510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION
DECISION SUMMARY
ASSAY AND INSTRUMENT COMBINATION

A. 510(k) Number:

K183160

B. Purpose for Submission:

Clearance of a new assay

C. Measurand:

Citrated Kaolin (CK), Citrated RapidTEG (CRT) and Citrated Functional Fibrinogen (CFF)

D. Type of Test:

Whole blood hemostasis

E. Applicant:

Haemonetics Corporation

F. Proprietary and Established Names:

TEG® 6s Hemostasis System

G. Regulatory Information:

1. Regulation section:

   21 CFR 864.5425, Multipurpose system for in vitro coagulation studies

2. Classification:

   Class II

3. Product code:

   JPA, System, Multipurpose For In Vitro Coagulation Control

   GGN, Plasma, Coagulation Control

4. Panel:

   Hematology (81)

H. Intended Use:

1. Intended use(s):

   The TEG 6s Hemostasis System consists of the TEG 6s Hemostasis Analyzer and TEG 6s Citrated: K, RT, FF Assay Cartridge. The TEG 6s Hemostasis System is intended for in vitro diagnostic use to provide semi-quantitative indications of the hemostasis state of a venous blood sample. The TEG 6s Hemostasis System records the kinetic changes in a sample of 3.2% citrated whole blood as the sample clots.

   The Citrated: K, RT, FF Assay Cartridge contains three independent assays (CK, CRT and CFF) and the system output consists of a table of numerical values for parameters R, LY30, and MA.

   The CK assay monitors the hemostasis process via the intrinsic pathway in 3.2% citrated whole blood specimens on the TEG 6s Hemostasis System. Clotting characteristics are described by the functional parameters R (clotting time) and LY30 (fibrinolysis after 30 minutes of reaching maximum clot strength).

   The CRT assay monitors the hemostasis process via both the intrinsic and extrinsic pathways in 3.2% citrated whole blood specimens on the TEG 6s Hemostasis System. Clotting characteristics are described by the functional parameter MA (maximum clot strength).

   The CFF assay monitors hemostasis of 3.2% citrated whole blood specimens in the TEG 6s Hemostasis System after blocking platelet contributions to clot strength. Clotting characteristics are described by the functional parameter MA (maximum clot strength).

   Results from the TEG 6s analysis should not be the sole basis for a patient diagnosis, but should be evaluated together with the patient's medical history, the clinical picture and, if necessary, further hemostasis tests. The indication for TEG 6s Hemostasis System use is with adult patients (18 years and older) where an evaluation of their blood hemostasis properties is desired. Hemostasis evaluation with the TEG 6s Hemostasis System using the Citrated: K, RT, FF Assay Cartridge is used to assess clinical conditions in a trauma setting to assess hemorrhage or thrombosis conditions.

   For professional use only.

2. Indication(s) for use:

   Same as Intended Use(s)

3. Special conditions for use statement(s):

   Prescription Use Only

4. Special instrument requirements:

   TEG 6s Hemostasis Analyzer

I. Device Description:

The TEG 6s Hemostasis System is comprised of the following components: TEG Hemostasis analyzer and TEG 6s Assay Cartridge. The TEG 6s Hemostasis System is intended for in vitro diagnostic use to measure the physical and developmental properties (rate, strength, and stability) of clot formation in a whole blood sample through the oscillating motion of a pendant drop of blood in response to external vibration. As the sample transitions from a liquid state to a gel-like state during clotting, the modulus of elasticity and resonant frequency increase, thus, the analyzer measures these variations in resonant frequency during clotting and lysis. The system output consists of a table of numerical values or graphic representation of the results from the hemostasis process over time.

The TEG 6s Citrated: K, RT, FF Assay Cartridge is used to perform the Citrated Kaolin (CK), Citrated RapidTEG (CRT) and Citrated Functional Fibrinogen (CFF) assays and consists of three independent measurement channels, each pre-filled with the dried reagents. The CK assay channel contains Kaolin and $CaCl_2$, the CRT assay channel contains Kaolin, $CaCl_2$ and Tissue Factor, and the CFF assay channel contains abciximab, Tissue Factor and $CaCl_2$.

CK (Citrated Kaolin) Assay: Kaolin acts as a contact surface activator (intrinsic pathway) which activates Factor XII and platelets and stimulates the reserve clotting ability of a blood sample. Kaolin is combined with $CaCl_2$ to neutralize any sodium citrated in the blood. Clotting characteristics are described by the functional parameters Clotting Time (R), the time from the start of the test until in initial fibrin formation, and Clot Lysis (LY30), a measurement of the rate of fibrinolysis 30 minutes after Maximum Clot Strength (MA) is reached.

CRT (Citrated RapidTEG) Assay: In the CRT Assay, the clotting process is accelerated by simultaneously activating the intrinsic and extrinsic coagulation pathways using a high concentration of Kaolin and Tissue Factor. Clotting characteristics are described by the functional parameter Maximum Clot Strength (MA).

CFF (Citrated Functional Fibrinogen) Assay: In the CFF Assay, the extrinsic pathway is activated using Tissue Factor and inhibits platelet aggregation using abciximab, a platelet inhibitor that binds to GPIIb/IIIa receptors. By excluding the platelet aggregation contribution to clot strength (MA), the assay determines fibrinogen contribution. Clotting characteristics are described by the functional parameter Maximum Clot Strength (MA).

J. Substantial Equivalence Information:

1. Predicate device name(s):

   Thromboelastograph Coagulation Analyzer (TEG)-5000 Series

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

   K002177

3. Comparison with predicate:

Similarities		
Item	Device TEG 6s Hemostasis System	Predicate TEG 5000 Series
Intended Use	The TEG 6s Hemostasis System consists of the TEG 6s Hemostasis Analyzer and TEG 6s Citrated: K, RT, FF Assay Cartridge. The TEG 6s Hemostasis System is intended for in vitro diagnostic use to provide semi-quantitative indications of the hemostasis state of a venous blood sample. The TEG 6s Hemostasis System records the kinetic changes in a sample of 3.2% citrated whole blood as the sample clots. The Citrated: K, RT, FF Assay Cartridge contains three independent assays (CK, CRT and CFF) and the system output consists of a table of numerical values for parameters R, LY30, and MA. The CK assay monitors the hemostasis process via the intrinsic pathway in 3.2% citrated whole blood specimens on the TEG 6s Hemostasis System. Clotting characteristics are described by the functional parameters R (clotting time) and LY30 (fibrinolysis after 30 minutes of reaching maximum clot strength). The CRT assay monitors the hemostasis process via both the intrinsic and extrinsic pathways in 3.2% citrated whole blood specimens on the TEG 6s Hemostasis System. Clotting characteristics are described by the functional parameter MA (maximum clot strength). The CFF assay monitors hemostasis of 3.2% citrated whole blood specimens in the TEG 6s Hemostasis System after blocking platelet contributions to clot strength. Clotting characteristics are described by the functional parameter MA (maximum clot strength).	The TEG 5000 Series Analyzer is intended to be used to provide a quantitative and qualitative indication of the coagulation state of a blood sample by monitoring, measuring, analyzing and reporting coagulation parameter information. The Thrombelastograph (TEG) Coagulation Analyzer TEG-5000 Series records the kinetic changes in a sample of whole blood, plasma or platelet-rich-plasma as the sample clots, retracts and./or lyses (breaks apart). Results from the TEG Analyzer should not be the sole basis for a patient diagnosis; TEG results should be considered along with a clinical assessment on the patient's condition and other coagulation laboratory tests. For professional use only.

Similarities		
Item	Device TEG 6s Hemostasis System	Predicate TEG 5000 Series
	Results from the TEG 6s analysis should not be the sole basis for a patient diagnosis, but should be evaluated together with the patient's medical history, the clinical picture and, if necessary, further hemostasis tests. The indication for TEG 6s Hemostasis System use is with adult patients (18 years and older) where an evaluation of their blood hemostasis properties is desired. Hemostasis evaluation with the TEG 6s Hemostasis System using the Citrated: K, RT, FF Assay Cartridge is used to assess clinical conditions in a trauma setting to assess hemorrhage or thrombosis conditions. For professional use only.	
Measurement Output	Graphical tracings of resonant frequency per reagent type; semi-quantitative	Same
Reagent- CK	Kaolin and $CaCl_2$	Same
Reagent- CRT	Tissue Factor (TF), Kaolin and $CaCl_2$	Same
Reagent- CFF	Abciximab, Tissue Factor and $CaCl_2$	Same
Cartridge Storage & Stability	Shelf-life: 2–8°C, 24 months In-Use: Room Temp, 2 hours Transport: 22–35°C, 7 days	Same Same Same

Differences		
Item	Device TEG 6s Hemostasis System	Predicate TEG 5000 Series
Operating Principle	Fully integrated Thromboelastographic analyzer Non-contact measurement of shear elasticity of a coagulating sample: Clotting process causes an increase in the modulus of elasticity, which increases stiffness and increases the force of the clot within the ring walls when moving up and down in the ring tube against the sample's own weight. This increases the resonant frequency, which increases the TEG 6S clot strength amplitude.	Direct-contact measurement of shear elasticity of a coagulating sample: Clotting process causes an increase in the modulus of elasticity, which increases stiffness and increases the force binding the cup and pin when the cup rotates. This increases the rotation of the pin, causing increased angular force on the torsion wire, which increases the TEG clot strength amplitude.

Differences		
Item	Device TEG 6s Hemostasis System	Predicate TEG 5000 Series
		During clot dissolution (lysis), the TEG angular force decreases, corresponding to decreasing clot strength amplitude.
Testing Configuration	Vertically-oriented cylindrical container (ring or tube) containing sample with meniscus formed at bottom; non-contact measurement of meniscus amplitude of vibration	Rotating cylindrical container (cup) with pin suspended inside cup; non-contact measurement of pin rotation
Matrix	Sodium citrated whole blood	Sodium citrated whole blood, sodium citrated plasma or sodium citrated platelet rich plasma
Measuring Technique	Non-contact measurement of shear elasticity of a coagulating sample	Direct-contact measurement of shear elasticity of a coagulating sample
Assays and Parameters	CK: R and LY30 CRT: MA CFF: MA	CK: R, k, α, MA
Measuring Channels	Three	One
Signal Transducer	Optical detection (silicon photodiode) of the motion of a free surface of the sample	Electromechanical detection (rotary variable inductive transformer) of rotary motion of a pin suspended in the sample
Temperature Control	20° to 50°C	20° to 40°C
Sample Volume (per cartridge)	20 µL	360–380 µL
Environment	Stable and level surface Operating Temperature: 10° to 32°C Storage Temperature: -20° to 50°C (analyzer only)	Level and vibration free position, no solar radiation Operating temperature: 10° to 35 °C Storage Temperature: -30° to +50 °C (analyzer only)
Sample Preparation	Performed under analyzer control within the disposable cartridge	Performed by the operator using pipettes to reconstitute reagents and mix reagents with the sample
Sample Application	Unmetered transfer pipette or syringe; blood sample is added until it fills to a	Manual accurate pipettes

Differences		
Item	Device TEG 6s Hemostasis System	Predicate TEG 5000 Series
	level above the line marked on the blood intake well of the cartridge	
Consumables	Carrier (acrylic plastic) with microfluidics laminate and test rings (acrylic plastic)	Cups & Pins (acrylic plastic)
Quality Control	AQC (Abnormal QC) and LQC (Lysis QC)	TEG coagulation control Level 1 (normal) and Level 2 (abnormal)
Mains Supply Voltage	100-240V, 50-60Hz (international power supply)	120V, 60Hz and 220V, 50Hz model available
Analyzer Input Voltage	12 volts DC, 60 watts max	24 volts AC, 30 watts max

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

CLSI EP05-A2, Vol.19, No. 2 *Evaluation of Precision Performance of Quantitative Measurement Methods; Approved Guideline*

CLSI EP07-A2, *Interference Testing in Clinical Chemistry; Approved Guideline*

CLSI EP25-A, Vol. 29, No. 20 *Evaluation of Stability of In Vitro Diagnostic Reagents; Approved Guideline*

CLSI C28-A3c, Vol. 28, No. 30 *Defining, Establishing, and Verifying Reference Intervals in the Clinical Laboratory; Approved Guideline*

IEC 60601-1-2:2014-02 Ed 4: *Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances - Requirements and tests*

IEC 61010-1 *Safety Requirements for Electrical Laboratory Equipment-Part 1: Edition 2*

IEC 61010-1-2:2007 Ed 3: *Medical Electrical Equipment Part 1-2: Electromagnetic Compatibility-Requirements and Tests*

L. Test Principle:

The TEG 6s Hemostasis Analyzer has four independent measurement channels. Each channel consists of a short vertically-oriented injection molded tube (ring) with a diameter of 2.5mm and a length of 4.5mm. The TEG 6s Hemostasis analyzer uses a resonant frequency technology with optic analysis by assessment of clot viscoelasticity through the response to vibrations over the spectrum of frequency. With LED illumination, a detector measures in the vertical motion of the blood meniscus. The resulting motion of the meniscus is monitored optically and recorded by the analyzer to calculate the resonant frequency and the clot's physical development such as clot rate, strength and stability. To measure the clot strength

with the resonance method, the sample is exposed to a fixed vibration frequency. The frequency leading to resonance is identified and then converted to the TEG system readout. The exact frequencies at which resonance occurs will depend on the clot stiffness and mass of the sample. During coagulation, the stronger clots will have higher resonant frequencies and higher TEG readouts. During fibrinolysis, the clot begins breaking down and the resonant frequencies decrease.

To perform a test, a disposable TEG 6s Citrated: K, RT, FF Assay Cartridge is inserted into the analyzer. Twenty microliters (20µL) of whole blood sample (3.2% sodium citrated whole blood) or control (AQC/LQC) material is added to an entry port on the cartridge and drawn into the cartridge under analyzer control. The amount of the sample drawn into the cartridge is automatically determined by the volume of the blood chambers in the cartridge and is metered into separate analysis channels. Reconstitution of dried reagents within the cartridge is accomplished by moving the sample back and forth through the reagent chambers, under the control of microfluidic valves and pumps within the cartridge. After each sample has been mixed with reagent, it is delivered to three designated test cells where it is monitored for visco-elastic changes due to coagulation. Excess sample material is moved under microfluidic control into an enclosed waste chamber within the cartridge.

In a typical test, blood that has been delivered to the test cell will not clot for several minutes. During this time the sample has no inherent stiffness except that provided by surface tension, and since this remains constant the measured resonant frequencies will not change. During coagulation, however, a clot will bind to the test tube (ring) and the resonant frequency will rise with increasing firmness of the clot. During fibrinolysis, the process is reversed, the clot stiffness and resonant frequencies decrease. The TEG 6s Analyzer collects meniscus motion data, tracks changing resonant frequencies and analyzes the frequency data to provide semi-quantitative parameters describing the clot.

M. Performance Characteristics (if/when applicable):

1. Analytical performance:

   The design of the TEG 6s Citrated: K, RT, FF Assay Cartridge is identical to the design of the TEG 6s Citrated Multichannel Cartridge: K, KH, RT, FF Assay Cartridge (formerly named the Citrated Multichannel Cartridge), cleared in K150041. Both cartridges also contain the same reagents. The difference between assay cartridges is the exclusion of the Citrated Kaolin with Heparinase (CKH) assay channel and the addition of the CK-LY30 parameter in the CK Assay for the TEG 6s Citrated: K, RT, FF Assay Cartridge (subject device cartridge). Therefore, CK-LY30 was the only parameter evaluated for the precision, linearity/assay reportable range and stability studies. The performance of the CRT and CFF Assays in addition to the CK-R parameter in the CK Assay for the precision, linearity/assay reportable range and stability studies, were evaluated in K150041.

   a. Precision/Reproducibility:

The CK-LY30 precision study was conducted using sodium citrated whole blood collected from three normal donors. Three sample types (no tPA, low tPA, high tPA) were made for each donor. A tPA working solution was used to create a low tPA blood sample with approximately 5% lysis and a high tPA blood sample with approximately 22% lysis. Testing was performed in 12 replicates per sample by three operators, using three reagent lots and 12 analyzers for five days. The mean, standard deviation (SD), and coefficient of variation (%CV) of each set of CK-LY30 values were calculated for each donor per sample (no tPA, low tPA, high tPA) per day. The determination of acceptability was based on the SD or %CV.

Donor	N	Day	Mean	High Lysis		Mean	Low Lysis		Mean	No Lysis	
				SD	%CV		SD	%CV		SD	%CV
1	12	1	13.54	2.08	15.37	2.52	0.33	13.21	0.08	0.08	100.18
		2	16.70	1.20	7.21	2.00	0.53	26.63	0.01	0.03	346.41
		3	17.96	1.00	5.58	2.56*	0.57	22.43	0.01	0.03	346.41
		4	18.62	2.14	11.48	2.58**	0.75	29.03	0.01	0.03	346.41
		5	19.93**	0.96	4.83	1.28*	0.30	23.09	0.06**	0.08	127.13
2	12	1	15.99	1.60	10.00	5.51	0.51	9.30	0.82	0.22	26.54
		2	15.98	2.63	16.44	3.13	0.47	14.93	0.91	0.33	35.89
		3	12.29	1.05	8.58	2.33	0.48	20.62	1.15	0.24	21.14
		4	16.31**	1.40	8.57	2.01	0.42	20.96	0.70	0.24	34.99
		5	18.43	2.51	13.63	1.85**	0.53	28.91	1.09**	0.20	18.54
3	12	1	15.53	0.97	6.25	5.43**	0.67	12.31	0.73	0.23	32.02
		2	14.90	1.10	7.38	3.89	0.62	15.86	1.10	0.13	12.26
		3	18.03	1.28	7.09	3.44	0.55	15.94	0.75**	0.19	25.00
		4	18.43	1.21	6.57	2.09	0.27	13.13	0.49	0.14	28.05
		5	14.26	0.87	6.10	3.18**	0.48	15.06	0.77	0.25	32.59

* The mean is based on n=11 due to statistical outlier.

** The mean is based on n=11 due to instrument error and no result for replicate generated.

The reproducibility study was conducted with three normal donors, three lots of cartridges on 36 instruments where all three cartridge lots were used on each instrument. Three sample types (no tPA, low tPA, high tPA) were made for each donor, where six runs per sample type and two replicates per run were performed for five days. To demonstrate precision performance for each sample per donor (no tPA, low tPA, high tPA), the mean, SD and %CV for each component of variability were calculated including: within-run, between-operator, between-lot, between-day and total reproducibility. The determination of acceptability was based on the SD or %CV.

Donor	Sample	N	Mean	Within-Day		Between-Operator		Between-Lot		Between-Day		Total Reproducibility	
				SD	%CV	SD	%CV	SD	%CV	SD	%CV	SD	%CV
1	High Lysis	59	26.23	1.22	4.66	0.00	0.00	0.74	2.82	1.35	5.14	1.96	7.48
	Low Lysis	60	7.44	1.08	14.49	0.00	0.00	0.28	3.78	0.84	11.33	1.40	18.78
	No Lysis	59	1.01	0.30	29.75	0.09	8.46	0.00	0.00	0.22	21.39	0.38	37.61
2	High Lysis	60	25.15	1.19	4.73	0.00	0.00	1.14	4.54	3.21	12.575	3.61	14.34
	Low Lysis	59	5.09	0.00	0.00	0.23	4.54	0.00	0.00	0.91	17.85	1.27	25.00
	No Lysis	60	0.46	0.23	49.49	0.12	25.48	000	0.00	0.15	33.28	0.30	65.04
3	High Lysis	59	17.82	1.10	6.17	0.59	3.31	0.49	2.75	1.12	6.29	1.68	9.42
	Low Lysis	58	5.03	0.63	12.59	0.00	0.00	0.54	10.74	0.96	19.15	1.27	25.32
	No Lysis	58	1.20	0.28	23.40	0.07	5.85	0.00	0.00	0.17	14.21	0.32	26.61

b. Linearity/assay reportable range:

The analytical measurement range for the CK-LY30 parameter is 0–22% as determined in this premarket notification, based on the data collected in method comparison study. The ranges for the CK-R, CRT-MA and CFF-MA parameters were established in K150041 (shown in the table below).

Assay	Parameter	Analytical Measurement Range
CK	R (min)	0.4-17
	LY30 (percent)	0-22
CRT	MA (mm)	40-75
CFF	MA (mm)	4-52

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

Shelf-life Stability of TEG 6s Citrated: K, RT, FF Assay Cartridge:
To support the shelf-life stability of the TEG 6s Citrated: K, RT, FF Assay Cartridge, normal donor samples were tested on three different lots of aged cartridges (previously manufactured production lots at 8–10 months, 15–16 months and greater than 25 months) compared to one freshly manufactured lot. At each time period, 15 samples (3 lots, 5 per lot) were tested using a single instrument. The study data support a 24-month shelf-life stability claim for the CK-LY30 parameter when the TEG 6s Citrated: K, RT, FF Assay Cartridge is stored at 2–8°C.

In-Use Stability of TEG 6s Citrated: K, RT, FF Assay Cartridge:
Three lots of TEG 6s Citrated: K, RT, FF Assay Cartridge, at three different time points (0, 2 and 4 hours) were evaluated to support the in-use stability of the TEG 6s Citrated: K, RT, FF Assay Cartridge. Sodium citrated whole blood from normal donors were used and tested on 30 cartridges (per time point per lot), for a total of 90 samples per lot using a single instrument. The assays were tested with different fresh normal donor blood at different storage times. The results from each assay were compared with their corresponding reference ranges. The data support a 2-hour in-use stability claim at room temperature.

Transport Stability of TEG 6s Citrated: K, RT, FF Assay Cartridge:
The transport simulation study was performed on three lots of TEG 6s Citrated: K, RT, FF Assay Cartridge to simulate transport under stressed conditions. To create the stressed condition, three cartridge lots were stored at 25°C for 24 hours then placed into four different temperature cycles (temperature ranging from 22–35°C) with variation of times (4 hours to 192 hours). The donor sample was collected in sodium citrate anticoagulant and tested with stressed cartridges and non-stressed cartridges (stored at 2–8°C). The study showed that there was no difference between stressed and non-stressed conditions and the data supported the 7-day stability claim at 22–35°C.

Sample Stability:
In order to assess sample stability, five consecutive runs of each of three patient samples (normal, hypo- and hypercoagulable) were tested. Blood samples were tested in quadruplicate at each time point demonstrating no significant sample deterioration within 2 hours after sample collection.

Expected Values for Controls:
Normal Control: The manufacturer does not provide external normal controls for the TEG 6s Citrated K, RT, FF Assay Cartridge. The manufacturer recommends that laboratories establish their own donor normal controls and may consider the following when establishing control donor groups:

- In accordance with the specimen collection and handling instructions provided in the labeling, collect whole blood from healthy adult donors.
- The normal donor should not have taken any medication that is known to affect coagulation and should have prior Citrated: K, RT, FF Assay Cartridge tests that have fallen within the established normal reference range.

Abnormal control: The manufacturer provides an abnormal QC kit (AQC (abnormal QC), bovine plasma based and LQC (lysis QC), tPA activator). To establish the control reference ranges, three lots of AQC and LQC control material were evaluated including both fresh samples and aged samples (samples challenged with elevated temperatures to stimulate storage lifetime), using two different lots of cartridges, on two different diluent water volumes to stimulate the boundary conditions of the water volume specification. These samples were tested the at two different in-use conditions (one was immediately after reconstitution (15 minutes), the other was 2 hours after reconstitution), at two different sites, with three replicates per testing point. Testing was performed on six analyzers by six operators, over three days, for a total of 216 data points collected. The expected values for the AQC and LQC were established using the non-parametric method, two-sided 95% CI as recommended in CLSI C28-A3c guideline.

Expected Values for Abnormal QC:

Assay	Parameter		
	R (min)	MA (mm)	LY30 (%)
CK	0.7–2.7		0.0–0.0
CRT		35–51	
CFF		35–51	

Expected Values for Lysis QC:

Assay	Parameter		
	R (min)	MA (mm)	LY30 (%)
CK	NA		82.0–98.0
CRT		NA	
CFF		NA	

d. Detection limit:

Not applicable

e. Analytical specificity:

Interference testing was conducted using one lot of TEG 6s Citrated: K, RT, FF Assay Cartridge on a single instrument. In this study, one sodium citrated whole blood donor was used to prepare samples with prescribed drugs such as direct oral anticoagulants (FXa and direct thrombin inhibitors: dabigatran, lovenox and rivaroxaban) and antiplatelet drugs (P2Y12 inhibitors: aspirin and ticagrelor). Five concentration levels (including control) were tested in triplicate for each interferent with and without tPA. Hemolyzed and hemodilution samples were also tested in the study. For hemolysis testing, the donor blood was pooled and split into two aliquots (one of which was treated with deionized water to generate hemolyzed condition) and comparing hemolyzed sample vs non-hemolyzed sample. A control sample was tested with each condition in which the blood was not treated with the potential interferent. The study was evaluated in accordance with CLSI EP07-A2. The study found that hemolysis and hemodilution above 30% interfere with the CRT-MA parameter and hemodilution above 40% interferes with the CFF-MA parameter.

The following exogenous interfering substances were evaluated and showed no significant interference up to the specified concentration in whole blood samples collected in 3.2% sodium citrate anticoagulant collection tubes.

Exogenous Substances	
Interferent	Concentration
Ticagrelor	1800 ng/mL
Dabigatran	180 ng/mL
Lovenox (LMWH)	0.003 mg/mL
Aspirin	0.065 mg/mL (325 mg/daily)
Rivaroxaban	500 ng/mL

f. Assay cut-off:

Not applicable

2. Comparison studies:

a. Method comparison with predicate device:
Method comparison testing with the predicate device, TEG5000, was conducted at 12 Level I and Level II Trauma Centers in the United States. The study enrolled 474 adult patients (326 males and 149 females), ≥18 years of age, admitted for blunt, burn, penetrating and other types of trauma conditions. Blood samples were drawn from Emergency Room, Operating Room or Intensive Care Unit (ICU) at time of

admission and used for method comparison. The Injury Severity Score (ISS[1,2,3,4]) was assessed on 371 subjects when all diagnostic procedures have been completed. There was 97.84% of total subjects (363/371) confirmed with an ISS score greater than or equal to one. These ISS scored subjects were categorized into 4 trauma groups: very severe, serve, moderate and minor. The very severe trauma group consisted of 20% of the total patients in method comparison and had the ISS ≥ 25. The severe trauma group consisted of 18% of total patients and had the ISS >15 and ≤24. The moderate trauma group consisted of 25% of total patients and had the ISS >8 and ≤15. The minor trauma group consisted of 37% of total patients and had the ISS <8. Up to 10% contrived samples were added (blood samples from normal healthy donors were spiked with dabigatran and ReoPro to create hypocoagulable values for CK-R, CK-MA and CFF-MA and tPA was used to create low and high lysis) in the study.

Passing-Bablok regression analysis and Bland-Altman Plot were performed. The regression analysis of all sites combined was summarized below.

Assay	N	Correlation (r^2)	Slope (95% CI)	Intercept (95% CI)
CFF-MA	450	0.95 (0.94, 0.96)	0.99 (0.93, 1.04)	-1.96 (-2.98, -0.94)
CK-LY30	86	0.91 (0.87, 0.94)	1.01 (0.91, 1.1)	0.48 (-0.12, 1.08)
CK-R	405	0.90 (0.88, 0.91)	1.05 (1, 1.1)	0.53 (0.27, 0.79)
CRT-MA	394	0.93 (0.92, 0.95)	0.93 (0.89, 0.97)	2.09 (-0.13, 4.31)
CRT-MA vs. CK-MA	336	0.86 (0.83, 0.89)	1.06 (0.99, 1.12)	-7.59 (-11.86, -3.31)

b. Matrix comparison:

Not applicable

3. Clinical studies:

a. Clinical Sensitivity:

Not applicable

b. Clinical specificity:

[1] Baker SP et al. in J Trauma. 1974 Mar;14(3):187-96: The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care.
[2] Baker SP et al. in J Trauma. 1976 Nov;16(11):882-5: The injury severity score: an update.
[3] Rutledge R et al. in J Trauma. 1997 Mar;42(3):477-87; discussion 487-9: Comparison of the Injury Severity Score and ICD-9 diagnosis codes as predictors of outcome in injury: analysis of 44,032 patients.
[4] American College of Surgeons' National Trauma Data Bank (NTDB) 2016 Annual Report: https://www.facs.org/~/media/files/quality%20programs/trauma/ntdb/ntdb%20annual%20report%202016.ashx

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:

The design of the TEG 6s Citrated: K, RT, FF Assay Cartridge is identical to the design of the TEG 6s Citrated Multichannel Cartridge: K, KH, RT, FF Assay Cartridge (formerly named the Citrated Multichannel Cartridge), cleared in K150041. Both cartridges also contain the same reagents. The difference between assay cartridges is the exclusion of the Citrated Kaolin with Heparinase (CKH) assay channel and the addition of the CK-LY30 parameter in the CK Assay for the TEG 6s Citrated: K, RT, FF Assay Cartridge (subject device cartridge). Therefore, CK-LY30 was the only parameter evaluated for the reference range study. The reference ranges for the CRT-MA, CFF-MA and CK-R parameters were established in K150041 (shown in the table below).

The CK-LY30 reference range was established according to CLSI C28-A3c from 132 apparently healthy individuals (58 males and 74 female), greater than 18 years old with no current or recent history of a bleeding disorder or unexpected extended bleeding episodes at three clinical sites in the U.S. Results from all sites were pooled and reference interval was established by calculating the non-parametric 95% confidence interval (2.5^{th} to 97.5^{th} percentiles). The calculated reference range for CK-LY30 is 0% to 2.6%.

Reagent/Parameter	Minimum	Maximum
CK R (minutes)	4.6	9.1
CK LY30 (percent)	0.0	2.6
CRT MA (mm)	52	70
CFF MA (mm)	15	32

N. Instrument Name:

TEG® 6s Hemostasis Analyzer

O. System Descriptions:

1. Modes of Operation:

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

Yes ___X_____ or No ___ _____

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

Yes _____ or No ___X_____

2. Software:

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

   Yes ____X____ or No _____

3. Specimen Identification:

   Manual patient identification entry

4. Specimen Sampling and Handling:

   Samples are collected in 3.2% sodium citrate anticoagulant collection tubes. No further additives or preservatives are necessary to maintain the integrity of the sample, but samples must be used within two hours of draw to maintain in-use stability. The blood is applied to the sample port and is pulled into the three channels, mixed with dried reagents before transfer to the test cells.

5. Calibration:

   The TEG 6s Hemostasis analyzer is factory calibrated and does not require routine calibration by the operator.

6. Quality Control:

   The TEG 6s Hemostasis System performs internal QC checks during a pretest when the cartridge is inserted. The internal QC check verifies that all electromechanical and pneumatic functions of the analyzer-cartridge combination are operating satisfactorily.

   The manufacturer recommends that laboratories develop a quality control plan and perform two levels of QC testing (normal and abnormal) on each new shipment of cartridges to ensure that cartridges have not been mishandled between production and arrival at the lab, or have not been subject to adverse environmental conditions or otherwise mishandled while in storage. Additional QC checks may be performed on a monthly, weekly, daily or shift basis based on the laboratory's quality control policies.

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

Not applicable

Q. Proposed Labeling:

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

R. Conclusion:

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