quantitative & Qualitative	Semi-quantitative
Test Reporting	Visual readout of fluid height in volume cup and visual readout of cell column height in Prop	Visual readout of cell column height in Prop
Test Principle	Centrifuged packed cell volume in Prop and graduated chamber fluid in volume cup	Centrifuged packed cell volume in Prop

[1] WHO laboratory manual for the Examination and processing of human semen, fifth edition, 2010

Differences		
Item	Device	Predicate
Volume Cut-off	1.5 mL (lower reference limit)[1]	None

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

World Health Organization. (2010). WHO laboratory manual for the examination and processing of human semen, 5th Ed. Geneva: WHO Press

CLSI EP12-A2: User Protocol for Evaluation of Qualitative Test Performance; Approved Guideline - Second Edition

L. Test Principle:

The Trak volume cups are used to collect, liquefy, and assess the volume of the semen sample. The volume cups are coated with a digestive enzyme to liquefy the semen sample and reduce viscosity. Markings on the volume cup allow for the qualitative interpretation of volume at, below, or above the 1.5 mL threshold.

To estimate the sperm concentration the Trak uses the principle of density gradient separation to isolate sperm cells from human semen. The Trak Engine spins a test Prop to compact sperm cells within an introduced semen sample into a visible column (or "pellet"). The Prop gives a defined shape to the column, the height of which corresponds to the concentration of sperm cells in the sample. Since semen may also contain cell debris, immature sperm cells, and other contaminant particulates that could contribute to the apparent size of a pellet, it is necessary to filter out the contaminants. Trak filters by removing contaminants from view based on density across a predefined liquid density medium.

During operation, approximately 0.17 mL of semen is metered by centrifugal action from the sample inlet into the metering chamber of the Prop. During rotation, the semen floats on "top" of the pre-loaded density medium. Sperm cells pass through the medium due to their high density while contaminants remain floating on the medium. When the spin sequence is complete, the sperm cells form a visible column that is displayed to the user for interpretation. Contaminants that are less dense than the liquid density medium are suspended "above" the medium, substantially separated from the sperm cells and are generally too diffuse to visualize.

M. Performance Characteristics (if/when applicable):

1. <u>Analytical performance:</u>

   a. Precision/Reproducibility:

   A five-day precision study was carried out by three operators using three lots of volume cups on five artificial semen samples with different volumes. The semen

volumes selected consisted of volumes around the 1.5 mL threshold which included: 1.2 mL, 1.3 mL, 1.5 mL, 1.7 mL, and 1.8 mL. For each volume tested, each operator tested a distinct lot of volume cups over five days with five replicates per day for a total of 75 replicates per semen volume. The following table includes averages for each condition, sum for each category, and percent correct calls with respect to the reference method.

Sample #	Reference Volume (mL)	Number of Results ≤ 1.5 mL	Number of Results > 1.5 mL	% Correct	Quant Volume result grand average ± SD (mL)
1	1.2 mL	75	0	100	1.32 ± 0.12
2	1.3 mL	74	1	98.7	1.43 ± 0.09
3	1.5 mL	17	58	n/a*	1.61 ± 0.10
4	1.7 mL	1	74	98.7	1.86 ± 0.16
5	1.8 mL	0	75	100	1.93 ± 0.10

* no performance goal at the threshold; data tabulated for information only

SD and %CV for between-day, between-operator/lot, and total precision for each concentration are tabulated below. Results were within the predefined acceptance criteria.

Sample Number	N	Mean	Repeatability		Between Day		Between Operator/lot		Total	
			SD	%CV	SD	%CV	SD	%CV	SD	%CV
1	75	1.32	0.08	6.1%	0.07	5.0%	0.00	0.0%	0.12	9.2%
2	75	1.43	0.06	4.0%	0.02	1.6%	0.02	1.3%	0.09	6.5%
3	75	1.61	0.09	5.5%	0.00	0.0%	0.00	0.0%	0.10	6.2%
4	75	1.86	0.09	5.0%	0.03	1.4%	0.00	0.3%	0.10	5.2%
5	75	1.93	0.10	5.1%	0.02	1.2%	0.01	0.6%	0.10	5.3%

b. Linearity/assay reportable range:

Not applicable

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

Shelf Life

A shelf-life stability study was conducted using two lots of volume cups with a total of 8 time points (1 day, 1 month, 3 months, 6 months, 9 months, 12 months, 15 months and 18 months) to assess the enzymatic activity of protein used to coat the volume cup. The enzyme activity was tested by using solidified gelatin. The data provided support that the enzyme activity is acceptable up to 15 months. Stability testing is still ongoing; therefore, the shelf-life stability of the volume cup is 12 months.

Track Prop Shelf Life:

Refer to K153683

Quality Control Shelf Life:

Refer to K153683

d. Detection limit:

Not applicable

e. Analytical specificity:

Not applicable

f. Assay cut-off:

Refer to K153683

2. Comparison studies:

a. Method comparison with reference method:

See Consumer Use Study (3.c)

b. Matrix comparison:

Not applicable

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):

Consumer Use Study:

Two studies were performed to demonstrate that the 1.5 mL reference marking on the new volume cup are interpreted correctly by lay users. Study 1 was to demonstrate

the accuracy of semen volume in the new volume cup as interpreted by the intended users using semen sample photographs and study 2 was to assess interpretation and ease of use of the physical volume cup filled with known volumes of artificial semen as interpreted by the intended users.

Study 1: Semen samples were collected by consenting donors, weighed and converted to volume as recommended in the WHO semen analysis manual, 5th edition, then photographed. The photographs were used to challenge both technicians and lay users. Demographics of the lay users include (n=52, male (57.7%) and female (42.3%), age range 18.0–68.0, 44.2% Caucasian, 25% Asian, 13.5% Latino/Hispanic, 3.8% Black or African American and 15.3% other and varying levels of education, 40.4% some college, 23.1% 4-year degree (bachelor's), 23.1% high school, 7.7% post graduate). A total of 232 semen sample photographs were interpreted as ≤ 1.5 mL or > 1.5 mL by lay users as well as trained technicians (blinded to the results), and were confirmed with the result obtained by the reference method.

Lay User Interpretation Compared to the Reference Method:

Sensitivity, % (95% CI)	**Specificity, % (95% CI)**	**Overall Percent Agreement (95% CI)**
97.0% (91.6 – 99.0%)	95.4% (90.4 – 97.9%)	96.1% (92.8 – 97.9%)

Trained Technician Interpretation Compared to the Reference Method:

Sensitivity, % (95% CI)	**Specificity, % (95% CI)**	**Overall Percent Agreement (95% CI)**
96.2% (90.5 – 98.5%)	96.9% (92.2 – 98.8%)	96.6% (93.3-98.2%)

Results of Lay Users Compared to Trained Technicians:

Overall Percent Agreement (95% CI)	**Percent Positive Agreement (95% CI)**	**Negative Percent Agreement (95% CI)**
97.8% (95.1 – 99.1%)	96.2% (90.5 – 98.5%)	99.2% (95.7 – 99.9%)

Study 2: Lay users (n=32, age range 25–59) with different ethnicities and varying levels of education were to assess interpretation and ease of use of the physical volume cup filled with known volumes of artificial semen. A total of 127 artificial semen samples were interpreted as ≤ 1.5 mL, > 1.5 mL, or Invalid. Each lay user interpreted 4 cups filled with 1 mL, 1.2 mL, 1.8 mL, or 2 mL of artificial semen in random order. Results for sensitivity 95.2% and specificity 96.9% suggest that in the hands of lay users, the volume cup with appropriate instructions provides

adequate resolution of semen volume using ≤1.5 mL or >1.5 mL of the WHO threshold for hypospermia.

Lay User Questionnaire Results:

After completing the volume cup reader study, lay users (n=32) also completed a Tester Questionnaire with 11 multiple choice questions. Five of the questions were designed to capture the user's perceptions of ease of use of the Trak device, and the remaining six questions were to gauge interpretation and understandability of the instructions. While slightly more than a quarter of the respondents assigned "somewhat difficult" or "difficult" to the task of finding the liquid level, more than 95% of the responses for interpreting cups were assigned correctly with respect to the reference method. Additionally, 90.6% of users gave answers indicating an understanding of the instructions according to the intended interpretation.

4. Clinical cut-off**:**

   Not applicable

5. Expected values/Reference range:

   Not applicable

N. Instrument Name:

Trak® Male Fertility Testing System

O. System Descriptions:

1. Modes of Operation:

   Not applicable

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

   Yes _____ or No ____X____

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

   Yes _____ or No ___X_____

2. Software/Firmware & Cybersecurity:

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

Yes ____X____ or No _____

Software Consult Needed? Yes_____ or No_____ X___

Cybersecurity Review Needed? Yes_____ or No _____X___

Cybersecurity Consult Needed? Yes_____ or No_____ X____

3. Specimen Identification:

   No specimen identification is available.

4. Specimen Sampling and Handling:

   Refer to K153683

5. Calibration:

   Not applicable

6. Quality Control:

   Refer to K153683

P. Other Supportive Instrument Performance Characteristics Data Not Covered In The "Performance Characteristics" Section above:

Semen Liquefaction

The purpose of this study was to determine the effectiveness of new volume cup in promoting semen liquefaction. A total of 20 semen sample aliquots from three semen samples were tested for liquefaction by measuring the volume of semen dispensed by the transfer devices included with the Trak System (250 µL exact volume pipettes) after incubation according to the instructions for use. The total average for these volume measures was 253.05 µL, with a 95% CI of 249.60–256.00 µL, meeting the acceptance criteria for liquefaction from the volume cups.

Trak Sperm Concentration

The objective of this study was to determine whether samples incubated in the new volume cup give equivalent Trak category results to samples incubated in the collection cup included with the predicate device. Two sperm concentrations 10 M/mL and 20 M/mL of the WHO threshold cutoff (15 M/mL) were tested in 20 replicates for each cup type on Trak Props, and results were categorized as ≤15 M/mL (Low), 15–55 M/mL (Moderate), and > 55 M/mL (Optimal). Sperm concentrations were confirmed by CASA, and then aliquots of the pooled semen samples were incubated in the new volume cups

and in the previous collection cups.

Nominal Condition	Average CASA result (M/mL)	# Trak Results ≤ 15 M/mL	# Trak Results 15 – 55 M/mL	# Trak Results > 55 M/mL
Concentration #1, control	11.4	20	0	0
Concentration #1, volume cup	11.7	20	0	0
Concentration #2, control	20.7	0	20	0
Concentration #2, volume cup	19.7	0	20	0

Trak results for both the new volume cup and the collection cup with the predicate device were correctly categorized with respect to the reference method. Results from this study met the defined acceptance criteria.

Semen Homogenization

The objective of this study was to determine whether sperm concentration is evenly distributed within the new volume cup compared to the previous collection cup with the predicate device when agitated. Semen samples were pooled and diluted to two sperm concentrations differing by more than 50%. Sperm concentrations were evaluated by CASA using multiple aliquots of the pooled semen samples after incubation in the new volume cups and in the previous collection cups. Twenty (20) aliquots were taken from the top and bottom of each cup for each pool, and its sperm concentration was accessed.

Sample ID	Cup Type	Location	n	Mean ± SD (M/mL)	Cup type Mean ± SD (M/mL)
A	Collection Cup (Predicate)	Top	20	17.1 ± 0.7	17.1 ± 0.7
		Bottom	20	17.2 ± 0.7	
	Volume Cup (Candidate)	Top	19	17.5 ± 0.7	17.5 ± 0.8
		Bottom	20	17.5 ± 0.9	
B	Collection Cup (Predicate)	Top	20	36.4 ± 2.2	35.3 ± 2.5
		Bottom	20	34.3 ± 2.5	
	Volume Cup (Candidate)	Top	20	36.7 ± 2.6	36.9 ± 2.2
		Bottom	20	37.1 ± 1.8	

No significant differences between variances between the two cup types were found. These data support that the new volume cup provides equivalent semen homogenization to the previous collection cup.

Cleaning Robustness

Refer to K153683

Q. Proposed Labeling:

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

R. Conclusion:

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